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A RESEARCH AGENDA FOR THE ENTREPRENEURIAL UNIVERSITY: THE ENTREPRENEURIAL UNIVERSITY IN THE DIGITAL ERA

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Introduction

The 2008 financial recession represented a strategic game-changer for most organizations and severe resource constraints with unpredictable conditions creating significant challenges for organizational survival (Guerrero et al., 2016). After this socio-economic event, higher educational organizations are facing more pressures as higher rates of unemployment, the reduction of public budgets, reduction in the demand of traditional higher education studies, rising tuition costs, and competing in environments that have become global (Guerrero and Urbano, 2019). Today, the COVID-19 pandemic has also represented an unprecedented challenge for education that affects more than 1.5 billion of students that are no longer able to go to school physically (Kandri, 2020). In response to this health emergency, universities have been resilient to move physical activities into new online activities (i.e., open access online training, hubs with courses, webinars, conferences, expert videos, multimedia materials, and others). However, post-pandemic, universities will face many challenges at all organizational dimensions (i.e., managerial, operational, functional, relational, financial) to satisfy their stakeholders' needs (i.e., students, employers, government, society).

The digital economy allows understanding the new ways of communications and the technologies that have produced profound organizational transformations on internal processes, strategic organizational decisions, and new versatility for doing any type of activity in real-time across many locations (Brynjolfsson and Kahin, 2002, p. 2). For universities, the digital economy has represented a competitive environment because it introduces new rules in the delivery of higher education services across traditional borders (Teece, 2018). Initially, the procurement from analogic to digital transformed essential university functions like registration, purchasing learning resources, administering classes, and accessing knowledge in the format now accessible by way of personal devices (Carter, 2016). Subsequently, digitalization has transformed the university's core activities, evidenced the need for dynamic entrepreneurial capabilities¹ for being competitive, as well as opened new market opportunities for providing educational services aligned with the needs of digital workplaces (OECD, 2016; CISCO, 2018; WEF, 2018). One plausible explanation is related to those students' generations – for example, students born in an online era demand continual digital access to social networks, multimedia resources, and flexible learning experiences (Amphlet, 2018). In this view, traditional learning models are unlikely to inspire new students' generations (or 'digital natives'). Another plausible explanation is the aging diversity in workplaces (Guerrero et al., 2019) – for example, older generations are demanding long-life courses or training to acquire such digital competence as data analytics, big data, social media, and others (Deloitte, 2017).

In reflective entrepreneurial and knowledge-based societies, university managers have been involved in the evolutionary process of higher education organizations. Traditional organizations tend to be rigid to change, take a narrow view of industry-university relations (Wright et al., 2007) and tend to believe that entrepreneurship and innovation are two different phenomena (Autio et al., 2014). In contrast, innovative and entrepreneurial universities tend to adopt an entrepreneurial orientation transversely and try to be resilient in their interaction with the university's stakeholders (Audretsch, 2014; Guerrero et al., 2015). In this assumption, higher education organizations are dichotomous, focusing on both innovation and entrepreneurship core activities that contribute to competitiveness and economic growth (Guerrero and Urbano, 2019). Therefore, entrepreneurial and innovative organizations (the so-called 'entrepreneurial universities') are more adaptable to the digitalization trends that are dramatically affecting the development of their core activities as well as transforming their stakeholders' expectations (students, industry, labor market). In this vein, entrepreneurial and innovative universities are looking for new digital opportunities to be exploited with restricted resources and considering students' needs and profiles.

Inspired by this argument, this chapter aims to discuss how entrepreneurial universities are managing new digital trends in order to be competitive in both the traditional and the digital higher education market. By exploring the current debates in academia and higher education policymakers, we identify several university challenges and higher education trends in the digital context. In this vein, we discuss how challenges and trends are converging into new opportunities for achieving teaching activities that are one of the core activities – teaching, research, and commercialization (Guerrero and Urbano, 2019).

Based on this information, we include several implications for academics, university managers, and policymakers.

The chapter is organized as follows. The first section discusses the entrepreneurial university in the digital economy. The second section introduces how universities are transforming their digital teaching challenges with the implementation of new digital strategies. The third section discusses the main implications of the theory, practice, and policymakers. Finally, we present our conclusions.

Entrepreneurial universities in the digital economy

Since the publication of the Clarks' book (1998), research on the phenomena of 'entrepreneurial universities' and their core activities has increased significantly (Guerrero and Urbano, 2019). The entrepreneurial university simultaneously fulfills three different activities – teaching, research, and entrepreneurship – while providing an adequate atmosphere in which the university community can explore and exploit ideas and contributing to the creation of a sustained competitive advantage that could be transformed into social and economic impacts (Guerrero and Urbano, 2012).

In the context of the digital economy, the core activities of entrepreneurial and innovative higher education organizations are also influenced by technological and digital revolutions. Internally, entrepreneurial universities should develop dynamic entrepreneurial capabilities to transform routines into new innovative and new digital ways of managing, teaching, learning, and working (Guerrero et al., 2020). However, the academic literature does not provide enough answers about how digitalization has influenced organizational processes, transformed paradigms and redefined core activities of both traditional and entrepreneurial universities (e.g., teaching, research, as well as fostering innovative, disruptive and entrepreneurial initiatives) (Guerrero and Urbano, 2019).

In our assumption, there are three gaps in the academic discussion about entrepreneurial universities' core activities in the digital era. First, for teaching core activities, digitalization represents a critical challenge of paradigm for traditional organizations given their routines and aversion to change. Regarding entrepreneurial universities, the implementation of new online and offline learning education programs to enhance students' digital capabilities (e.g., digital entrepreneurship² that implies digital marketing, digital technologies and digital operations, as is explained by Giones and Brem, 2017 and Nambisan, 2017) represents an opportunity for introducing new business models, entry into new international markets, and generating higher social impact via human capital (Guerrero and Urbano, 2019). For instance, the most entrepreneurial universities have implemented massive online open courses with short modules for updating digital entrepreneurship capabilities exploiting internal capabilities (Teece, 2018), as well as creating online platforms oriented to support entrepreneurial and innovative initiatives (Sussan and Acs, 2017; Nambisan et al., 2019; Allahar and Sookram, 2019). However, the entrepreneurship and management fields need further studies to understand how entrepreneurial universities are exploring and exploiting internal and external challenges linked with teaching activities in the digital era.

Second, in relation to research core activities, anecdotal evidence reveals that entrepreneurial universities have also promoted the exploration and exploitation of data science (Waller and Fawcett, 2013; Guerrero and Urbano, 2019), as well as promoting the generation and commercialization of digital technologies such as social media, business analytics, the Internet of Things, big data, advanced manufacturing, 3D printing, cloud and cyber-solutions (Rippa and Secundo, 2019). Nevertheless, the entrepreneurship and innovation fields demand more investigations to understand how entrepreneurial universities are managing internal and external challenges linked with research and knowledge transfer activities in the digital era.

Third, in relation to entrepreneurship core activities, anecdotal evidence shows how some entrepreneurial universities have also encouraged entrepreneurial initiatives at the university community level (students, graduates, alumni, academics) based on artificial intelligence, big data and digital technologies (Guerrero and Urbano, 2019; Obschonka and Audretsch, 2019). As a result, academic and student entrepreneurs focus on exploring and exploiting digital technologies or transforming paradigms in collaboration with multiple stakeholders to generate societal impacts (Rippa

and Secundo, 2019). However, the entrepreneurship field needs more research to understand how entrepreneurial universities are exploring and exploiting internal and external challenges linked with entrepreneurial and knowledge commercialization activities in the digital era.

Given the complexity related to digital adoption across all entrepreneurial universities' core activities, this chapter focuses on the digitalization challenges of teaching core activities of entrepreneurial universities.

Linking teaching challenges with new digital trends

The digital economy has transformed the rules of the game in higher education trends, job market demands, low-cost business models, and global competition. In this vein, entrepreneurial university managers are facing several challenges that may be transformed into sustained competitive advantages. Table 9.1 shows a selection of challenges and digital trends that will be discussed in this section.

[INSERT TABLE 9.1 ABOUT HERE]

External challenges

New students' needs and hybrid learning approaches

Based on the standards and regulations, higher education systems have increasingly focused on the effectiveness and its alienation with job market requirements, as well as with students' learning expectations (Entwistle and Ramsden, 2015). This alienation requires an in-depth understanding of the main characteristics of new generations, which, in turn, influence and enhance the design of digital learning activities. The design of teaching courses requires the co-creation and involvement of the university community with stakeholders in identifying the skills and technical knowledge necessary in a competitive job market (WEF, 2018). According to Amphlet (2018), the very nature of the target audience – mainly young and highly connected – means the higher education sector must adapt to accommodate their students' expectations. Current student generations have grown up online and will expect the same levels of technology in their learning environments as in their day-to-day lives (Amphlet, 2018). Therefore, traditional, rigid modes of classroom instruction are unlikely to inspire students whose online life outside the classroom is dynamic and evolutionary.

A hybrid of traditional and digital learning approaches could help to be more empathetic with students' needs, encourage high-level cognitive activities, and create appropriate learning environments. An example could be the insertion of real workplace experiences using simulations, experiments, real-time interventions, and digital workplace practices per subject, defining explicit pedagogic purposes, learning designs, skills, and competencies associated with each practice. More concretely, in this hybrid approach, the course delivery combines face-to-face classroom activities with lectures, plus online guided practices in work placements (Collins and Halverson, 2018), as well as connecting with outside experts – both national and international – that share ideas that increase students' learning process (Amphlet, 2018). As a result, students can be engaged in authentic, real, collaborative and experiential learning processes based on a variety of theories, approaches, and environments to enrich human capital, as well as making sense of the demands of students, university teaching missions and labor market needs (Gibb et al., 2013). These hybrid practices facilitate the development of learning models that work best for students as well as communication improvements to deliver exciting lectures and to provide more personalised feedback and mentoring using any device.

Hybrid practices are particularly relevant when at least four generations of adults are working together in current workplaces (European Commission, 2012). New generations of graduates will be part of this diversified (digital) workforce characterized by multiple profiles, motivations, perspectives, and adapted to work design, objectives, incentives, and metrics of performance (King et al., 2017). Therefore, this challenge represents an opportunity to be more open to new methods and technologies that enhance students' professional development, facilitates new transformations of learning and professionalizes teaching experience, so achieving the requirements of the new labor market.

Despite the growth and potential of using devices (i.e., laptops, smartphones, tablets, mobile applications, wireless applications, games applications) in the learning process, the embryonic stage of this type of learning does not generalize the learning outcomes (Motiwalla, 2007). On the one hand, studies with positive outcomes have recognized that technology makes learning more adaptive, flexible, and easier for learners to boost their achievements (Grand-Clement, 2017). Concretely, Tiven et al. (2018) showed primary learning outcomes from digital learning such as digital literacy,³ language communication, self-efficacy, academic engagement, and critical thinking. From the entrepreneurship perspective, the digital learning process also encourages creativity, appreciation for diversity, a cultural approach, global knowledge, and global engagement. On the other hand, studies with unfavorable outcomes for digital learning have shown the resilience for adopting technologies. Concretely, technologies are seen as expensive tools that only cause learner distraction (Douglas et al., 2012) and learner confusion (Arguel et al., 2017). As a consequence, learners capture adverse outcomes in their digital learning respect to traditional learning. To that end, there is no conclusive debate about the positive or negative impact of digitalization on learning outcomes.

New student needs and e-learning environments

The technological evolution has also influenced the method of teaching and learning. Although higher education organizations have rigid routines in the development of their core activities – teaching and research (Guerrero et al., 2016) – managers of entrepreneurial universities have implemented diverse strategies to be simultaneously competitive in the traditional and digital market. The most innovative and entrepreneurial implementation behind these strategies has been associated with the e-learning or digital learning revolution, such as the massive online open courses (MOOCs), the design of ‘virtual classrooms’ connecting students’ devices to the learning process or the ‘digital university campus’ using virtual reality plus artificial intelligence. Given the embryonic stage of these research trends, we focused on the analysis of MOOCs.

Although MOOCs have not been the only mechanism used in the digital transformation of innovative and entrepreneurial universities, it is recognized that MOOCs have been considered the most significant technological advance in the pedagogic part of higher education in a millennium (Teece, 2018, p. 98). By contrasting traditional and digital environments, MOOCs have attracted substantially larger audiences in a relatively short period without formal requirements – fees, previous accreditations (Al-Atabi and DeBoer, 2014) – and voluntary depending on individual needs and interests (Hollands and Tirthali, 2015). These large audiences are demanding to learn something new using low-cost digital mechanisms to improve their competencies and careers to enhance salaries in better workplaces. Pioneer universities such as Stanford and MIT have implemented a business model that offers free digital courses with the possibility to obtain a paid certificate and diploma that could also represent credits in specific traditional courses. The world of MOOCs is very complex but provides a digital learning environment instead of merely traditional methodological foundations (Christensen et al., 2013). MOOCs play an essential role in the transition through new educational and pedagogical paradigms concerning an open way of learning, technological design of specific contents, and innovative learning methodologies using digital tools (Liyangunawardena et al., 2013).

Considering the MOOCs student’s profile, the motivation is the access to specific knowledge exposed in a short period using multimodal digital artifacts (image, videos, web resources, simulations, platforms, devices, and others) with the possibility of being discussed among participants from diverse countries, as well as real-time evaluation using social media (Knox, 2014). Unfortunately, the academic literature does not provide enough answers about innovative and disruptive teaching and learning tools associated with MOOCs that have increased students’ recruiting and university visibility (Ospina-Delgado and Zorio-Grima, 2016; Guerrero et al., 2020). Indeed, there is no reliable evidence about the transformation process of hybrid teaching models (on-offline) or the resources required to create digital MOOCs platforms, or clarity about the requirements of collaborating with existing platforms that supply the link between the course and the students. Therefore, a critical research paradigm is the transformation of university routines into new entrepreneurial capabilities to survive and sustain performance in the digital context (Guerrero et al., 2016; Klofsten et al., 2019).

Regarding outcomes, the advantages of MOOCs are associated with access to free courses offered by professors at the top schools across the globe; the learners' performance is monitored across the courses; professors and learners get worldwide exposure; and MOOCs can be used as a tool in a blended learning program (Al-Atabi and DeBoer, 2014; Eesley and Wu, 2015; Guerrero et al., 2020). Furthermore, MOOCs' learners have highlighted favorable learning outcomes such as labor promotion, an increase of self-efficacy, and increment of salaries (Al-Atabi and DeBoer, 2014; Eesley and Wu, 2015; Guerrero et al., 2020). Intuitively, MOOCs are advantageous for those learners who need basic knowledge but also for those who want to improve knowledge obtained in previous educational training programs. On the other hand, the disadvantages of MOOCs are the lack of providing personalized courseware, attention, the difficulties in keeping track of students' assignments and involvement, learners with a poor internet connection or disabilities who cannot access to the courses, the language barrier, and the courses cannot be used as credit-earning courses in some universities (Eesley and Wu, 2015; Guerrero et al., 2020). Intuitively, MOOCs are advantageous for those learners with limited resources and not familiar with digital learning styles. Based on these views, university performance evaluations should be revised and analyzed to understand what these evaluations are measuring in both digital and non-digital learning environments (Bedggood and Donovan, 2012).

The challenges of the digital economy should be transformed into an opportunity for creating value-added into the current students' generations as well as for capturing an international presence to open doors to students and collaborations across the globe. It explains that an increasing number of universities have adopted MOOCs with different purposes such as internationalization strategy, international recognition, and to capture sustained competitive advantages. The success of MOOCs has positioned and legitimized new digital teaching and higher education learning environments (Guerrero et al., 2016). However, from a systemic point of view, the enormous limitation of MOOCs is recognition of their modalities by both higher education systems and the labor market.

Labor market demands and the new digital curricula

Automation and advanced digital technologies have transformed industries and corporate work, providing new opportunities to explore and posing significant threats to those across the globe that do not adapt to the times (Alcácer et al., 2016). Consequently, skills requirements have also changed across organizations, industries, and countries (Zysman and Kenney, 2018). For senior and elderly employees, the importance of acquiring digital skills is reflected in the wage returns for these skills compared to workers who can only perform the most basic skills. As a consequence, the demand for digital training programs has notably incremented during the last decade. For governments, the challenge is ensuring that everyone has the right skills for an increasingly digital and globalized world that is essential to promote inclusive labor markets and to spur innovation, productivity, and growth (OECD, 2016, p. 1). Therefore, governments have implemented several public actions⁴ to support learners and educators during the acquisition of necessary digital skills. For traditional universities, the principal inhibitor to digital uptake is digital literacy and the resilience to acquire these internal capabilities. By adopting an entrepreneurial universities' perspective, this labor market challenge will be translated into the re-design of the curricula with digital contents that enhance digital skills using hybrid learning approaches and hybrid learning environments.

Entrepreneurial universities are challenging the labor market demands of human capital that should possess traditional mixed skills (e.g., creativity, persuasion, collaboration, adaptability) and digital skills (e.g., cloud computing, artificial intelligence, big data analytical reasoning) (WEF, 2018). In this respect, entrepreneurial universities have adapted their curricula by introducing contents according to the needs of their specific target groups, as well as digital tools like online platforms, e-books, simulations, virtual reality, and artificial intelligence (see Karpati, 2011; Conrads et al., 2017; Makarova and Makarova, 2018). For example:

By focusing on new users, the curricula content has been oriented to provide generic skills that allow devices to be applied effectively (i.e., use of laptops, tablets, smartphones, digital artifacts), generic software tools to be utilized in users' lives or works (i.e., certification of specific software), and developing capabilities to adapt to current changes in infrastructures and applications (i.e., digital resilience).

By paying attention to academic fields, in the business and engineering fields, the curricula content has been oriented to develop skills and competencies for exploring and exploiting business opportunities most advanced digital technologies⁵ (i.e., digital entrepreneurship, digital marketing), as well as efficient and effective performance in the new ways of conducting new and established business (e.g., cryptocurrency, digital banking, digital government, digital entrepreneurial ecosystems). Similarly, in engineering and technological developer fields, the curricula content has included high-level specialized knowledge for researching, developing, designing, managing, protecting, and selling technological tools, devices, and platforms (i.e., data science, advanced digital technologies). Besides, these curricula contents have been transversally introduced in all university faculties, departments, and schools.

Consequently, entrepreneurial universities have redefined their business models to provide higher education programs oriented to new generations of students (e.g., general diplomas with digital competencies or specialized digital diplomas) or for long-life learning students (e.g., specialized training and certifications in collaboration with experts and companies). In addition, entrepreneurial universities' academics and staff should be specialized experts in disruptive technologies, analyzers of enormous amounts of information, and improvers of digital educational tools (WEF, 2018).

Internal challenges

Teachers and researchers' digital capabilities and train-the-trainers

According to the PWC (2018, p. 6), many academics and staff may not be confident in using digital tools, as well as nervous about engaging in digital spaces where they may feel at a disadvantage to students or digital natives. It represents the highest internal obstacle at the university level for delivering curricula that ensure the fair use of technologies and the development of digital skills. According to Grand-Clement (2017), there is a general assumption about the familiarity and comfortability of educators, trainers, and academics in the use of digital technologies in their teaching and research activities. Especially, when their perception such as motivators, inspirers, and builders of trust in the participants is disrupted by the use of digital technologies given the multiples sources of information, the discrimination of the valid information, the distraction or waste of time, and the implementation of adapted pedagogy in different settings. Two plausible explanations are associated with the barriers to educators, trainers, and academics:

The first barrier is the lack of digital and technological skills. This collective is not always systematically well prepared to deal with the increase in the use of technologies in multiple teaching settings. We need to take into consideration that this collective is almost integrated by elderly generations in which continuing professional development or training to upskill has not always been mandatory. Anecdotal evidence reveals how entrepreneurial universities (e.g., Cambridge⁶) have implemented continuous professional development options to support the role of digital educators, digital trainers, and digital academics by explaining their contribution to the university digital framework as well as providing full information about digital tools, techniques, and training (i.e., ensuring critical competencies for teaching effectively with technology covering the different components: the digital classroom, designing learning, delivery learning, evaluating learning). In more specialized fields, digital educators, digital trainers, and digital academics have implemented successful technological elements like interactive training simulations and digital storytelling for design, developing, and evaluating their educational programs (Dörner et al., 2002). In this case, these technological elements support teachers and learners in expressing their stories to ensure communication interfaces between technology, storytelling, and application domain (i.e., using artificial intelligence).

The second barrier is looking at the future tasks and roles of educators if learners can retrieve knowledge for themselves. On the one hand, some authors argue that universities will disappear because of technology (O'Donoghue et al., 2001; Vieira et al., 2019). The students' convenience, online providers, and higher personnel universities' costs high pointed out the disadvantages of digitalization. On the other hand, some authors have argued that educators should be using digital technology as a 'weapon of mass stimulation' where knowledge can be shared in advance with the class so that educators can maximize the contact time they have with their students and focus on mentoring and coaching them

(Grand-Clement, 2017). Although the role of technology cannot be overemphasized, traditional universities will not disappear but universities should transform their capabilities to be competitive in the digital economy (Dennis, 2019).

Consequently, entrepreneurial universities' human resource managers should internally ensure continuous professional digital development as well as considering these professional digital capabilities during the hiring processes (i.e., usually these universities attract talent and expect to generate digital entrepreneurs and digital intrapreneurs) (Scuotto and Morellato, 2013; Allahar and Sookram, 2019; Rippa and Secundo, 2019).

Transforming and generating universities' dynamic capabilities in the digital era⁷

Previous studies have focused on the development of university capabilities to achieve an entrepreneurial orientation (Kalar and Antonic, 2015), international orientation (Minola et al., 2016), diversification orientation (Guri-Rozenblit, 1993), value creation, and new business models (Abdelkafi et al., 2018). However, there are no studies that have discussed the relevance of digital capabilities in entrepreneurial universities (Teece, 2018; Guerrero et al., 2020). In this vein, strategic management studies consider dynamic capabilities such as higher-level competencies that determine the universities' ability to integrate, build, and reconfigure internal/external resources/ competencies to shape rapidly changing business environments (Teece, 2018). Entrepreneurship studies consider capability as part of the organizational resources that are durable and difficult to imitate, and differentiate the organization from its competitor (Antoncic and Hisrich, 2003). By merging theoretical foundations, dynamic capabilities are higher-level competencies to improve and to transform routines into entrepreneurial actions that allow reconfiguring internal and external resources to the refined core activities in the digital economy (Guerrero et al., 2020).

In the context of the digital economy, Teece (2018) argues that universities should exploit ordinary capabilities (i.e., teaching and research activities) to re-configure the new core activities and to transform these ordinary capabilities into unique dynamic capabilities (i.e., exploiting their competitive advantages for sensing opportunities assuming risks, transforming routines by being innovative and seizing by being proactive). In this reconfiguration, ordinary capabilities are associated with the quality of universities' human capital (i.e., teachers, academics, researchers), the quality of research resources, and the quality of the administrative process. According to Guerrero et al. (2020), the expertise of university human capital, the quality of research, and the experience of administrative staff have contributed to building new and digital capabilities.

As a result, entrepreneurial universities will be able to generate sensing capabilities (i.e., scanning new opportunities to date digital educational strategies), seizing capabilities (i.e., open innovation practices for sharing resources/technologies with providers and platforms), and transforming capabilities (i.e., renewal of higher education services both online and offline) (Guerrero and Urbano, 2019). As a result, these university capabilities are expected to capture sustained competitive outcomes in the digital era. Therefore, entrepreneurial university managers have the challenge to effectively transform, generate, and manage the existent resources and capabilities into new requirements and rules of the digital economy.

University response to COVID-19 pandemic

The global lockdown of education organizations has been the primary reason for classroom go-to distance teaching and learning (Kandri, 2020). It required a rapid response of teachers to adjust pedagogies into online assignments by using digital tools (i.e., Blackboard, Zoom, Moodle, CANVAS, MOOCs platforms, Skype, and others). According to UNESCO (2020b), the most common distance learning strategies in response to COVID-19 should include how students can access remotely delivered content and communicative support; how learners' rights and data privacy can be protected; how teachers are supported in the transition to remote teaching; and how financial and technological resources can be mobilized to sustain the provision for several months.

In the context of remote learning, to ensure sustainable teaching quality outcomes, universities should strengthen communication and cooperation among teachers, learners, and parents (UNESCO, 2020a).

Teachers are investing extra hours to ensure curricula appropriateness, increase communication with students, and ensure the inclusion of minority groups (i.e., people with physical disabilities; those who do not have access to the internet). Entrepreneurial universities are exploiting their technical infrastructures, licenses, and capabilities to optimize distance learning and achieving stakeholder outcomes (Marinoni et al., 2020). Despite these efforts, many students have had their education and learning interrupted because they do not have access to the internet or computers at home (Burgess and Sievertsen, 2020). This issue is generating educational inequalities across the world. Similarly, many graduates have been affected by the interruption of final exams, as well as the weak labor conditions.

Discussion

This chapter has discussed how entrepreneurial universities are facing the current challenges of being competitive both in traditional and digital higher education markets. Our discussion highlights the implications for entrepreneurial university stakeholders, particularly since university stakeholders should be oriented to enhance, develop, and update the digital universities' capabilities required for developing their digital core activities (Teece, 2018; Guerrero et al., 2020). We identified several strategies implemented by universities to ensure digital learning approaches, digital learning environments, and curricula with digital components and competencies. However, our study was limited by the embryonic stage of the literature about digitalization, digital entrepreneurial universities, digital learning and training, and digital impacts. In this way, this limitation opens a window of research opportunities in multidisciplinary fields.

Implications and opportunities for entrepreneurial universities in the digital era

Although some higher education organizations have tried to adapt to the challenges, most have needed to prioritize resource allocation, institutional introspection, proactive cultural change, and the development of effective processes for diagnosing teaching and learning problems and decision making (Teece, 2018). However, there are numerous reasons why these changes are likely to be difficult, and some stakeholders will inevitably feel short-changed by the process. In this section, we pay attention to the following four implications.

The first highest digital economy opportunity is transforming the rigid tertiary education system with 'un-updated rules of the game' that tend to evaluate new education and learning practices compared with the norms of the last century. Some prestigious higher educational bodies and agencies have been working together to ensure the quality of new teaching and learning courses as well as recognizing new digital modalities of education as a part of the education and training of individuals (OECD, 2016; WEF, 2018). However, the promise of generating new value for society could be the critical promotor of the configuration of an entrepreneurial higher education ecosystem. For a time, the reality is that every day the world is changing, and higher education organizations need to be aligned with this change in order to be competitive and sustainable. Therefore, collaboration with stakeholders as an entrepreneurial and innovative higher education ecosystem should be essential to co-design teaching and learning courses, tools, and delivery in a hybrid (traditional and digital) learning way that supports and enhances employability and work inclusivity (Tomlinson, 2017) – notably, 'growing skills instability' scenarios that are characterized by a rapid technology change, new digital skills, and workers' displacement by robot automation in many workplaces (Charlton, 2019).

The second highest digital economy opportunity is the engagement and motivation of new generations of students ('digital natives') who are living in a transformative world where every day is a new opportunity for learning and influencing their environments. Consequently, higher education organizations need not only to adapt curricula and learning environments but they should also foster an entrepreneurial and innovative culture that allows them to be more proactive instead of reactive in respect of learning and teaching activities (CISCO, 2018). This is only possible if higher education organizations work more like entrepreneurial ecosystems that encourage asking for and listening to students' opinions and requirements as well as bringing all university departments together in the definition and co-creation of sustained educational plans for generating an impact on society. It also demands the creation of a learning and training culture among academics, staff, and students to identify the best technological solutions for the growing digital campus imprint (Carter, 2016). In this regard,

an eclectic collection of learning pedagogies, practices, and adequate learning environments will contribute to students' achievements, satisfactions, sustainable university objectives, academic standards defined by the educational system, labor market requirements, socio-economic development and well-being (Bradley et al., 2015).

The third highest digital economy opportunity is the transformation of university archetypes, new business models, and ensuring organizational sustainability (Teece, 2018). University managers should adopt an adequate university model to be competitive in traditional and digital markets according to their ordinary capabilities and dynamic capabilities. Sustainability is generally consistent with the development of goals that are, in turn, relevant for tackling fundamental societal challenges (Pacheco et al., 2010). For higher education organizations, sustainability could have two central angles: (a) at the organizational level, sustainability represents a new university business model that allows the moderation of funding based on restrictions and resource constraints; and (b) at the operational level, sustainability is associated with the generation of impacts in quality and outcomes of learning and teaching by strengthening responsibility, recognition, and rewards (e.g., affordable schemes to help students to participate in tertiary education as well as supporting and contributing to graduates' employability). Therefore, university digital economy actions should also consider it measured in terms of graduation rates, employability, students' and employers' satisfaction, awards, international students, the ratio of students per professor, etc. (Guerrero et al., 2015). By paying attention to sustainability, new metrics are required to understand the effect of universities' dynamic capabilities on organizational performance and looking for excellence in teaching and learning individuals with a societal, environmental, and economic responsibility. By adopting an entrepreneurial ecosystem perspective, university managers must evaluate digital strategies in respect of the universities' measurements of performance, sustainability, digital entrepreneurial innovations rates, digital entrepreneurship initiatives, and students' employability (Nambisan, 2017; Klofsten et al., 2019). Consequently, university managers should be oriented to explore the role of entrepreneurial universities in digital entrepreneurship ecosystems (Sussan and Acs, 2017).

The fourth highest digital economy opportunity is related to the COVID-19 pandemic. According to Marinoni et al. (2020), the move to distance learning represents a significant opportunity to explore mixing synchronous learning with asynchronous learning with multiple learners, as well as to increase innovations in teaching pedagogies and assessments. In this view, QS (2020) has highlighted the highest students' interest in studying their degree online but a group of overseas students is uninterested in online learning. Therefore, post the COVID-19 pandemic, entrepreneurial university managers should (a) embrace distance learning by considering all participants' needs and interest, (b) estimate the cost-benefits analysis, (c) improve the overseas recruiting strategy, (d) update graduation and administrative procurements, (e) enhance cooperation among university stakeholders, and (f) ensure well-being across the university community. Similarly, public policy implications should emerge based on experiences and best practices across the world.

Research agenda

Based on the topics discussed above, it is evident that there is a need to extend the analysis of the role of entrepreneurial universities in the digital economy. Concretely, natural extensions for future research should be focused on the following five potential research gaps.

To contribute to the strategic management literature by understanding the complexity of digital entrepreneurial university capabilities (Teece, 2018; Guerrero and Urbano, 2019; Guerrero et al., 2020). It is not only implied the analysis of resources and capabilities that will be the micro-foundations but also how to manage conflicts, attitudes, cultures and motivations during the conversion into digital capabilities. Given the nature of this phenomenon, it is necessary to explore longitudinal studies that allow understanding of the role of space and time in the digital transformation trajectory. In this regard, multiple theoretical approaches could be adopted such as RBV, dynamic capabilities, strategic management approaches, evolutionary approaches, agency theory, and others. Several research opportunities emerge in the pre-post COVID-19 pandemic analysis. The strategic management analysis is critical for understanding the relationship between university investments and university outcomes. In this way, it is possible to provide insights about the digital transformation of universities across the

globe, as well as to identify the digital dynamic capabilities of universities across the globe. Another research opportunity should be teachers' work-life balance and productivity as a consequence of working remotely.

To contribute to the entrepreneurship and innovation literature by understanding how advanced technologies are configuring entrepreneurship initiatives into the university community: digital graduates entrepreneurship, digital academic entrepreneurship, digital intrapreneurs (Nambisan, 2017; Rippa and Secundo, 2019; Obschonka and Audretsch, 2019; Guerrero et al., 2019). Given the nature of this phenomenon, it is necessary to explore both qualitatively and quantitatively the digital entrepreneurial process as well as the implementation of metrics to understand the benefits of digitalization for entrepreneurial universities' stakeholders. From the theoretical point of view, multiple approaches could be adopted like open innovation, entrepreneurial universities, digital entrepreneurship, knowledge spillover theory, and others. An interesting research question related to the pre-post COVID-19 pandemic should be the emergence of entrepreneurial students and academics involved in innovative projects and entrepreneurial initiatives associated with the COVID-19 pandemic.

To contribute to the education and pedagogy literature by exploring the impacts of offline and online learning programs for diverse target groups (i.e., native digitals, elderly generations), the analysis of the digital learning process (i.e., including design, delivery, evaluation, and follow up), the effectiveness of higher education regulations, support regarding digitalization, and the pedagogy implementation in multiple learning settings (Motiwalla, 2007; Murray and Olcese, 2011; Grand-Clement, 2017; Guerrero et al., 2019). Given the nature of this phenomenon, it is necessary to adopt mixed methodologies, including experiments and simulations for capturing perceptions, outcomes, and tendencies. The COVID-19 pandemic also represents an open window for research related to the role of innovations and digitalization in distance learning, as well as the analysis of learning differences between minorities (i.e., students with and without internet access, male and female students, students with or without disabilities)

To contribute to the national innovation and entrepreneurial ecosystems by exploring the role of entrepreneurial universities in the configuration of digital innovation and entrepreneurial ecosystems (Sussan and Acs, 2017; Nambisan et al., 2019; Ahluwalia et al., 2020). Assuming the role of space/time, researchers could analyze the systemic relationships in offline and online ecosystems in order to measure the efficiency and effectiveness in terms of the creation of digital entrepreneurs. In this vein, new metrics/theoretical approaches should be implemented for testing the role of entrepreneurial universities as part of digital entrepreneurial ecosystems. By focusing on the COVID-19 pandemic, an interesting research question is related to the effectiveness of the digital entrepreneurial ecosystem in the creation of new ventures pre and post COVID-19 pandemic analysis.

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1. By dynamic entrepreneurial capabilities, we refer to higher-level competencies that determine universities' ability to integrate, build, and reconfigure internal and external resources and competencies to shape rapidly changing business environments like the digital economy (Guerrero et al., 2020). By assimilating Teece's (2018) ideas, these university capabilities should be oriented to seizing resources, sensing opportunities, and transforming these into new business models.
 2. Digital entrepreneurship is understood as the intersection of entrepreneurship and digital technologies (e.g., digital artefacts, platforms and infrastructures) where entrepreneurial ideas emerge (Nambisan, 2017, p. 1031).
 3. The knowledge, skills and confidence to use the technologies and devices to deliver the outcomes you want (PWC, 2018).
 4. The US government has implemented a digital literacy program for supporting learners and educators (see <https://digitalliteracy.gov/>). Similarly, a support program called SELFIE (Self-reflection on Effective Learning by Fostering Innovation through Educational technology) has been implemented in Europe for students and teachers (see <https://ec.europa.eu/education/schools-go-digital>).
 5. More advanced digital technologies include the Internet of Things, additive manufacturing, big data, artificial intelligence, Cloud computing, virtual reality and blockchain technologies (Nambisan, 2017; Rindfleisch et al., 2017; Ahluwalia et al., 2020).
 6. For further details, see https://thedigitalteacher.com/?_ga=2.8433717.165517393.1575808033-453659041.1575808033.
 7. In Europe, a good tool has been the HEInnovative project, which has supported university managers in the development of university capabilities for being more entrepreneurial, innovative and digital (<https://heinnovate.eu/en>).