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Universities as Catalysts of Digitalization and Sustainable Socio-Economic Transformation

Case studies of telemedicine, digitalization, and cultural aspects of the study programs in academic collaborations

Summary:

The pandemic was a catharsis in many aspects, including digital development, followed by the widespread use of digitalization and artificial intelligence, which continues to reshape the labor market, societal norms, economies, and governance. Universities are uniquely positioned as research and knowledge dissemination centers in this rapidly evolving landscape. They are not only at the forefront of sustainable practices and digital integration but likewise have the potential to raise a sense of social responsibility among their stakeholders. This empowerment can drive positive change in their communities and beyond, nurturing environmentally conscious mindsets and practices for a mobile society and generational inclusiveness, both with digital natives and members of an aging society, which will be a focal point of discussion.

The paper aims to explore the complex role of universities in driving sustainable socio-economic development through implementing new courses and engagement in education proposals that follow the challenges of digitalization and environmental considerations. To illustrate these concepts, the analysis includes two specific case studies of innovation in the study

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programs: telemedicine and healthcare projects and security and cultural aspects of digitalization in teaching.

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A. The role of academia in developing digitalization and sustainable development

To explore universities' multifaceted role in driving sustainable socio-economic development amidst the challenges of digitalization and environmental considerations, we research the interplay between academia, public administration, digitalization, and sustainability. As digitalization processes and the use of artificial intelligence continue to reshape societal norms, economies, and governance, universities must navigate these transformations being actively engaged in relations with their socioeconomic environment. Diverse administrative cultures and legal frameworks require adaptable approaches to address local needs while enhancing a harmonious regional and global ecosystem. Universities, as the centers of research and knowledge dissemination, are uniquely positioned at the forefront of sustainable practices and digital integration. They play a crucial role in using innovative teaching methodologies that help to raise environmentally conscious mindsets and practices for a mobile society, cultural diversity, and generation differences. We explore the complex role of universities in driving sustainable socio-economic development within the challenges of digitalization and environmental considerations in the light of cooperation models³, highlighting the main features and mechanisms of digitalization in education for future employment in the labor market, which would promote a more inclusive society.

The study aims to show how universities can align their research and teaching to outreach digital initiatives and contribute meaningfully to digitalization challenges and sustainable development goals. Following this aim, we highlighted two case studies, being successful examples of cooperation of academia, business, and public administration in technology implementation based on realized projects: (1) innovative interdisciplinary study programs focused on telemedicine and healthcare projects, and (2) security and cultural aspects of digitalization in teaching. The case study examples

3 Cai, Yuzhuo & Henry Etzkowitz: Theorizing the Triple Helix Model: Past, Present, and Future, in: *Triple Helix*, 2020 7(2-3).

covered the digitalization-related projects realized at European universities in 2018-2023.

B. The models of cooperation of academia, business, and public administration in developing digitalization and sustainable development

I. Helix models of business, academia, and government cooperation

The general models explaining the relations in the socioeconomic environment are helix models, among which triple, quadruple, and quintuple models of cooperation between businesses, universities, and administration are most recognized for researching sustainability problems⁴. The contemporary subschemas continuously develop, reaching the new layers of the N-tuple Helix for innovation, Sustainable Development Goals (SDGs), and growth⁵. Etzkowitz and Zhou also proposed a Sustainability Triple Helix of university-public-government complementing the Innovation Triple Helix of university-industry-government, a new dynamic element into the traditional model⁶. The Triple Helix Model, pioneered by Etzkowitz and Leydesdorff, emphasized the dynamic interaction between academia, industry, and government as crucial actors in promoting innovation and economic development⁷. It underscored the importance of university-industry-government collaborations in driving technological advancements and societal progress⁸. However, as the innovation landscape continues to evolve, the

4 Leydesdorff, Loet & Henry Etzkowitz: Emergence of a Triple Helix of University-Industry-Government Relations, *Science and Public Policy*, 1996 23(5). doi: 10.1093/spp/23.5.279.

5 Gebhardt, Christiane, Mariza Almeida & Henry Etzkowitz: Triple Helix Twins: Operationalizing the Sustainability Agenda in the Northern Black Forest National Park in Germany, in: *Triple Helix*, 2022 5(2). doi: 10.1163/21971927-bja10031. Zhou, Chunyan & Henry Etzkowitz: Triple Helix Twins: A Framework for Achieving Innovation and Un Sustainable Development Goals, in: *Sustainability*, 2021 13(12). doi: 10.3390/su13126535.

6 Leydesdorff, Loet & Henry Etzkowitz: Emergence of a Triple Helix of University-Industry-Government Relations, *Science and Public Policy*, 1996 23(5). doi: 10.1093/spp/23.5.279. Etzkowitz, Henry & Chunyan Zhou: Triple Helix Twins: Innovation and Sustainability, in: *Science and Public Policy*, 2006 33(1). doi: 10.3152/147154306781779154.

7 Etzkowitz, Henry & Chunyan Zhou: Triple Helix Twins: Innovation and Sustainability, in: *Science and Public Policy*, 2006 33(1). doi: 10.3152/147154306781779154.

8 Leydesdorff, Loet: The Triple Helix, Quadruple Helix, ..., and an N-Tuple of Helices: Explanatory Models for Analyzing the Knowledge-Based Economy? in: *Journal of the Knowledge Economy*, 2012 3(1). doi: 10.1007/s13132-011-0049-4.

role of universities has shifted from only knowledge generators to active participants in the innovation process⁹. This transition gave rise to the Quadruple Helix Model, introduced by Carayannis and Campbell, who added a fourth helix, the civil society¹⁰. This model recognized the integral role of citizens, communities, and societal values in shaping innovation ecosystems. The Quintuple Helix Model, furthermore proposed by Carayannis and Campbell, introduced a fifth helix: the natural environment¹¹. It emphasized sustainability and the need for responsible innovation practices that consider environmental impacts. As these helix models evolve, universities are increasingly positioned as catalysts for inclusive and sustainable innovation ecosystems that transcend traditional boundaries and embrace diverse stakeholders¹². This shift highlights the imperative for universities to adapt their strategies and collaborations to address complex societal challenges while adopting innovation for the benefit of all.

The helix models redefine universities' roles in innovation ecosystems. However, they impact students' preparation for the labor market and acting as entrepreneurs. Emphasizing interdisciplinary collaboration and engagement with diverse stakeholders, students are encouraged to develop technical expertise, intercultural communication, teamwork in transnational teams, and ethical reasoning skills¹³. The traditional model of education, focused solely on academic knowledge acquisition, is giving way to a more holistic approach that integrates practical experiences, real-world problem-solving, and social responsibility.

In this context, universities are challenged more than ever to rethink their curricula and pedagogical approaches to better align with the needs

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- 9 Leydesdorff, Loet & Henry Etzkowitz: The Triple Helix as a Model for Innovation Studies, in: *Science and Public Policy*, 1998 (25).
- 10 Carayannis, Elias G. & Campbell, David F. J.: Triple Helix, Quadruple Helix and Quintuple Helix and How Do Knowledge, Innovation and the Environment Relate to Each Other? A Proposed Framework for a Trans-Disciplinary Analysis of Sustainable Development and Social Ecology, in: *International Journal of Social Ecology and Sustainable Development*, 2010 1(1). doi: 10.4018/jsesd.2010010105.
- 11 Ibidem.
- 12 Bonilla-Jurado, Diego, Guevara Cesar, Sánchez Montero, Ivanna Karina, Iza Pazmiño, Sarah Jacqueline, and Chenet Zuta, Manuel Enrique, The Triple Helix Model Linked to Knowledge Transfer and Economic Progress from Universities. *Salud, Ciencia y Tecnología*, 3 2023. doi: 10.56294/SALUDCYT2023314.
- 13 Trencher, Gregory, Masaru Yarime, Kes B. McCormick, Christopher N. H. Doll, and Steven B. Kraines, Beyond the Third Mission: Exploring the Emerging University Function of Co-Creation for Sustainability, *Science and Public Policy* 41(2) 2014. doi: 10.1093/scipol/sct044.

of the evolving market competencies. Interdisciplinary programs and experimental learning opportunities, such as internships, industry projects, and community engagement initiatives, become essential for student preparation. Implementing a Triple Helix relationship practically contributes to the creation of study program enhancing innovation, and supporting the changes in the program structures¹⁴. The Triple, Quadruple, and Quintuple Helix Models have created influential frameworks for understanding innovation ecosystems and universities' roles. Scholars continue to propose new conceptualizations and frameworks to capture the complexity of innovation processes and the roles of various stakeholders¹⁵.

II. Other models of business, academia, and government cooperation

In H. Chesbrough's open innovation concepts, scholars have explored different models emphasizing innovation's collaborative and open nature¹⁶. These models often highlight the importance of external partnerships and co-creation in driving innovation. With the increasing interconnectedness of global innovation networks, there's a growing focus on understanding how organizations, individuals, and institutions collaborate and exchange knowledge. Network-based innovation models emphasize the dynamics of relationships and information flows within and across ecosystems¹⁷. Given the pressing challenges of digitalization, climate change, or environmental degradation, there's a rising interest in models integrating sustainability principles into innovation ecosystems. Sustainability-oriented models balance economic, social, and ecological objectives¹⁸. As digital technologies continue transforming industries and societies, models specifically address-

14 Schiller, Benjamin, and Liudvika Leišytė, Study Program Innovation in the Triple Helix Context: The Case of Cooperative Study Programs at a German University of Applied Sciences, *Triple Helix* 7(2-3) 2020. doi: 10.1163/21971927-bja10002.

15 Bonilla-Jurado, Diego, Guevara Cesar, Sánchez Montero, Ivanna Karina, Iza Pazmiño, Sarah Jacqueline, and Chenet Zuta, Manuel Enrique, The Triple Helix Model Linked to Knowledge Transfer and Economic Progress from Universities. *Salud, Ciencia y Tecnología*, 3 2023. doi: 10.56294/SALUDCYT2023314.

16 Chesbrough, Henry W., The Era of Open Innovation, *MIT Sloan Management Review* 44(3) 2003.

17 Breuer, Henning, & Florian Lüdeke-Freund: Values-Based Network and Business Model Innovation, in: *International Journal of Innovation Management*, 2017 21(3). doi: 10.1142/S1363919617500281.

18 Zhou, Chunyan & Henry Etzkowitz: Triple Helix Twins: A Framework for Achieving Innovation and Un Sustainable Development Goals, in: *Sustainability*, 2021 13(12). doi: 10.3390/su13126535.

ing the dynamics of digital innovation ecosystems are needed¹⁹. The digital innovation models explore how platforms, data, and technologies shape innovation networks and value creation. Although all these models have some limitations and may not explicitly use the ‘helix’ metaphor, they contribute to understanding society's ecosystems and the changing roles of universities, businesses, governments, and other stakeholders.

III. Knowledge sharing process between academia, business, and public administration

Knowledge sharing is a dynamic process through which individuals and organizations acquire new know-how, skills, and attitudes by interacting in the social environment. By sharing experiences, perspectives, and best practices, stakeholders can collectively identify challenges, explore innovative solutions, and co-create knowledge that effectively addresses local needs. Engaging students in real-world problem-solving provides hands-on learning experiences and promotes civic engagement. By empowering students to participate actively in sustainable partnerships, universities prepare them to make meaningful community contributions.

Practical cooperation between business, public administration, and academia fosters sustainable partnerships and drives innovation. Public administration agencies provide valuable insights into local needs, regulatory requirements, and policy priorities, while academia offers expertise in research, analysis, and knowledge generation. By collaborating on joint initiatives, such as research projects, policy development, or capacity-building programs, public administration and academia can effectively leverage their strengths to address complex societal challenges²⁰. This cooperation enhances research efforts' relevance, leading to informed decision-making and better outcomes for communities. Investing in human capital through training ensures collaborative long-term sustainability and impact, building key competencies and organizational resilience.

Technological advances and societal expectations profoundly transform governance models in the digital era. Digital transformation promises increased transparency, accountability, and efficiency in government opera-

19 Leising, Eline, Jaco Quist & Nancy Bocken: Circular Economy in the Building Sector: Three Cases and a Collaboration Tool, in: *Journal of Cleaner Production*, 2018 (176). doi: 10.1016/j.jclepro.2017.12.010.

20 Schiller, Benjamin & Liudvika Leišyt: Study Program Innovation in the Triple Helix Context: The Case of Cooperative Study Programs at a German University of Applied Sciences, in: *Triple Helix*, 2020 7(2–3). doi: 10.1163/21971927-bja10002.

tions and service delivery. *E-government* initiatives leverage digital technologies to streamline administrative processes, enhance citizen engagement, and improve the accessibility and quality of public services. *E-study* platforms provide opportunities for lifelong learning, skill development, and knowledge sharing, enabling individuals to access educational resources anytime, anywhere. By embracing the opportunities and challenges of the digital era, governments can build more responsive, inclusive, and resilient governance systems that empower citizens and drive innovation. An example may be the concept of *e-health* supported by telemedicine and healthcare projects. On the other hand, *e-universities* can contribute to knowledge sharing and the efficient management of resources and promote sustainable and inclusive growth, social development, and environmental protection.

C. Case study – telemedicine and healthcare projects studies at the University of Gdansk

In 2019, just before the pandemic, the University of Gdansk in Poland launched the study "Telemedicine²¹ and Projects in Health Care. Health Care Technology", which responded to the contemporary challenges of remote provision of medical services. It was a unique, interdisciplinary, first-in-Poland study that combined economic, legal, and technical perspectives in telemedicine. It addressed the needs of the university to prepare well-educated graduates and the market needs for the qualified administration of healthcare units conducting telemedicine services. This field of study with a practical profile was run jointly by the Faculty of Economics and the Faculty of Law and Administration of the University of Gdansk part-time, which enabled the upgrading of the competencies of candidates working daily²². The program's economic, legal, and technical aspects prepare graduates to work and manage healthcare entities implementing organizational

21 The term 'telemedicine' is commonly used to describe the remote delivery of healthcare and health information. Despite their distinct meanings, 'telehealth' is often used interchangeably with 'telemedicine'. Both terms refer to the electronic transmission of health information between the medical center and the patient.

22 The field of study was planned as part of the project Development Program of the University of Gdansk (ProUG) realized in 2018-2023 and co-financed by the EU Operational Program 'Knowledge Education Development' within the National Centre of Research and Development.

and technical solutions²³. The possibility of using applications and devices that facilitate health monitoring is becoming increasingly common. Intensive development in telemedicine technology implementation is associated with consistently meeting international standards regardless of geographical barriers. The increasing openness of both patients and doctors to new technologies is a global trend. Telemedicine is likewise mentioned in Europe's WHO Regional Digital Health Action Plan for 2023-2030, which concerns European countries²⁴.

Ethics and data protection are essential issues for telemedicine. Nittari, Khuman, and Ricci researched gaps in ethical aspects such as informed consent, data protection, confidentiality, physician malpractice, liability, and telemedicine regulations, which are considered a matter of concern for healthcare operators and public administration²⁵. Similarly, Tiribelli, Monnot, and Kong noted ethical risks that should be detected, prevented, or mitigated due to the responsible use of AI-based telemedicine in and for public health²⁶. Due to the expansion of AI, ethics frameworks and legislation have been developed to support AI-based telemedicine solutions, especially for its adoption in and for public health. In the European Union, the alignment is a Proposal for a Regulation of the European Parliament and of the Council on the European Health Data Space²⁷. Detecting ethical issues for telemedicine services and IT has been critical since its launch. Langarizadeh, Moghbeli, and Aliabadi suggested that the moral issues in telemedicine can be investigated from aspects such as technology, doctor-patient relationship, data confidentiality and security, informed consent, and patient and family satisfaction with healthcare services²⁸. Following ethical

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- 23 American Telemedicine Association. 2024. "Telehealth Basics." Retrieved February 19, 2024 (<https://www.americantelemed.org/resource/why-telemedicine/>).
- 24 WHO. 2022. EUR/RC72/5: Regional Digital Health Action Plan for the WHO European Region 2023–2030.
- 25 Nittari, Giulio, Ravjyot Khuman, Simone Baldoni, Graziano Pallotta, Gopi Battineni, Ascanio Sirignano, Francesco Amenta & Giovanna Ricci: Telemedicine Practice: Review of the Current Ethical and Legal Challenges, in: *Telemedicine and E-Health*, 2020, 26(12).
- 26 Tiribelli, Simona, Annabelle Monnot, Syed F. H. Shah, Anmol Arora, Ping J. Toong & Sokanha Kong: Ethics Principles for Artificial Intelligence–Based Telemedicine for Public Health, *American Journal of Public Health*, 2023 113(5), p. 577–584.
- 27 European Commission, *Proposal for a Regulation of the European Parliament and of the Council on the European Health Data*, COM (2022) 197 final, 2022/0140(COD), Strasbourg 3.5.2022.
- 28 Langarizadeh, Mostafa, Fatemeh Moghbeli & Ali Aliabadi: Application of Ethics for Providing Telemedicine Services and Information Technology, *Medical Archives (Sarajevo, Bosnia and Herzegovina)*, 2017 71(5).

issues in telemedicine is a primary aspect of the HL7 Protocol or the Digital Imaging and Communication in Medicine (DICOM).

Rising healthcare costs significantly impact people's quality of life. Continued population growth and aging impact healthcare needs for more advanced scientific solutions. Since the early 1990s, ICT has improved healthcare access, efficiency, quality, and effectiveness. Technological advances, like the *internet of things* and *cloud computing*, have led to the proliferation of low-cost sensors capable of monitoring human body functions and generating large amounts of data in such convenient devices as a watch or a band²⁹. Telemedicine involves conducting diagnostic and therapeutic tests remotely, checking blood pressure, heart rate, or sugar level, and performing surgical and rehabilitation procedures. Innovations in this area change how the medical market works, patient behavior, and providing insurance and assistance services. Telemedicine and healthcare projects include assistance in consultations, improvement of medical care in isolated areas, continuity of care, and quick diagnosis in emergency services. It responds to new, essential social and economic needs by using the latest technologies in health care and the rapidly developing services market. Innovations in this area change changed the medical market and patient behavior. It should be emphasized that a practical field of study responds to the needs of the dynamically developing labor market in telemedicine services (Table 1).

29 Islam, S. M. Riazul, Daehan Kwak, Md Humaun Kabir, Mahmud Hossain & Kyung Sup Kwak: The Internet of Things for Health Care: A Comprehensive Survey, IEEE Access 3, 2015 doi: 10.1109/ACCESS. 2015.2437951.

Table 1. New jobs in the labor market connected with telemedicine and health-care projects

Area	Job positions
communication and patient contact	telemedicine consultant (e.g., in the Patient Information Center) patient service specialist specialist coordinating the patient's treatment path specialist in organizing remote consultations specialist for telemedicine services in the field of night and holiday medical care
data security	data security coordinator data security controller
system service	specialist in the implementation of telemedicine systems specialist for telemedicine services telemedicine platform administrator medical services operator
medical e-consultations	specialist for telecardiology consultations rehabilitation specialist/physiotherapist coordinating the treatment of patients with chronic diseases rehabilitation specialist/physiotherapist with individual practice general practitioners conducting teleconsultations
insurance	insurance company consultant employee of the Health Insurance Office of an insurance company consultant/manager of insurance assistance services telemedicine expert in health insurance
management	healthcare project manager telemedicine project manager head of the medical unit telemedicine manager
finance	auditor of healthcare entities financial controller in a medical facility
market analysis	telemedicine and medical market analyst

Source: own elaboration.

Recent events have confirmed that telemedicine solutions and the development of e-health are the fastest-growing trends in medical facility management. Telemedicine studies align with innovative solutions concerning the vital relationship between academia, administration, and business, marking a step on the map of other successfully implemented programs in the academic ecosystem.

D. Case study. Digitalization – security aspects and code of conduct

The imperatives of digitalization, globalization, and the COVID-19 pandemic have compelled universities to enact structural and technological transformations while pioneering novel teaching methods, like gamification, into new study fields tailored to accommodate a cohort of learners often referred to as digital natives³⁰. As a result, integrating digital tools in higher education, particularly security, has become increasingly important³¹. With the rise of digitalization and online learning, in 2018, the European Union issued the world's strictest data protection legislation, the General Data Protection Regulation (GDPR). It is becoming imperative for academic and administrative staff and students to implement and enforce data protection and privacy policies, emphasizing the need for teachers to be prepared to address information security issues, particularly in distance learning and digital exams³². This approach is particularly relevant in the digital transformation of higher education institutions that need help implementing specific regulations when delivering online courses.

The participants in the international project “DigiMates: Development of Innovative, Gamified and Interactive Method for Advanced e-Teaching and E-learning of Skills”³³ faced such a challenge. The project concerned the development of a concept for a didactic game implemented as the e-course, accompanied by detailed security rules (toolkit) dealing with privacy, respect, and understanding of cultural differences, emphasizing digital gender equality, sustainability, and respect for any other differences at the digital level of communication. In addition, recommendations have been made to indicate the principles of the Code of Conduct, considering the national and local rules of the country and university. The toolkit addressed tools and platforms for online courses, sharing game materials with students,

30 Fernández-Raga, Maria, Aleksić, Darija, Ikiz, Aysun Kapucugi, Markiewicz, Magdalena & Streit, Herbert: Development of a Comprehensive Process for Introducing Game-Based Learning in Higher Education for Lecturers, in: *Sustainability*, 2023 15(4), 3706.

31 Marchisio, Marina, Fabio Roman, Matteo Sacchet & Enrico Spinello: Students' Digital Competencies in Remote and Online Higher Education in the Security and Defence Field, in: *Ubiquity Proceedings 2023* 3(1), p.452–457.

32 Mantykangas, Arja, *Information security issues in higher education*, 14th International Conference eLearning and Software for Education, 2018 (4), p. 378-381. doi: 10.12753/2066-026X-21-267

33 The project under Erasmus+ KA226 Partnership for Digital Education Readiness (2020-1-SI01-KA226-HE-093593) was realized in 2021-2023 by the international consortium: University of Ljubljana (leader), University of Gdansk, Heilbronn University, University of Leon, and Dokuz Eylül University.

contacting students about course-related issues, logging into the game platform, protecting private laptops or other mobile devices used for online courses, keeping records related to online classes, etc. On the one hand, significant similarities were shown between the project's partner universities in several areas related to online course security (data security policies for online teaching by recommending the use of an e-learning platform used as a learning management system or the use of a specific online learning tool for lectures). However, there was no unification regarding the platforms: Moodle, Canvas, Sakai, and Ilias were among the most popular. There were a lot of online learning tools for lecture delivery (Fig. 1).

Teachers shared files for courses taught to students mainly on learning management system platforms and the university's website, although some used Google Drive, MS Teams, OneDrive, or other methods. An apparent similarity was identified in the registration method: The universities mostly automatically registered students on e-learning platforms. Students used their username/university email address and password to log in, which can be considered desirable for security reasons.

Fig. 1. A word cloud showcasing online learning tools used for lectures



Source: own elaboration.

Academic teachers could use university-owned laptops, tablets, or mobile devices for online courses. However, most university teachers in the Digi-Mates project used private devices. Updating the operating system and installing and updating anti-virus, firewall, and malware software is one of the basic security requirements. Monitoring device performance, analyzing user activity, and verifying websites visited, files downloaded from the web, and applications running are the most beneficial functions of anti-virus programs. Teachers only sometimes protect their devices with a strong password. With the software, computers allow infinite login attempts using different password combinations in short intervals. As an additional safeguard, passwords can be changed regularly at specified intervals. In this way, even

without being aware that the password has been stolen or read by others, the user will effectively protect their data from cyber theft.

There were likewise significant differences regarding how teachers use private email addresses for teaching purposes and the provisions of anti-virus software for teachers' private computers. The compliance aspect of keeping records related to online courses can also be different. University regulations specify how long and where records must be kept. At one university participating in the DigiMates project, the documentation can be deleted immediately after the course. In contrast, it must be kept at four universities for over a year. Different security and privacy policies may apply to various aspects, such as sharing documents or other materials (including links to meetings) within the course with external parties, camera use, methods of communication between student-teacher, etc. Differences were additionally noted in policies regarding recording online classes. Due to privacy, security, and general data protection aspects, it is important to inform students about the rules regarding taking screenshots or recording any material or communication used during online classes. It should be noted that a university lecture and the presentation displayed during it are protected, provided they meet the prerequisites for being considered a work under copyright law. For their lawful use, permission must be obtained from the creator – the author of the lecture and presentation. However, some exceptions to this general rule include the so-called permitted personal use, which allows the unrestricted use of already distributed works for one's purposes without the author's permission. From the point of view of copyright, a lecture can be recorded and listened to alone or in the company of people with whom someone has a personal relationship - such as family or friends. On the other hand, its further dissemination, e.g., by posting it on the Internet so that it would be available to an unlimited number of people, does not fall within the limits of permitted personal use. Therefore, such action may result in copyright infringement and, consequently, sanctions provided by law for its violation. Analogous rights and restrictions apply to using images. In recording a lecture, the risk of violating the lecturer's and attending students' rights associated with the recording and subsequent use of his voice is worth noting. The information on whether students can record online classes or take screenshots should be provided to students before or during the first meeting. Rules regarding screenshots or recording any material or communication used during online courses may vary considerably depending on the university and in between national regulations.

Online learning and teaching require a better understanding of the cultural, security, and technical issues in the didactic process, which may

be analyzed from different perspectives. The DigiMates project set out clear rules for communication in online lectures. The idea was to help teachers prepare smooth meetings for group and individual activities with recommendations for better togetherness. A Code of Conduct was prepared based on interview protocol, including feedback and experiences from students and lecturers from the universities participating in the project. It covered external appearance, behavior, formalities and etiquette, and technical and safety issues (Table 2).

Table 2. The summary of the Code of Conduct in online learning from the point of view of students and academic teachers

Academic students	Academic teachers
Be respectful: Respect your teacher, classmates, and the learning environment. Adjust your appearance and voice activity. Avoid using inappropriate language and comments or engaging in discrimination or harassment.	Be respectful: Show respect towards your students by creating a welcoming and inclusive learning environment. Avoid using inappropriate language or critical comments.
Be punctual: Attend class on time and avoid late or missing classes without a valid reason. If you must miss a class, consider informing your teacher beforehand.	Be punctual: Start and end the class on time, and be available before and after class to answer questions and provide additional support if needed.
Be prepared: Come to the class with all the necessary materials, such as textbooks and notebooks, within the reach of your hands.	Be prepared: Come to the class with a well-organized lesson plan. Have all the necessary materials and resources ready for the course.
Participate actively: Engage actively in the learning process by asking, answering, and contributing to discussions. Share your thoughts and ideas with your classmates and teacher.	Communicate effectively and clearly with your students. Be sure you know and have prepared the digital tools properly. Use various teaching methods to cater to different learning styles and abilities.
Follow instructions: Listen carefully and follow your teacher's instructions. If you need help understanding something, ask for clarification.	Encourage participation: Encourage students to participate actively in the learning process by asking questions, answering questions, and contributing to discussions.
Have a positive attitude and a willingness to learn. A positive and respectful learning environment benefits everyone.	Provide feedback: Provide timely and constructive feedback to your students on their progress, assignments, and tests. Help them identify areas for improvement and provide guidance on how to improve.
Be honest: Be honest with your teacher and classmates. Do not make excuses or lie about your progress. If you are struggling with something or need extra help, ask for it.	Treat students fairly: Treat all students fairly and without bias. Avoid showing favoritism or discrimination based on race, gender, religion, or socioeconomic status.
Be responsible: Take responsibility for your learning by completing assignments and homework and studying for tests. Avoid plagiarism and cheating.	Follow ethical standards: Adhere to ethical standards and professional codes of conduct. Respect your students' privacy and confidentiality and avoid any misconduct.

Source: own elaboration.

Overall, it was important for academics and students to recognize and be aware of the different challenges and create a supportive learning environment. These recommendations can help create an engaging and productive online classroom community.

Summary and conclusions

The convergence of digitalization, globalization, and the impact of the COVID-19 pandemic has necessitated profound structural and technological changes within universities. These changes are reflected in the adoption of innovative teaching programs, like telemedicine, e-focused studies, and the involvement of AI and methodologies tailored to accommodate the needs of digital-native learners. Telemedicine revolutionized healthcare services, increasing patients' and physicians' acceptance of new technologies and adherence to ethical data and data protection rules. Ethical considerations such as informed consent and data confidentiality are paramount in telemedicine. The practical field of study responding to evolving labor market demands exemplifies successful collaboration among academia, administration, and business, marking significant strides in the ecosystem.

Simultaneously, integrating digital tools into higher education, crucial for enhancing student engagement and motivation, furthermore brings significant challenges, particularly in ensuring information security and data privacy³⁴. Initiatives like the DigiMates project exemplify efforts to address them by developing a comprehensive security toolkit and code of conduct, emphasizing privacy, cultural sensitivity, and gender equality in digital communication. While universities share common approaches in implementing online teaching platforms and security measures, disparities in policies regarding data retention, communication methods, and intellectual property rights underscore the need for standardized protocols and greater awareness of legal and ethical considerations in online education.

Addressing the challenges of digitalization in education requires enhanced collaborative efforts from academia, industry, and policymakers. Creating a supportive learning environment that prepares students for future careers requires adhering to best practices and guidelines. The Code of Conduct underscored values such as respect, integrity, and responsibility, which are fundamental in professional settings. Employers increasingly val-

34 Doherty, Neil Francis, Leonidas Anastasakis & Heather Fulford: The Information Security Policy Unpacked: A Critical Study of the Content of University Policies, in: *International Journal of Information Management*, 2009 29(6). doi: 10.1016/j.ijinfomgt.2009.05.003.

ue these skills by seeking individuals capable of effectively collaborating, communicating, and problem-solving in digital contexts, contributing to the key competencies of the future. Following the Code of Conduct rules similarly forwards a culture of accountability and mutual respect among peers, mirroring the dynamics of professional environments. Participants who internalize these principles during their academic journey are better equipped to solve ethical dilemmas and take on challenges they may encounter in their future careers.

The analysis of two case studies of innovation in the study programs, telemedicine and healthcare projects and security and cultural aspects of digitalization in teaching, showed the complex role of universities in driving sustainable socio-economic development, which aligns with the triple, quadruple, and quintuple helix model principles. This collaboration among academia, administration, business, and society enhances digital education and creates a supportive and inclusive learning environment that benefits all these parties.

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