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Technology for sustainability in the educational context: A portrait of the Italian universities

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Abstract. This paper aims to investigate the topic of sustainability within the educational context, specifically the link between the adoption of digital and smart technologies, including AI applications, and sustainability within higher educational institutions. Starting from the consideration that digital and smart technologies play a crucial role in supporting any organizational processes, including educational and training processes, we aim to provide a portrait of the Italian universities and their way to be much more sustainable adopting digital and smart technologies (water dispensers; waste recycling; accessible website; visual content in PowerPoint slides; student-facing online tools, such as, clickers, discussion boards, chat bots, and WIKIs accessible, etc.). Starting from a deep review of the literature on the topic, we investigate the Italian universities mapping them considering some specific main features (i.e. the development and adoption of sustainability practices and solutions also through digital and smart technologies, the adoption of e-learning solutions, etc.). This qualitative research, through a multiple case study, provides possible interesting insights for the future, investigating one specific country, where some factors, such as cultural, contextual, geographic, and organizational factors, should significantly impact the way universities try to be much more sustainable through the adoption of digital and smart technologies, and, consequently, becoming 'smart and sustainable' universities.

1 Introduction

In the current technological and globalized world digital and smart technologies, such as ICT and AI applications, play a crucial role becoming essential and are a fundamental element which significantly affects the way to act and the development of the overall society. In the last three decades, digital and smart technologies have grown considerably, also because of COVID-19 pandemic, in any areas of daily life, including educational

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processes, working processes and so forth. In some cases, the use of digital and smart technologies is becoming fundamental to help organizations to become much more sustainable; for instance, higher education organizations thanks to digital and smart technologies can be much more sustainable, taking a look at the several dimensions of sustainability, such as social sustainability with services accessible and usable especially for people with special needs, achieving and fulfilling sustainable development goals (SDGs) (UN Agenda 2030), in terms of infrastructure, industrialization, and innovation (SDG 9), good health and wellbeing (SDG 3), quality and inclusive education (SDG 4)[1]. Digital and smart technologies become useful tools for higher education institutions, e.g., by making content more interactive and engaging for learners and to improve the quality of materials, as well as by activating the in-depth dematerialization of documents. Thus, it is important for all these organizations to incorporate technology in their overall management as well as in their teaching and educational processes and any activities to generate benefits for their students and for the entire community.

Most research shows an increasing attention paid by higher education organizations to sustainability and also technology, where significant improvements occur especially regarding the accessibility and usability for students with disabilities by combining special methods and materials with the use of digital and smart technologies. Indeed, several technological solutions have been developed and largely implemented by high education institutions making them much more sustainable, especially inclusive [1], for instance, for improving the accessibility and usability of services for anyone or for enhancing the waste management and water and energy savings practices.

This paper aims to provide a portrait of the Italian universities outlining their degree of sustainability orientation combined with technology innovation. In fact, we analyse the Italian context taking a picture of the national universities and their way to be sustainable adopting digital and smart technologies (AI applications for supporting organizational processes; accessible website; visual content in PowerPoint slides; student-facing online tools, such as, clickers, discussion boards, chat bots, and WIKIs accessible, etc.). Hence, after a deep review of the main contributions existing in the research and practice on the topic, we investigate the Italian universities mapping them considering their sustainability orientation (environmental, economic, and social) through the adoption of technological solutions, that is, if and how these institutions investigated sustainably perform thanks to digital and smart technologies. Hence, our qualitative research, through a multiple case study, aims to provide interesting insights for the future analysing one specific country, where some factors, such as cultural, contextual, geographic, and organizational factors, should significantly impact the way the universities try to be much more sustainable through the adoption of digital and smart technologies, and consequently becoming ‘smart and sustainable’ universities.

2 Sustainable universities through digital and smart technologies: Theoretical and contextual background

During the last thirty years, sustainable development has been receiving an increasing attention by the academic community, following the spread by organizations of behaviours and actions based on the logic of socio-environmental responsibility and the use of accountability tools that allow stakeholders to be accountable for the commitment of the organizations in pursuing sustainability objectives [1, 2]. Likewise, universities have begun to play a role of agents and subjects of change, respectively, the promotion of research and training courses about economic, social, and environmental sustainability, and the definition and internal implementation, above all, of policies, practices, and initiatives able

to sustainably perform (e.g., waste management, energy savings, mobility management, inclusion of employees and students with disabilities and special needs) [3]. Specifically, universities are doing multiple actions to engage in sustainability, such as integrating sustainability issues in the curricula, research, outreach, and campus operations.

Most universities try to reach sustainability focusing on technological solutions and operational activities, for instance, greening of university contexts and campuses, while actions addressed to promote reflection on cultural and behavioural topics within universities are often absent, also if they are crucial for a transition to sustainability. Indeed, from the point of view of the universities, sustainability means revolutionary transformation, developing a broad reflection on the organization's inherent behavioural and cultural aspects to redefine and build new practices, relying on technological solutions, anticipating future challenges, improving efficiency and the compliance of regulation, targeting aims beyond the organization, networking with other institutions through partnerships with academic, government, private, public organizations, adopting a new set of values, attitudes, and behaviours. The main actions suggested for the implementation of the cited sustainable universities criteria are: technical features, looking at the development of technological advances in curricula, research, operations, campus experiences; behavioural features, in terms of assessment and reporting, educators training, academic collaboration; systemic features, in terms of transdisciplinary, outreach and collaboration beyond universities, advocacy [4].

The revolutionary transformation for sustainability development of the universities can follows three stages: in the first stage, called "operational optimization", universities should increase the efficiency of the technical solutions applied to reach sustainability challenges and to comply with legal requirements; in the second stage, named "organizational transformation", they could act to infuse sustainability within the organization, and to prioritize engaging with the behaviours and attitudes of students, teachers and other internal stakeholders; in the third stage, called "systems building", universities could develop a change in their vision and values to create a sustainability culture, contemporary collaborating in doing this actions with other actors in society, extending them beyond the limits of their organizations [5].

Regarding the functions performed in the economic and social context, universities have been called upon to adopt an approach towards sustainability that is different from that of other organizations. Indeed, teaching, research, and development of socially useful links with the territory (Third Mission) represent the three core activities of the universities. For this reason, universities have found themselves playing an elective role in the process of spreading the logic of sustainability. Starting from the Talloires declaration [6], universities have been officially called to fulfil for sustainability. Otherwise, universities are paying a growing attention and have been significantly involving in the digitalization transformation process, hence, universities must focus also on digital and smart technologies trying to develop and implement them for supporting their activities also in the perspective of sustainable performing. Specifically, Education for Sustainable Development (ESD) is a learning approach for teachers and students, connected in a multi-stakeholder digital platform, based on ideals and principles instrumental to plan, and find solutions for issues that threaten the sustainability of our planet, through undergraduate and graduate teaching, professional training, executive and adult education, online learning, co-curricular activities, and student clubs and societies, in ways that are locally relevant and culturally appropriate, generating critical consensus on key principles leading the scope, purpose and practice of ESD [7].

Thus, the way through universities could be internal and external agents of human communities change adopting SDG and sustainability teaching practices, is fundamental for both academics and practitioners [4]. Educational problems due to the COVID-19

pandemic generate the following universities needs on the matter of sustainability: integrate environment and health courses in the curriculum, to make them responsive to the needs of the world at the present times, accessible to all students in the university, and not just for the science-related majors since everybody deals with environmental and health problems [8]; strengthen environmental policies and hygiene practices, environmental hygiene should be a priority in schools and universities to prevent the transmission of infectious diseases in the future [9]; incorporate online mental health and medical services, academic and career counselling, medical counselling, mental health teleconferencing, and other online health services furnished by health experts such as psychologists and counsellors, to contain the increasing number of mental disorders among college students [10-12]; scale up teachers' training for online learning instruction, the teachers need to acquire online-driven competencies in planning, implementing, and assessing the performance of their students, and they should be assisted to effectively implement the courses through electronic delivery; strengthen research efforts, data monitoring, and evidence-based practices, demonstrating effectiveness and efficiency in the educational administration, and, thus, responsiveness to the stakeholders expectations [13].

The digital transformation of teaching should imply the right technological decisions made by people and for people, to achieve a more inclusive, participative, and human university supported by technology. digital transformation is a social requirement of governments, companies, and institutions, and it should consider the associated risks of the unethical use of technology, which leads to the dark side of transformation processes. The Technological Pedagogical Content Knowledge (TPCK) eLearning approach and model [14] states that teachers need to develop three kinds of knowledge: technological (use of tools included in the curriculum, knowing not just the subject matter they teach but also how the application of technology can change the subject matter), pedagogical (practices and methods used to promote learning), and of contents adequate (subject to be taught), for using information and communication technologies (ICT) in education.

Even when universities ensure that there are sufficient opportunities and learning environments, some students prefer to stay away from them. So, the problem is not only about attending classes [15,16], it is about various movements done by the students in their daily lives. The trajectory movements of the students in certain cases, like those participating in excessive clubbing, partying, and traveling outside holiday periods is a problem for ensuring sustainable academic performance. Besides the Technology Acceptance Model (TAM), initially developed by Davis [17] to explain technology use resistance, the Social Cognitive Theory (SCT) of Bandura [18], focused on individual psychological factors, the Expectation-Confirmation model (ECM) developed by Bhattacherjee [19] to analyse use and reuse of information systems, the main explanation of difficult factors by classmates leads to motivation and respect according to the base of attachment theory [20], because avoidance of close relationships generates students' anxiety. Students who have a regular tendency to go to the classroom, lab, library, and so on as a routine trajectory movement, may develop a greater attachment to their classmates. Attachment significantly affects the success of the students [21,22].

Besides importance of focusing on the students, digital revolution generates the necessity to create cognitive and affective alliances among professors, connecting them through collaborative networks with other stakeholders interested in the development of SDGs [23]. It could be useful to develop learning communities which follow the training of teachers including the affective dimension among teachers interested in the development of SDGs. The group could be constituted by professors from different disciplines interested in the inclusion of ethics university curriculum and teaching programs [23], through the development of courses, conferences, classroom sharing of reflection about the initiatives of the teachers of the group [23]. Digital transformation meets the expectations of the

different interest groups in terms of sustainable economic, social, and environmental dimensions, thus universities should use and develop clean technologies in their activities, reducing negative environmental impacts through higher levels of energy efficiency, and sustainable use of resources, less polluting, more sustainably materials, more waste recycle, telecommunications services hosted online in the cloud to eliminate additional physical devices and hardware [24].When employees get involved in green practices such as green HRM, ecological universities spaces with water charge and green food in HEIs, they will become more passionate about the environment and will put in extra effort beyond their actual job and learning responsibilities, eventually contributing to the environmental performance of the organization. [25,26].

Pira [27] studied how to promote the social inclusion of students with autism spectrum disorder via mobile technologies. Autism Spectrum Disorder (ASD) is the most diagnosed neurodevelopment disorder in the world. Students with autism demonstrate impairments in language, communication skills, and social interactions: they show serious difficulties to communicate and interact with their peers, and educators. During last 10 years, many interventions were based on the use of mobile technologies in assisting students with ASD in developing their social, communication, language, and other educational skills required for their academic success, despite social inclusion, and learning progress of these students in the classrooms is still challenging.

Finally, inclusive educational institutions could develop internal and external humanization, ensuring the full participation of all members of society, with their legal, social, pedagogical, economic, and educational characteristics, and developing the exchange of information between system elements, as fundamental communicative role [28]. The concepts of inclusive education, humanization, sustainable development, are strictly linked with the etymology of inclusion based on the concept of integration: inclusive education in the context of sustainable development should represent a system with a high integrative ability, to guarantee the full participation of all members of society. “The humanization is the core of inclusive education and is built on the principles of a new humanitarian model for the development of civilization, including the principle of evolution, personal responsibility, justice, solidarity, moderation, rationality, sustainability, which pre- supposes the restructuring of the entire economic, social, and political system. It has been substantiated that the implementation of this new social paradigm is possible not only through improving the social level and increasing attention to the individual with his needs, but also through the humanization of values. In this regard, inclusive education is assigned with the role of an institution for creating a sustainable society with rational moral foundations” [27: p. 121].

The following exploratory research aims, therefore, to evaluate the current degree of sustainability orientation by the Italian university system by providing an analysis of the Italian university realities considering the combination of the topics, that is sustainability and technology innovation. We focus on two perspectives for universities, that is, on one side, on the internal organization of universities highlighting existing strategies, practices and policies and consequent behavioural models in a perspective of sustainability through digital and smart technologies; on the other hand, we focus on proposals and interventions in terms of training, research and Third Mission activities implemented by universities in the perspective of sustainability involving the overall community.

In summary, this study focuses on the way universities through digital and smart technologies try to be much more sustainable, becoming smart and sustainable. In this direction, the idea is to provide to universities and all the stakeholders useful information about new challenges that universities must accomplish with, considering the significant role they play in the society, planning and implementing effective solutions for being much more “smart and sustainable” considering the increasingly complex scenarios.

3 Methodology

After a review of the main contributions in the research and practice, this exploratory study adopts a qualitative methodology by providing an in-depth analysis of the technological solutions and initiatives introduced in the Italian universities in the perspective of sustainability. A portrait of Italian universities is provided in the empirical analysis, going to outline and investigate the behavioural models and initiatives introduced from the perspective of sustainability (environmental, economic, and social) using digital and smart technologies and, thus, defining the degree of sustainability orientation related to technological innovativeness. In detail, a multiple case study approach has been adopted, which is a method that is usually used to achieve descriptive purposes.

The qualitative research, indeed, was primarily conducted to describe the current state of the degree of sustainability orientation related to technological innovativeness of Italian universities. Our empirical analysis aims to answer to the following research questions (RQs) which were defined thanks to the review of the literature: What are the strategies, policies, practices, and initiatives developed and introduced by Italian universities to be sustainable through the adoption of digital and smart technologies? How do Italian universities deal with the phenomenon of sustainability through digital and smart technologies in their organization? What is the degree of sustainability orientation of Italian universities using technology?

In more detail, the Italian universities have been selected using a non-probabilistic sampling to answer the research questions. Indeed, we identify specifically only the Italian universities that meet the defined criteria: presence in the *Universitaly* portal, ANVUR- MUR accreditation, website presence. We used the *Universitaly* website for creating the sample of Italian universities, this website represents the portal of the Ministry of University and Research (MUR), an online platform that provides information about the universities operating in Italy with its offer, training and referrals through links available to official websites and all their existing communication channels, also with a summary sheet for each university highlighting its size (mega, large, medium and small), nature (state, non- state, telematic) and geographical area of reference (North, South, Center, Islands). The research tools and protocols were defined for providing the portrait of the Italian universities using primary and secondary data sources [university documentation available online, reports, official and non-official websites of the Italian university system (MUR, Istat, UNESCO, specialized associations, World Ranking, etc.), university websites, SNS (Facebook, Instagram, Twitter, etc.), press and magazines, ANVUR and RUS website and university reports]. The sample of Italian universities responding to the selected criteria consists of 92 organizations. The portrait of the 92 selected Italian universities has been drawn outlining their sustainability orientation combined with their degree of technology innovation. Therefore, the sample is made up of 92 case studies of universities throughout the country that present a different degree of sustainability orientation related to technological innovativeness.

A manual content analysis was conducted for all the documentation collected. The framework of the strategies, policies, practices, and initiatives promoted and implemented by the investigated Italian universities was built by collecting and processing information and data through reports (MUR, Istat, etc.), analysis of archival data, university documentation, university websites, university social network sites (SNS), press and magazines, focusing on issues related to inclusion and digital technologies. All the solutions, policies, practices, and initiatives aimed to promote a sustainable performance through digital and smart technologies of universities analysed were identified and investigated. After collecting primary and secondary data for all the universities investigated, we also compared some of the most significant initiatives and experiences

carried out by some small, medium, large, and mega-sized universities to identify the key organizational and managerial implications that characterize the main differences with a specific focus on their approach and orientation to sustainability and technological innovativeness. Hence, we have built a portrait of Italian universities as a sustainable environment through the adoption of digital and smart technologies.

4 Results and Discussion*

The sample investigated consists of 92 Italian universities of which 62 state universities and 19 non-state universities, 11 are telematic universities and there is 1 university for foreigners. The analysis of the sample investigated was conducted with the aim to highlight some positive aspects but also some critical issues answering to the RQs according to the main universities criteria already highlighted, that is technical, behavioural, and systemic criteria. For example, among the positive aspects we can observe that many universities, from a sustainability perspective, have specific internal figures who focus on strategies and practices for making the organization much more sustainable. Indeed, among the 92 universities, only 74 universities have a specific figure, such as delegate, pro-rector, or advisor to the Rector, who is entrusted with the function linked to the area of technological innovation, disability, social inclusion, equal opportunities, and digital services. In the selected sample, most universities which are part of the University Network for Sustainable Development (RUS) present an increasing attention to sustainability issues. In this direction, 84 universities are registered in the University Network for Sustainable Development (RUS). Eight universities are not registered in the sustainability network (RUS) (5 telematic, 3 non-state and 1 state), these are mainly small and medium-sized universities. The network is promoted by the Conference of Rectors of Italian Universities. It is the first experience of coordination and sharing between all Italian universities involved in the issues of environmental sustainability and social responsibility.

All the universities in our sample have implemented a degree course or a master's degree on the topic of technological innovations. One university does not have active courses on technologies, probably, because it is based only on disciplines that deal with physical activities and sport. As shown from the sample analysed, the universities that pay more attention to sustainability issues are the universities that try to adopt more advanced technological solutions. For example, implementing virtual tours to support students, especially students with disability or special needs. Despite all universities have their own websites, only 15 universities have implemented the virtual tour of the same university (10 state, 4 non-state and one telematic universities) and just few universities provide for their website accessibility and usability tools.

A winning case is represented from the University of Siena which uses a 360° virtual tour inside the University buildings, classrooms, and laboratories. This service is available online, which thanks to Google Street View, Virtual Tour technology, allows you to visit the University premises directly from your PC, tablet, or smartphone. The universities that are most technologically advanced are those that provide accessible tools for website navigation. Unfortunately, only 14 state universities (only 1 telematic university) have their website completely accessible and usable in practice for a blind or partially sighted person, for a person who cannot hear, for those who have dyslexia, for those with physical problems, and for elderly people. Most of these universities have only screen readers on their website to read the text on the computer or device screen but only in specific sections

* This empirical analysis of the Italian universities follows a previous study conducted aimed to investigate the Italian universities outlining their degree of accessibility and usability using digital technologies [1].

of the website. To use screen readers don't need to download any additional programs, simply click on the listen button and the reading aloud will start immediately. Very few universities have the website with accessible tools, such as speech synthesizers, navigation via voice commands, braille display, text-based navigation, audio description for videos.

Our analysis shows that universities investigated do not have any support in their website in terms of choosing colours according to the specific regulation and major guidelines for visually impaired people. Most universities have their own centre/office/desk for disabled students and those with special learning disorders (Specific Learning Disorders, *disturbi speciali dell'apprendimento*, DSA). The Inclusion Service provides a series of services to support the study activities and university life of students with disabilities and DSA. In general, with regards to disability policies, most universities tend to introduce classic compensatory measures, such as the essay, exam support, psychological consultancy and listening services, the digitization of texts, specialized peer tutoring, total accessibility to buildings and classrooms, the definition of differentiated programs, the recognition of concessions for university fees and the planning of personalized interventions.

There are numerous technologies that universities can implement to support people with disability and special needs from a sustainability perspective. New technologies can certainly support and improve services for disabled people. In the sample, 78 universities promote and adopt technological solutions for students with special needs (e.g., Multimedia Interactive Whiteboard, LIM, acoustic reader, audiobooks, and computer with touchscreen). Among these universities we can distinguish 14 non-state universities, 61 state ones and 3 online universities. They are mostly large and mega universities. The main activities, that use advanced technologies to promote greater inclusion and integration of students with disabilities or special needs, are: the self-study support service for blind students; the loan of a laptop with installation, upon request, of video reading and text recovery programs at the University libraries; assistance service, in collaboration with the competent structures involved from time to time, for the completion of bureaucratic procedural obligations; the use of an Opti book scanner, a Topaz video magnifier and an on-site Maestro workstation; a specific orientation service aimed at choosing a study path" (www.uniud.it).

For instance, in 2020, the University of Tuscia purchased the license for the Easyreading font, which "provides a font dedicated to those suffering from dyslexia. It is a highly readable typeface that overcomes reading barriers even for those suffering from dyslexia. It is used as the default for transporting learning activities online. In this case the aim is to facilitate the academic path of students with DSA, offering them a new type of teaching outside the classic schemes and closer to their needs. The University has the right to use the Fonts for installation on its internal computers and personal computers of students with DSA teachers in order to create, both in paper and digital format, teaching material, paper material, non-commercial publications and internal and external communication tools, also for the University website" (www.unitus.it).

Technologies can facilitate learning and organizational processes. Especially after the Covid-19 pandemic, Italian universities carry out and promote training activities in e-learning mode. E-learning adoption from a sustainability perspective can be considered as a positive technological solution, able to promote much more the training and learning process especially for some people with disability mostly physical disability or special needs, although the widespread adoption of e-learning solutions, significantly increased because of Covid-19 pandemic, can negative affect social interactions and in general the socialization process. Universities have started a process of educational innovation. They have invested in improving teaching methodologies and practices also with the use of digital technologies and tools attributable to e-Learning, multimedia, and audio-visual production.

In our sample, only 2 universities do not provide e-learning activities. Over the years, the offer of online courses and modules has grown, mostly provided as a supplement to the educational courses carried out in person, but in some cases also as substitutes. Today there are two e-Learning platforms in use: Ariel and Moodle. Ariel supports web-enhanced teaching, with information, materials and resources for training and study activities. Moodle is more aimed at online teaching and is used for projects and training courses, including post-graduate ones. These are educational initiatives, alongside the traditional in- person ones, aimed at students and training courses for university staff. They use e-learning platforms to support traditional teaching. The Sacro Cuore University of Milan offers its students innovative teaching for some courses. The course takes place in blended mode: 50% in-person training activities and 50% online activities. The educational path is carried out through integrated frontal lessons, for an equal number of hours, with moments of distance learning (online) with Delivery Teaching methods (Video lessons, Self-learning, E-activities) and Interactive Teaching methods (Exercises, Case Studies. Histories, Simulations, Webinars, Video chat). From a social inclusion perspective, thus related to social sustainability, the Oriental University of Naples (Orientale University) has activated an online path designed for immigrants residing in Italy. The course helps to learn the Italian language and discover the rights and duties of a citizen. It presents many activities, with audio and video texts and many important information about the labour market and training and on social, health and welfare services in Italy.

Another useful technological innovation concerns the Virtual Room. Unfortunately, few universities use this solution. It is used especially by online universities. It is a web conferencing service that allows teachers, technical administrative staff, and students to plan and manage virtual meetings in a simple and integrated way. During meetings, participants can share documents, applications, web content, or their desktop computer. The University of Pavia has activated the UNIPV SmartCard, University services card. The card is an innovative multi-service card. It is issued without activation costs, upon request of the student. The card can be activated as a rechargeable prepaid credit card. It is automatically used by the University to credit any refunds, scholarships and sums due for student collaborations. The card can also be used in shops in contactless mode. It is the magnetic card that allows you to use water dispensers, access to the Library, access to bathrooms in some reserved areas of the University with controlled access gates. The University of Padua offers 26 beds for students with physical disabilities, with equipped bathrooms and the possibility of hosting their assistants/caregivers, as well as two home automation units. Accommodations are also available for students with visual impairments (with tactile signals, the possibility of hosting a guide dog and having caregivers) and accommodations for students with hearing impairments (equipped with luminous and fax alerts).

With reference to social inclusion, the Virtual Exchange is an accessible, innovative international experience. It does not involve physical mobility, but leverages the support given by technologies and the use of a common language as a means of communication. It consists of a training activity, organized in synergy with international universities, in which frontal/traditional teaching plays a marginal role, in favour of a collaborative experience focused on the student and group work. Its objective is the creation of a common project and/or the discussion of interdisciplinary issues, according to a challenge-based approach. The groups, made up of students from different institutions, meet on remote collaboration platforms independently or with the support of facilitators. Therefore, the Virtual Exchange differs profoundly from virtual mobility, which instead consists of several lessons held remotely (in synchronous or asynchronous mode) by teachers at the destination university who will also provide the training credits at the end of the course.

In the sustainability perspective, the adoption of mobile applications can be read as effective technological solutions for making universities much more sustainable for two

main reasons, the significant reduction of paper use and the overcome of physical and social barriers because these solutions help people to be connected everywhere and every time and they are updated on real time about everything (events, procedures, etc.). We observe that 56 universities, 41 state universities, 9 non-state universities and 6 online universities have implemented their mobile application. Italian universities have implemented several mobile applications. In this case, most universities are mostly located in northern and central Italy, they are above all mega, large, and medium-sized universities. They have been placed in a perspective of inclusiveness, environmental, economic, and social sustainability. With the mobile application, students can manage their university career directly from their smartphone. They can, for example, consult exam dates and book exams; check the progress of their career and consult your university career; fill out the teaching evaluation questionnaires; check the status of payments; receive notifications and personal communications; access the contents of the lessons. Most universities that have a library have implemented an online service. Ten universities have developed a mobile application, which can allow you to consult the University's online catalogue, check if a book is available, make loan requests for available books and reserve books on loan, cancel requests and reservations of interest, extend a loan online, view the loan situation, send a purchase suggestion to a library.

One online university has implemented an app that allows students to get to know each other, exchange opinions and, more generally, to be able to start cooperative and collaborative activities, even between colleagues on the same degree course but resident in different locations (including abroad). The application allows club users to know and share each other's (approximate) geographic location while running the app and using connected services.

From the perspective of environmental sustainability, Bicocca University has created "Polpo", a smartphone application for the qualitative and quantitative monitoring of waste separation collection by university users, developed by the POLARIS Research Center and Geomatic Lab. The eCampuss university has activated an interactive teaching app, which allows you to simulate the carrying out of written exam tests, just like during an exam.

Furthermore, 31 universities have a university radio (25 state universities, 2 non-state universities and 4 telematic universities). For the most part they are in central and northern Italy. University web radios offer numerous podcasts on teaching, research, and business. Likewise, the University of Udine has launched a carpooling service. Students, teachers, and technical/administrative staff can share the car and related trips via an app that makes information on origins, destinations, and route times available. By using the service, it is possible to obtain economic savings of up to 30% for individual users, drastically reducing emissions and fuel costs.

From a sustainability perspective the "Reuse Portal" was born at the University of Udine. It is a system through which the University provides goods and equipment free of charge to other public bodies, schools, and non-profit organizations. This project was created to prevent goods and equipment no longer needed by the university from remaining unused, as in the case of computers, furniture, books, and so forth. The web portal allows the publication of discontinued objects, the display of a catalogue of available objects, accreditation by the structures authorized to acquire the objects, and a transparent queueing and attribution procedure based on simple rules. The survey revealed that in Italy 37 universities have at least one museum. Of these 35 are state universities and 2 are online universities. Most of them are mega, large and medium-sized universities. Only 15 universities have implemented a virtual tour of museums. 1 university has developed an app dedicated to the museum. 3 museums have implemented programs dedicated to people living with Alzheimer's. 2 museums have joined projects for children, adolescents and adults with autism spectrum disorders.

In most cases, to promote equal opportunities, Italian universities have equipped themselves with a Single Guarantee Committee (CUG) which, in particular, aims to support and promote the integration of gender equality in all the Universities, through tools such as the Gender Report and the Positive Actions Plan, i.e., the action aimed at promoting the experimentation of spatial-temporal methods of carrying out 'innovative' work services (for example, smart working). Specifically, these features promote and implement the following services and initiatives: reception services to facilitate the university career of the weakest and most difficult categories; initiatives to encourage the chosen training path; assistance services, technological aids, educational and specialist tutoring; public selections for part-time contracts with 'senior' students; initiatives to improve the working conditions of staff with disabilities [26].

Table 1: A brief portrait of the Italian Universities

SAMPLE OF UNIVERSITIES DISTINGUISHED IN TERMS DISTINGUISHED IN TERMS OF SIZE/NATU	RUS MEMBER	PRESENCE OF PROTECTED CATEGORIES POLICIES	PRESENCE OF DISABILITY MANAGEMENT POLICIES	DIGITAL ASSISTANTS	CALL CENTER	TECHNICAL & ONLINE SUPPORT	WEB-SITE	WEB-SITE ACCESSIBLE	APP	COURSES (E-LEARNING PLATFORM)	VIRTUAL TOUR
Mega Universities	10	7	10	2	11	20	12	4	8	12	3
Large Universities	20	15	20		4	10	23	2	17	23	3
Medium Universities	21	10	22		7	21	24	4	16	24	6
Small Universities	13	13	17	2	4	13	29	4	15	31	3
State Universities	55	37	49	2	23	54	59	13	41	60	10
Non-state Universities	12	9	14	3	4	12	17	0	9	18	4
Telematic Universities	1	5	6		3	11	11	1	6	11	1
North Universities	25	21	26	2	9	24	32	4	23	32	5
Centre Universities	27	19	30	3	12	32	32	6	21	34	6
South Universities	11	9	17		5	17	18	2	9	18	1
Islands Universities	5	3	5		4	5	6	2	3	6	3

As shown from our analysis, digital innovation, that is the increasing development and adoption of digital and smart technologies, has increasingly involved Italian universities. Technological transformation process introduces new opportunities and challenges for academic institutions to better perform in the sustainability perspective. The analysis conducted briefly outlined a synthetic picture of Italian universities regarding the combined topics of sustainability and technology innovation. The sample of Italian universities selected has been analysed from a perspective of environmental, economic, and social (inclusion) sustainability through the lens of digital and smart technologies providing some interesting considerations. Mega, large and medium universities stand out more for promoting and adopting technological solutions to be much more sustainable, while almost all universities offer at least one online course and use digital technologies and tools especially related to eLearning, multimedia and audio-visual production. Starting from these preliminary results, in terms of empirical implications, universities should be more sensitive to social sustainability (inclusion issues) to promote and introduce blended or online learning courses, virtual support tools or digital assistance and specific programs. Otherwise, it should be useful for universities, through the same RUS network, to systematize much more their main technological solutions in the sustainability perspective and share all their experiences activating an active collaboration for being much more sustainable also through technological solutions. Otherwise, most universities focus their

attention on environmental sustainability, without sharing their practices but the technological solutions adopted are still limited (energy savings systems; water dispensers; waste recycling tools, tec.).

5 Concluding remarks

This exploratory study provides a short analysis of the Italian context by taking a picture of the Italian universities from the perspective of sustainability and technological innovativeness, by outlining that these organizations mostly still pay a limited sustainability orientation through the adoption of advanced technological solutions. Some considerations have arisen. First, it is necessary to adopt a system able to compare and share experiences and best practices developed and adopted by Italian universities to make them much more sustainable using advanced technologies. In fact, the analysis underlines the still existing geographical and dimensional gap between universities in terms of the adoption of digital and smart technologies for being much more sustainable. Second, it should be useful to internally promote at universities, recognized as exclusive managers of the training of future generations, a process of radical change in the individual and organizational culture to truly acquire the fundamental principles of sustainability, to continue this process of change externally involving the entire community, to allow universities to become "smart and sustainable".

The limitations of this study mostly related to its exploratory nature can be overcome planning in the future to directly involve the viewpoint of university staff and students conducting in-depth semi-structured interviews about technological solutions provided from the university for becoming much more sustainable, and also to investigate directly some specific universities in order to collect useful information and data about the concrete degree of sustainability orientation of universities through digital and smart technologies.

From a managerial perspective, sustainable Universities should create educational and administrative guidelines for strengthening sustainability in the university programmes, for instance, regarding social sustainability through effective technological solutions for being much more inclusive.

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