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Digital Innovation in Higher Education and Commerce: Bridging Skills, Entrepreneurship, and Sustainable Growth

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Abstract

The strategic importance of digital innovation to the sustainable functioning of society and business is not in contention. Yet, there is little effort at defining frameworks that could assist in defining interventions to make skills useful for employability and entrepreneurship. This study looks at how higher education and trade can co-create inclusive digital systems capable of providing support for skills development and entrepreneurship functioning in alignment with the growth objectives of the nation and their respective institutions. Using the lenses of digital innovation, skills and entrepreneurship development, the study presents a novel multidisciplinary framework for the commercialisation of higher education. The analysis exposes some important questions for policy, practice and future research.

- *What strategies can school or colleges implement to effectively engage the local economy?*
- *What other formal and non-formal pathways complement conventional curricula to enhance digital skill sets to aid employability and venture creation?*
- *What social and economic inclusion and sustainability features should the design of digital interventions and curricula that derive from and/or expand existing commercial engagement contain?*

This contribution provides a systems-based economic perspective to a detailed analysis of the digital innovation, skill sets, and entrepreneurship of academic chambers of commerce and commerce in the context of higher education, identifying cross-sector drivers, barriers and co-creation opportunities across a number of socio-economic sectors. The findings contradict stakeholder beliefs on higher education; highlight the important role of entrepreneurship in

national goals; bring to attention under-resourced institutions; and highlight a need for multidisciplinary collaboration between these institutions and enterprises. The findings show the necessity to clarify how digital innovation is related to the national and institutional types and the role of commercialisation in digital innovation and multi-institutional engagement.

Keywords: *Advanced technology, higher education, academic business, technology transfer, digital skills, sustainable development and commercialisation.*

1. Introduction

Institutions offering higher education (HEIs) are a worldwide business. There is a global need to improve the quantity, quality and employability of graduates with an academic degree, higher skills and/or entrepreneurial aspiration, who can fill job vacancies and grow the economy. This requires fit-for-purpose, adaptive, relevant and effective platforms/methods to transfer knowledge, stimulate learning and sustainably integrate the academic and entrepreneurial activities of HEIs, students and society.

HEIs have roles to create and co-create socio-economic development among academia, industry, and governments towards building a resilient and sustainable nation. Entrepreneurship does not simply mean creating a new business. It also includes identifying problems and unmet needs and offering creative solutions, whether or not a business is to be created.

As the fissures in education, skills, and entrepreneurship broaden and COVID-19 creates outrage, it is essential to figure out how education-commerce interfaces have been deployed and solutions provided. Dealing with higher and commerce innovation in the digitalisation and entrepreneurship era, teaching-learning enhances sustainable incorporation in pedagogies, curricula, research, and outreach partnerships among HEIs and Technology transfer from academia to commerce (Marzo-Navarro & Berné-Manero, 2022) ; (Yuan & Powell, 2015).

2. Theoretical Foundations of Digital Innovation in Higher Education and Commerce

Digital innovation means involving the use of digital technologies. The use of information, communication, and other technologies in an activity or process is digital innovation. As per the proposed digital transformation model, in response to pressure emanating from multiple factors, technological diffusion intervenes on digital capabilities, which then interacts with governance processes that in turn impact overall performance, both commercial and educational (A.

Qureshi et al., 2016). The model, developed in the context of new digital platforms like learning platforms and massive open online course (MOOC) ecosystems, can provide a framework to inform research, modelling, and understanding of digital innovation in higher education (HE) institutions (Recker & von Briel, 2019). Digital skills have now become a pertinent basic to entrepreneurship and an economy-based venture. University education marks the beginning of the entrepreneurial journey for many entrepreneurs. It also offers access to committed early-stage funding and market opportunities. This can include the development of advanced solutions that address the serious commercial issues confronting large companies. In this article, we shall discuss university education and various things related to it.

Basically, an entrepreneur is someone who seeks out an opportunity, and entrepreneurship is the means to pursue that opportunity. As such, the provision of entrepreneurship education by higher education institutions, and the provision of skills development/sponsorship in areas such as data analytics, programming and digital fitness, for free or at minimal costs, is very important. University-based startup venture creation should assist with funding and mentoring, with either a business challenge competition like the Venture Cup or a preliminary customer programmer pre-seed funding competition. There is strong support for student-led innovation, particularly in relation to requests for funding and partnerships with the industry for the co-creation of models and projects for social innovation.

2.1. Technological Diffusion and Knowledge Transfer

The process by which new technologies and scientific knowledge are distinctly transferred through space and time (Uruchurtu et al., 2018) is referred to as technological diffusion. Translating knowledge helps informal businesses, especially small and medium enterprises (SMEs), to make contributions and build environments. Digital technologies exhibit a high degree of connection and communication capability, enabling rapid and continuous knowledge exchange. Innovations in technology are driven by operational capacity and sector applicability based on technological and market feasibility. The efficiency of knowledge transfer is closely related to the digital transformation of informal economies (A. Qureshi et al, 2016).

The diffusion of technology has the possibility of entrepreneurship development through the online business model, in addition to informal business. The new competencies and understanding are needed to grasp the transition from offline to online commerce. The rapid advancements in

ICT may often not match the technical expertise and online business capacities of businesses. In most cases, training in the higher education system of physical technology does not meet any need for online entrepreneurship. Newly introduced programs and workshops at educational institutions should enhance online business knowledge, competence, and management skills.

2.2. Entrepreneurship Education and Skill Development

Training in entrepreneurship and skills relates to work-related competencies as well as self and social competencies needed to get a job or create an enterprise (Zenner et al., 2017). Countries are developing national strategies and curricula to include employability skills in their general and vocational education. Countries like India are implementing policies to reform their TVET systems to enhance skills development and make education systems responsive to the labour market (A. Qureshi et al., 2016). Studies show that improvement of learners' motivational bases, metacognition and experiential learning is particularly important to developing entrepreneurial capabilities. It is expected that a large pool of learners would become ready for work, improve their ability to create and manage new ventures and address the issue of inclusiveness by extending skill development initiatives to low-income areas and sectors.

2.3. Sustainability and Responsible Innovation

Sustainable and responsible innovation for skills development and entrepreneurship in education and business. The upgraded Third Mission wakes up networks between institutional and private actors and provides opportunities for the social and economic processes. Universities are regional hubs involving inquiring students, engaged citizens, NGOs, businesses and regional governments in economic, social and environmental issues. Sustainable development in social entrepreneurship is associated with education; university policies are increasingly concerned with useful corporate social responsibility and sustainability. The Lisbon Agenda, which has international recognition, intends to reconcile sustainability with innovation and entrepreneurship to improve the quality of life. Education moulds attitudes and skills. It helps build entrepreneurial skills with the help of activity-based learning and a shift in attitude. Universities are responsible for more than merely offering university degrees. They connect. The design and delivery of curricula must be aligned with market requirements.

The economic, ecological and social components of sustainable development. The industry and society can be

sustainably developed through innovation and entrepreneurship. Universities foster innovation and entrepreneurship through education, research and direct support. According to a top expert on innovation, people are the most important for innovation. Motivation, information, and networking are also very important for innovation. To achieve long-term success, excellence and sustainability are very important. We claim that the efficacy of an innovation should be assessed as generating a positive economic impact and sustainability. It should not be just the number of patented inventions or startup applications. Stability and durability are more valuable than temporary success (MITITELU et al., 2017); D. Wood construction, 2005.

3. Digital Ecosystems in Higher Education: Platforms, Data, and Collaboration

Digital ecosystems are key to the continued relevance of higher education. This digital ecosystem is a way of thinking about changes to core higher education propositions that maintain a strong commitment to diversity and inclusion in learning, research and commercial activities in a global network of campuses. It captures the key characteristics of digital transformation defined by the United Nations Sustainable Development Goal 4: Quality Education (Cheers, 2017).

The sharing of programs, courses and materials across institutions is facilitated by learning platforms and MOOC ecosystems. Centralised platforms that offer additional courses for anyone are beneficial to both people and institutions. According to Petkovics (2018), in co-created and co-shared-ownership models, institutions contribute services and gain from cross-institutional programmes supporting global learning networks. These arrangements also avoid strategic reliance on a single platform. It is anticipated that platform-based ecosystems will develop into the dominant higher education model, resulting in ownership, curation, and quality assurance policies for materials created for formal learning becoming a priority for many institutions.

The context of data analytics in higher education refers to the analysis of institutional data and educational materials for improved decision-making and learning outcomes. Machine-learning techniques enable the discovery of patterns in large datasets for multiple applications. The initiatives involve tracing links between existing courses, estimating uptake of individual courses, predicting student dropout rates, and customising feedback. The automated extraction and synthesis of resources related to specific topics or search queries is possible, as is the generation of data-driven personal learning paths. The problematic nature of these practices

refers to the acquisition of identifiable personal data without informed consent for machine learning (Teini, 2016).

3.1. Learning Platforms and Massive Open Online Courses

In the last few years, many higher education institutions have engaged in the platforming of MOOCs as a means of widening participation and as an opportunity for fresh collaborations and partnerships (Yuan & Powell, 2015). The new partnerships that result often create a new set of entrepreneurial opportunities for institutions and for educators. Educational content is now reaching new audiences in different ways, including fully "open" models, which provide free access with no requirement for learners to register or submit any personal data. Such offers are accompanied by what might be called accreditation-lite, where the option of institutional, credit-bearing or other accreditation remains, provided that learners submit standardised assessments and undergo a system of identification. Open courses with low-fixed-variable-cost structures enable existing educational providers to build a sustainable business model while meeting wider institutional missions. There is scope for partnerships, not just around the pedagogical design of MOOCs but also around marketing, delivery and accreditation.

3.2. Data Analytics, Artificial Intelligence, and Personalised Learning

Education is experiencing three major changes: big data, artificial intelligence (AI), and personalisation. Learning Analytics and Educational Data Mining enhance teaching and learning practices across all levels, settings and contexts. In the past five years, AI applications to automate pedagogical activities – creating personalised course material, enhancing the engagement of students, and improving outcomes – have increased manifold.

With globalisation taking place at a rapid and fast pace, the demand for industrial innovation and creativity has altered the skills and competencies desired for a smooth school-to-work transition of students. The worldwide market in graduate skills and competencies in various fields indicates students must not only possess discipline knowledge but also acquire cross-domain literacy as well as 21st-century skills (Luan et al., 2020).

3.3. Industry-Academic Partnerships and Co-Creation

Working together with colleagues is a necessity of the industry. It is important to reach commonly desired goals and mutually beneficial plans if you wish to achieve success. With the goal in mind to provide students with quality education, knowledge and practical opportunities,

the industry designs projects; similarly, universities modify these projects to transform theoretical concepts into real-time projects. Businesses that are not closely tied to academia will advance more slowly and find it more difficult to recruit graduates. Industry collaboration can be more effective and promoted through the use of open innovation. Skills acquisition and team teaching are imperative towards effective integration. (Nkhangweleni Mafenya, 2013)

4. Digital Transformation in Commerce within Academic Contexts

The higher education sector can venture into commerce, entrepreneurship, and graduation skills with e-commerce. Despite being relevant for student and graduate ventures (Kumar Nayak, 2017), campus economies underutilise digital channels. There should be a digital strategy at the institution level, course level, and personal level to enhance physical store activities. When universities enable marketplaces, it gives students experience and increases revenue share. Most students are familiar with digital devices and can easily enter into e-commerce or other businesses. By supporting industrial ecology models and hybrid distribution approaches, institutions can consolidate purchasing and set up systems for affordable, low-impact products.

Digital skills crucial for future employability include interaction with digital content, big data analysis, threat awareness, the Internet of Things, process optimisation, and collaborative tools (Petkovics, 2018). Academic institutions can spur workforce and startup ecosystem digital skills development through digital commerce engaged with co-creation, cross-input, and reciprocal benefit. Free scientific exchange facilitates joint research establishment and knowledge spillover, enabling the study of ventures that foster infrastructure development. Entrepreneurial ventures promote learning and contribute to coopetition engagement. The entrepreneurial process entails environmental phenomenon appreciation, business idea generation and investigation, preliminary outline formulation, and sanctioned operation commencement (Marzo-Navarro & Berné-Manero, 2022). Sourcing, processing, storage, and communication facility features and costs must be defined to realise the concept; operational knowledge acquisition initiates the process. Knowledge is protected via formal channels, trade secret maintenance, and non-disclosure agreements. Innovation value assessment guides econometric modelling for commercialisation selection; convenient models for prospective investor-oriented prediction simplify this process.

4.1. E-Commerce Enablement for Campus Economies

E-commerce enablement significantly transforms campus economies, fostering entrepreneurial initiatives and establishing systematic marketplaces within and beyond educational institutions. Platforms such as University Bazaar, Student Market, and University Shop connect students on campuses and across continents, creating global allowances for student-led microbusinesses and supporting the entrepreneurial endeavours of both students and alumni. These economies not only facilitate buy-back services for users' textbooks and sell second-hand items—mitigating growing financial stress on students—but also teach diverse entrepreneurial opportunities and create jobs for digital natives after graduation. Universities worldwide thus establish their own marketplaces to encourage student entrepreneurship, formulate prototype ideas, and ensure sustainable growth (Yuan & Powell, 2015). Digital devices and social media have fully penetrated students' lives, freely exchanging information, knowledge, talents, and ideas across boundaries, lowering collaboration and transaction costs. E-learning enhanced the technical skills participatively learned from adult training whilst introducing together the provision and acquisition of digital products and virtuoso services for e-commerce in a wide range of higher-educational disciplines (Parker & Swatman, 2001).

4.2. Digital Skills for the Workforce and Startup Ecosystems

In Industry 4.0 ecosystems, nations compete to produce industries with higher productivity and value-added to the local economy. After finishing their studies, graduates transition from institutions into the workforce and the job market. They are equated after graduation with job seekers, causing them to engage in simple work to start their careers. Digitally competent data scientists and digital technology engineers are in high demand. Many start-up companies prefer to hire graduates with digital skills and competent technology knowledge. Work-ready graduates and entrepreneurs who are equipped with digital and entrepreneurial skills are needed to drive sustainable economic growth. Institutions, therefore, deploy digital skills training, a Work Readiness Programme, and Technopreneurship-driven outreach activities in order to prepare graduates proactively to cope with the impending challenges for the future of work (U. Tatpuje et al., 2022).

4.3. Intellectual Property, Innovation Valuation, and Commercialisation

Knowledge transfer (KT) is the process through which knowledge is accessed, acquired, and assimilated by a person or entity in a manner that enables its application (Buitendag, 2018). Knowledge transfer is one of the critical

dimensions of technology transfer and is guided by various approaches, including the explicit–tacit, coding, heuristic, and resonating modes. Acquiring knowledge and the ability to apply it in specific contexts is understood to require a combination of skill development and entrepreneurship training. The acquisition of commercial awareness and the ability to valorise assets enhance success in growing university enterprises (Marr & Phan, 2020).

Patents	Trade Secrets	Copyrights
Protection: Registration required	Protection: Requires secrecy maintenance	Protection: Automatic upon creation
Innovations: New processes, machines, compositions	Innovations: Confidential processes/algorithms	Innovations: Software, educational materials
AMC Examples: Drugs, devices, diagnostics	AMC Examples: Datasets, care models	AMC Examples: Apps, videos, textbooks
Duration: ~20 years	Duration: Indefinite (until disclosed)	Duration: Life + 70 years

Commercialisation refers to the process of turning an idea or innovation into a business. Often, this journey requires the creation of an innovation roadmap that is similar to a business plan but more detailed. Despite many faculty members being highly creative, few are engaged in the commercialisation of their ideas, and thus, there is a widespread entrepreneurial activity among them and a greater incidence of barriers to engagement.

5. Pedagogical Innovation, Assessment, and Quality Assurance

A major challenge in pedagogy design is to facilitate online and hybrid learning at scale whilst promoting inclusion and equity. Institutions must consider their pedagogical philosophy, define

opportunities for online learning across every programme, and make the necessary investments in addition to enabling more digitally fluent staff (Rossi & Notargiacomo Mustaro, 2022). For example, the public sector adult education strategy developed in New Zealand responds to a pressing concern about reevaluating the methods used to educate weakly educated and digitally illiterate populations. According to the principles underpinning the strategy, equal access to learning is necessary for all parties involved; participants are enabled to choose the content they want to learn about, and participants are empowered to work with one another, thereby enhancing the social aspects of learning and the sense of community.

Academic institutions have discovered a need to rethink how they assess student achievement in the digital era. The introduction of online learning has not been matched with innovations in assessment, which has probably remained unchanged since paper-based delivery was introduced. A lot of the e-learning toolbox is underused because assessment is assumed to be a separate phase at the end of a learning experience. There is no other medium or tool for experimenting with formats and ways to verify achievement and offer feedback to learners, either in the classroom or beyond, than online learning and technology associated with it. As Williams (2014) notes, such evaluation can have unit-wide, degree-wide or wider impacts.

5.1. Pedagogical Models for Digital Mastery

New education opportunities have been provided by technology. The students can share and make use of any educational content from anywhere through online learning, which is used across all fields. The world of work is rapidly changing, impacted by various disruptive forces, including the COVID-19 outbreak (Rossi & Notargiacomo Mustaro, 2022). Maintaining all education and training offerings ensures relevance for long-term sustainable growth. More and more people are becoming aware of the potential disruptions in their lives and professions as a result of the digital economy, and the lack of correspondence between the learning pedagogies designed for academic courses and programmes with the digital economy challenges and opportunities continues to be a problem. Frameworks for lifelong learning, recognition of prior learning and validation of skills gained through informal learning are poorly defined. Many people in the world do not benefit from formal education. The lack of access to digital devices divides the population, affecting educational programs. Due to the greater unavailability of verification (regarding the honest completion of your assignment or your examination) of the

degree to which you can complete your assignment or examine yourself, the term "assessment" is not effective. This is due to the digital economy encouraging human beings and their respective machines to coalesce to obtain and duplicate information. Thus, other facets of assessment are crucial for maintaining quality in education.

Digitisation brings both local and global dimensions to education; academic institutions consider how, why, where, and when learning takes place (Marzo-Navarro & Berné-Manero, 2022). The regional scope of a campus can define the limits of the establishment. Digitalisation provides an instantaneous connection to resources and people not encompassed by traditional dimensions. Adopting a circular understanding of education, learning occurs whenever and wherever an individual accesses relevant material. Globalisation, technological change, rapid innovation, and other forces shape new work and practices, necessitating a reevaluation of institutional responses. Examination of entrepreneurial education, digital skills, e-commerce, validation of skills and qualifications, and intellectual property rights emerges as timely and important.

5.2. Assessment in a Digital Era

Social media has transformed the way individuals communicate, collaborate, and share knowledge. The emergence of Industry 4.0 has introduced digital types of work such as freelance, crowdsourcing, gig, home, portfolio, telework, and—most importantly—e-entrepreneurship and online entrepreneurship; e-business is now widespread and applying a large number of categories of work requires new forms of assessment. Many educational institutions have adopted blended learning or flipped classroom models that require the use of online learning materials outside class time to allow in-class time to focus on more engaging learning activities such as case studies and exercises, group projects, and discussion forums. Both individual and team-based project work have been widely employed in many educational institutions as part of the course assessment (Williams, 2014).

Managing assessment-related activities is extremely important for maintaining stakeholder satisfaction. There is frequently an overload of information in communications between educational institutions and project groups; frequently, meetings that involve too many stakeholders lose focus. Tight deadlines and late contributions from project group members can generate dissatisfaction. Too much reliance on a single application, such as an email system, generates information overload. Report-writing and presentation-preparation software such as Microsoft Office remain widely used within project groups; innovative tools that resolve

these issues further enhance stakeholder satisfaction and student experience.

5.3. Quality Assurance and Accreditation in Online and Hybrid Modalities

The swift shift to online and hybrid learning during the pandemic highlighted the need for quality assurance and accreditation to ensure the educational quality of alternative delivery modes (ADMs). Multiple frameworks have been developed to verify the quality of learning processes as influenced by new technologies (Rossi & Notargiacomo Mustaro, 2022). Nonetheless, traditional accreditation frameworks were not designed to facilitate and have not been adapted to the characteristics of online courses, which have different pedagogies and technologies (Rice et al., 2018).

Institutional and programmatic accreditation are not obligatory but allow credible institutions that demonstrate continuous enhancement of their programmes to obtain federal financial aid, and they ensure that established parameters are satisfied concerning educational aims, platform selection, course design, teaching methodologies, and learner assessment. Maintaining quality assurance is even more crucial for alternative delivery modes, which can still suffer from negative perceptions arising from early experiences with packaged online courses and binge-watching videos that are perceived to be unengaging or episodic.

6. Economic and Social Impacts: Growth, Inclusion, and Sustainability

The growing adoption of digital technologies will result in further economic growth. Through digital technologies, higher education institutions and businesses can operate more efficiently and productively, with knowledge spillovers to other sectors also generated (P. Halsall et al., 2022). Digital technologies increase social equity by enabling disadvantaged groups to access courses, training, and lifelong learning that might not otherwise be available.

Digital technologies can enhance the sustainability of business and educational activities. They help reduce resource use and emissions, notably through remote and hybrid working and learning, reduced travel, improved resource efficiency, and decreased paper use (MITITELU et al., 2017).

6.1. Economic Growth and Productivity

The enhanced diffusion of digital innovation has led to productivity gains and economic growth. These effects are transmitted in part through knowledge spillovers, since collaboration between higher education institutions and commercial enterprises provides a major vector for the effective dissemination of knowledge and skills (Kruss et al., 2015).

E-commerce reflects this broadening of the commercial landscape. New avenues for the generation of revenue and income creation are therefore emerging for both higher education institutions and student start-ups within commerce and e-commerce in particular (Gros & Roth, 2008). Digital innovation facilitates entrepreneurship and provides craftsmen with a much broader exposure to markets, thereby releasing additional economic potential.

6.2. Social Equity, Access, and Lifelong Learning

Challenges in education and the workplace have increased the need to learn and acquire knowledge in a world that is continuously changing. Before the pandemic, programs such as EDUCAUSE were looking into programs that would support the students in connecting with their local environment and expanding across the globe. COVID-19 only accelerated the need for virtual connection and collaboration.

In light of the COVID-19 pandemic, 95% of all learning institutions of higher education went online. Presently, discussions have emerged about the future of education. The need for universities to shift courses and programs online or develop hybridised programs has quickly arisen. It is feasible to go completely online with MOOCs and other platforms, but the issue is whether the programmes are going to be produced in-house (P. Halsall et al., 2022).

6.3. Environmental Sustainability and Resource Efficiency

The pandemic revealed the fragility of open and interconnected systems in an increasingly knowledge-based globalising world (Deda et al., 2022). Awareness of burgeoning climate change and the infinite nature of data and digital resources has grown tremendously. Despite digitalisation enhancing business continuity and environmental sustainability in commerce, all services have global exposure and can be destroyed or saturated. The crisis escalated the otaku phenomenon; many retained and upgraded capacitated under huge demand on bandwidth and telecommunications. The new frontier of teach-and-learn service in digital transformation has yet to mature. Need for reconfiguring multi-modal architecture of next-generation higher-education 4.0 system, responding to trend-oriented innovation in economy, commerce and business, has never been greater.

7. Policy, Governance, and Governance of Digital Innovation

Digital public services are increasingly framed as strategic vectors for the transformation of societies. The digitalisation of education, entrepreneurship, commerce, news, and, of course, governance and public

services is likewise becoming a critical priority. Structured governance approaches help in clarifying the goals and in framing the measures needed to achieve such goals. Three guiding principles of any design are to clarify purpose, to remain flexible to the particularities of the environment, and to accompany any practical implementation with rigorous parallel assessment. Five main components—public policy, governance, funding, co-creation, and support services—structure how to operationalise the necessary transformation.

In the five components supporting governance initiatives, the diversity of actors involved, their high level of specialisation, and the maturity of the underlying regulations limit the capacity of global frameworks to ease local governance initiatives. Hence, the a necessity for comprehensive but free frameworks that guide without restricting local initiatives. Such frameworks propose urging shifts from government to governance, from government-only to collaborative approaches, from top-down only to top-down-and-bottom-up, from regulation-only to consideration of sector-specific initiation and generation, from budget-only to the examination of alternative funding aggregation and management, from accountability-after to co-creation-with-accountability-toward (Halmos et al., 2019). The broad phenomenon of e-learning offers many opportunities for such horizontal governance frameworks, notably when coupled with high-throughput open-source technical and reference-problem datasets (Chang & Uden, 2008).

7.1. Public Policy and Funding for Digital Higher Education

Public funding shapes innovation across sectors. In most countries, support during the first industrial revolution was largely directed toward the private sector. Today, funding is spread across public and private research, embodied in what is called the technology-push model for higher education (Laufer et al., 2021). One of the most decisive changes of the policy framework toward education in the nineties has been the shift from cost-driven approaches—which assume that the presence of a wider range of institutions will automatically reduce costs—to value-driven ones that emphasise the importance of widening access and improving quality. The economic crisis has brought increasing pressure on higher education institutions to make sound financial decisions in order to ensure effective management of public resources, as well as concern over the effective use of public funding. At the end of the eighties, it was also clear that, to achieve access to the new technologies, the capabilities of students and teachers were paramount.

The policy framework needed a comprehensive review since the global technological revolution required a different, more consensual type of interaction between government, industry, and higher education institutions. The present hospitable environment makes it possible to consider policy frameworks in terms of potential scenarios over a ten-year horizon that reflect the multi-dimensional nature of the system and that, at the same time, indicate broad policy directions for the immediate future (Yuan & Powell, 2015). Since a clearer view of the larger system is required to understand how the education opportunities offered by the government interact with the degree of investment by households, Munoz and Teini therefore also propose to explore alternative public and private roles and what is the investment required in each scenario for access to a level of user-friendly technology that can be taken for granted.

7.2. Governance Mechanisms for Digital Innovation

The governance mechanisms—regulative, normative, and cognitive, as classically defined by Scott—assist efforts to clarify and coordinate responsibilities for digital innovation across HE and commerce. These mechanisms can help eliminate uncertainties in IHE–business engagements and education–training partnerships, providing an integrated overview across various stakeholder groups within the broader ecosystem. By deploying a governance framework rooted in these three dimensions of digital-innovation governance, the involved actors can make the digital-foundation and domain-specific innovation processes more consistent and transparent—for instance, permitting HEIs to assert their stature vis-à-vis other partners. Consonant with the extended Scott framework targeted toward digital innovation, such mechanisms will collaboratively develop, codify, and disseminate guidelines, principles, and expectations on digital practices.

Governing these digital-innovation processes entails investment both in various infrastructure elements by IHEs and in foundational skills by several actors. The requisite specific measures—derived from ecosystem and digital-foundation commons analyses—range extensively, addressing, among numerous other topics, design and adoption of e-working guidelines, signatures, data enterprise architecture, financial record-keeping, staffing protocols, and service-design principles (Chang & Uden, 2008). Without an active effort to develop a range of reciprocal, compatible, and complementary assets across the broader coalition of participants, many digital-innovation opportunities may be irrevocably lost.

7.3. Ethics, Privacy, and Responsible Data Use

Higher education institutions, students, faculty, senior management, and governing bodies are increasingly recognising the importance of assessing the ethical, privacy, and governance implications of obtaining, using and analysing data about their students, staff and constituents (L. Borgman, 2018). Organisations must regard their data stewardship responsibilities in the context of educational practices and processes. The issues are complex enough to warrant a detailed examination by decision-makers of the higher education data ecosystem, coupled with an examination of the ethical implications that govern their data practices and other common activities.

8. Methodologies for Studying Digital Innovation in Higher Education and Commerce

Mixed-methods approaches, which combine qualitative and quantitative data such as interviews and surveys, are useful for studying digital innovation in higher education (HE) and commerce to investigate cross-sectoral opportunities. In the HE space, institutional case studies on COVID-19 responses enable comparability, while frameworks for digital skills can be employed to assess strategy implementation across several institutions. Models are presented for longitudinal studies on e-commerce digital transformation, including assessments of the role of innovation types, impact metrics, and network considerations. Analysis of cross-institutional collaboration is possible with the association networks (Marzo-Navarro & Berné-Manero, 2022; Lukovics & Zuti, 2016).

8.1. Mixed Methods Approaches

Diffusion of digital technologies, innovations, and entrepreneurship is regularly the subject of specific studies or investigations in diverse regions and economies. This diffusion may influence social equity, access, entrepreneurial skills, or other aspects. Select research documents with contributions in these areas include the following.

Several research studies contribute analysis of diverse aspects of higher education and commerce that may be interrelated in particular university contexts or ecosystems. An analysis of “cross-cutting competencies" acquired through an online entrepreneurship course considers the acquisition of firm creation, business plan, human resource management, and marketing skills through collaboration among students and businesses; positive impacts on academic performance and task collaboration; and an overall positive assessment of the experience. A study of open online learning considers the capacity of Massive Open Online Course

(MOOC) platforms to support the development of entrepreneurial initiatives for wider outreach through national and international collaboration.

Research, thus, indicates that, in particular, the dual diffusion of digital technologies and entrepreneurship may be collected in the context of higher education, allowing analysis of relevant supports and barriers (Marzo-Navarro & Berné-Manero, 2022; Yuan & Powell, 2015).

8.2. Case Study and Comparative Analyses

The case study investigates the digital ecosystem of a university in Spain that operates an initiative for sustainable enterprise creation and development connected to entrepreneurship education. The initiative involves four closely interrelated cross-institutional and cross-sector public–private partnerships, including collaborating universities and partners from the commercial business and public service sectors. The case study reveals that various cross-cutting competencies and entrepreneurial mindsets are critical for students who aspire to create start-up businesses of their own and to do so successfully, and that co-creating the educational experience within a university–company partnership with both student and teacher participants has positive effects on learning as perceived by all. Comparative analyses span a number of dimensions to identify and apply innovative measures that respond to Academia 4.0 requirements.

References cite the need for change in higher education institutions in response to networked and knowledge economies, especially the e-learning phenomenon (Nikolov, 2009). Globalisation and increasing competition for students have intensified the quest for flexible, sustainable, and affordable higher education pathways. Open educational resources (OER) help in the growth of the economy and well-being of society through the dissemination of knowledge, collaboration and co-creation (Yuan & Powell, 2015). Educational providers may cooperate and thus develop capacity, through their entrepreneurial initiatives focusing on openness, revenue models and the disaggregation of provision in a collective ecosystem that spans boundaries and supports diversity and experimentation. A blended approach that incorporates the advantages of open on-campus teaching and open distance learning methods will foster more connectivity among all involved. Boosting entrepreneurial education, capability development, and direct investment in on-campus digital education options drives simultaneous institutional re-orientation and commercialisation of lecturing services (Marzo-Navarro & Berné-Manero, 2022).

8.3. Metrics, Evaluation Frameworks, and Longitudinal Studies

Measuring the digital delivery of learning is done using metrics and evaluation frameworks that are carefully developed by a Higher Education Institution (HEI) (Ross et al., 2018). There are two opposite views: (i) emphasis on measures which describe the online, blended and physical dimensions of the courses on offer and (ii) references to measures which are focused on the student experience and engagement in their learning. The second viewpoint is reinforced by a wealth of research which stresses the importance of studying the experience, engagement, motivation and achievement of students in digital contexts.

The availability of open or personal data on e-learning, blended learning, and technology-enhanced higher education has led to numerous studies relating to the economy and efficiency of these modalities. The provision of blended or digital learning is undertaken in modules, course units, and degree programmes within HEIs as well, and, therefore, the degree programme is proposed as a natural unit for assessing levels of e-learning. The publication of studies on the impact on learning outcomes and investment in e-learning has increased considerably, particularly around blended learning, massive open online courses (MOOCs), and learning analytics. All reports reflect the emergent nature of this area and the need for methods, frameworks, and instruments that can be scaled to become generalizable to different types of digital learning.

9. Future Horizons and Strategic Scenarios

Digital ecosystems in higher education will allow learners to pursue blended and non-linear journeys through degree programmes and start-up activities leading up to graduate work and business entrepreneurship. Campus-based and online courses, vocational education, international mobility, adult education and upskilling modules, micro-credentials, internships and work assignments may take a standard degree beyond the campus walls. Digital transformation of higher education remains slow because of legacy systems as well as physical legacy campuses.

A brighter perspective involves learning to learn, rather than just learning to know. The challenge is to go beyond merely increasing access to courses to ensure the sustainable performance of both, now termed campus commerce and commerce-on-campus. A demand study has mapped a sample of over three hundred digital campus economy categories covering diverse academic disciplines, student steps and life cycles as well as industrial sectors. A campaign promoting fifteen campus-based enterprise models engages students and staff across the still uncharted territory of the digital campus economy to create

entrepreneurs rather than jobs. Digital innovations in radically transforming commerce comprise another aspect of commercially fertile ground.

Individual, societal and environmental needs now drive the smart cities agenda. "Green digital university & campus" emerges as a global priority, and the global higher education OER movement signals that free educational materials are gradually becoming a commodity. At the level of public policy, investment strategy and commercial partnerships, digital innovation policy in higher education and commerce inspires further initiatives to enhance individual, societal and environmental sustainability. Digital higher education and commerce are therefore major contributors to collectively defined economic, social and environmental development objectives and encompass relevant objectives in both the private and public sectors (Teini, 2016).

9.1. Artificial Intelligence and Personalised Pathways

Over the next three decades, innovation in the education sector will focus on defining the role of human expertise and developing omni-channel platforms with artificial intelligence (AI)-enabled knowledge transfer. Such personalised pathways will not substitute human expert instructors but ensure knowledge continuity, career decision-making, and skillset reorientation. Future advancements will include personalised learning, gamification, and simulation tools, as well as massive open online courses (MOOCs) driven by elite faculty. Completion rates for online courses remain problematic, especially for introductory classes, whereas demand for small interactive classes persisted during the pandemic (G. Escajeda, 2019).

AI-driven transformation, understood as a cross-sector system change rather than merely a technological upgrade, will alter how higher education institutions (HEIs) interact with external stakeholders and competitors, create value, and govern themselves. Competition hinges on counteracting cheating, which is central to effective job placement, a crucial factor determining enrolment and revenue. Innovative, transformative AI governance will significantly shape institutional evolution: notably, generative AI can enable the development of personalised AI assistants for students, faculty, and administrators, with profound implications for time allocation (Katsamakas et al., 2024).

9.2. Global Collaboration Networks and Capacity Building

Global competition in higher education is driving the need for larger institutional and individual engagement. Universities must enjoy full and rapid access to global development in education, innovation, research, and collaboration (Nikolov,

2009). The Global Campus is a joint digital concept that enables arbitrary freedom of cross-institutional enrollments within a selected group of accredited institutions. Students gain added transferable credits in collaboration with partner universities, attain digital competencies and cross-curricular capabilities in higher demand, and engage with a global peer community.

Global Collaboration Networks and Capacity Building

The Global Campus concept is complemented by the creation of external global collaboration networks addressing academia, industry, innovation, pedagogy, skill formation, incubation, and the like. Networking fills current wide gaps and undertakes commitment to integrated engagement and capacity building, targeting digital readiness and wider coverage on digital influence in education and economy, along with adjacent domains. Global collaboration is also realised through joint participation in CRE8 (Global Forum on Entrepreneurship Education Creation), the International Innovation Centre in Geneva, and broader partnerships within the World Alliance for the Digital Economy (WADE).

9.3. Resilience, Crisis Readiness, and Sustainable Growth

Around the world, increasing institutional resilience and readiness for crises are prioritised. The COVID pandemic supported this view by causing a series of management changes in the education sector to enable action. Some institutions managed this situation better than others did. These organisations already had equipment and systems to manage the crisis; combined with an ability to transition digitally, they managed to come out of the crisis and, in fact, secure further expansion in many cases (SECUNDO et al., 2021). Resilience is the potential of systems to absorb (in a stable way) disruptions so as not to prevent (or not) fundamental functions from becoming irreversible. The pandemic highlighted the fact that even developed countries rely on adult solutions through a system that proved vulnerable in terms of education (Rowe et al., 2019).

Institutions tend to concentrate on maintaining productivity during crises, but growth also remains a possible dynamic. Historically, when competing trends push down education and commerce demand, decision-making focuses on expanding profitable segments. The high volatility of demand in commerce related to educational services during the pandemic indicated that simultaneous action on increasing demand could be viable. Readiness to address even marginal demand presents a possibility for extra income and market

entry to new regions. Supporting the educational ecosystem, while promoting more intensive and diversified use of existing resources, proved to constitute areas for institutional growth. In this respect, readiness for crises incorporates elements of a long-term sustainable growth strategy.

10. Conclusion

Digital innovation should be regarded as the combination of technological and non-technological changes that help to create new market space by the introduction of radical innovation or entering into new industry segments. Digital educational transformation is a growing area of interest in the academic and government sectors due to its potential to promote further economic growth. Digital innovation in higher education can boost entrepreneurship and sustainable growth by enhancing the development of IT skills and the development of high-level entrepreneurship, start-ups, and digital skills for entrepreneurship and employability, respectively (Yuan & Powell, 2015). Digital transformation further supports e-commerce activities by enabling the commercialisation of research outputs, building campus economies, and facilitating the establishment of academic start-ups (Marzo-Navarro & Berné-Manero, 2022). However, further steps are needed across all dimensions of the analysis of digital innovation in higher education. Policy measures supporting the move to the next stage in a more structured form can be identified for each element of the platform.

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