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University 4.0: Digital Transformation of Higher Education Evolution and Stakes in Morocco

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ABSTRACT

Facing the challenges of the new industrial revolution, the deep coupling between universities and industry 4.0, the integration of information and communication technologies in education, and the enhancement of the ability to serve society on the basis of internal and external synergy should become the common choice of different types of universities. The university plays an important role in the n development in any advanced economy. In the age of knowledge and globalization rapid technological changes involve new disruptive processes. In this permanent challenge, it is necessary to adapt to the digital transformation, in order to better respond to the needs and challenges of a constantly changing environment. It is necessary to pay attention to technological advances, to a total transformation in the new university, University 4.0, In order to face the challenges of the technological development and the efficiency of universities in Morocco, it is necessary to introduce modern technologies, blockchain technology, artificial intelligence, chatbots..... into the sphere of Moroccan universities.

INTRODUCTION

This Digital transformation is about focusing the development of universities and higher education institutions on the application of technology, as is the case in other sectors. Dewar (2017) defines University 4.0 as a university that is other-oriented, to primarily serve students, outward-looking, engaged, and connected to the surrounding productive environment, in line with Barnett's (2017) concept of the ecological university, which refers to the interconnection of the university with various ecosystems (knowledge, social institutions, people, economy, learning, culture, and natural environment).

Precisely, in order to follow a logical sequence until reaching version 4.0, Barnett describes the evolution of the university in different phases: a university 1.0, which would be the metaphysical university developed in medieval times, with a strong presence and dominance of spiritual and religious beliefs. Version 2.0 is born in post-industrial societies, more focused on the deployment of research within the university as a driver of technological progress oriented towards economic development. It would correspond to the universities created from the 15th century onwards, with teaching that was increasingly open to different approaches to thought. A few centuries later, version 3.0, which could be called an entrepreneurial university, defined by Barnett, as a university for itself, serving many different functions and communities, but above all concerned with optimizing its own interest or strategy in an increasingly competitive world. This university 3.0 is also defined by Pulido, (2019) as an advanced and social university, developing in Europe in the 19th century, combining teaching and research functions, with self-governance and institutional autonomy.

This article introduces us to the digital era, trying to show the relevance and impact it has on contemporary society. It identifies the main disruptive technologies that are shaping it and how, from these, the models and processes of organisations are being transformed, generating profound, abrupt and at the same time ephemeral changes. From this point of view, the challenges of universities in the digital age, the debate on the future of the university cannot be postponed in the face of the challenges of Industry 4.0. This transformation is seen as a necessity that must be tackled without delay, but with a critical view and taking into account the particularities of each institution. We also try to sketch some ideas on the role that higher education institutions could play in this coupling between university and industry 4.0.

METHODOLOGY

In order to understand and analyze the close link between universities and Industry 4.0, we focused on the digital transformation of higher education as a common choice of different types of universities, in this sense a systematic literature review (SLR) was conducted. This form of review is based on the application of different scientific strategies that limit bias, through a systematic collection of information as well as a critical evaluation and synthesis of all relevant studies on a specific topic (Cook *et al.*, 1995). In this work, we applied the methodology proposed by Tranfield *et al.* (2003), which can be summarized in three main steps: planning the review, conducting the review and presenting the results and reports.

LITERATURE REVIEW

Plan the systematic literature review

Dewar, (2017) argues that University 4.0 will provide on-demand learning in multiple formats, with continuous transfers between different modalities, with more intense collaboration between universities and the productive fabric in a digitised environment. In this context, Pulido

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(2019) interprets University 4.0 as a university that undergoes such a disruptive change that it requires a radically new university (4.0) in organisation, technology, and education-research strategy that responds to the needs of a profoundly evolved society. Indeed, digital technologies are driving digital transformation, a new form of organisation and increasing and unpredictable changes, generating a wide range of new challenges. It is therefore University 4.0 that corresponds to a modern university, as a metamorphosis of previous versions in a technological environment that is advancing into the digital age and must meet the demands and commitments of a globalised society.

Due to the digital transformation, the university has ceased to be what it used to be. The university today has to follow the trends imposed by globalisation and the increasing use of technology by organisations and individuals. There is a concern about whether the university can survive the intelligent world resulting from the advances in digital technology brought about by the Fourth Industrial Revolution. Is it possible to envisage the university of the future as a smart 4.0 university that has begun to emerge? The answer to this research question thus contributes to enriching the literature both on the notion of University 4.0 and on the new dynamics integration of information and communication technology for education.

Conducting The Systematic Literature Review

In order to target the articles to be explored, we chose to use the following databases which we believe provide an adequate picture of the current literature in the field: Scopus, Web of science and google Scholar. We also used various websites including We then identified a series of keywords in order to select the most relevant articles for the research. In particular, we chose scientific articles that included the following terms in their subject, title or abstract: "Digitization" or "University 4.0" and "ICT". In a second step, we introduced the terms "artificial intelligence" or "blockchain" in order to better focus the research on the University 4.0 theme. Regarding the period of time to be covered, we have chosen a sufficiently long period to adequately present the state of the art in the field.

RESULTS

The economic impact of digitisation is accelerating as countries evolve in their degree of digitisation. The most digitally restrictive economies benefit less, largely because they have not yet developed an ICT ecosystem to reap the benefits of digitalisation (Cerezo, *et al.*, 2017, Tamer, 2022). According to these authors, digital transformation is understood as a relatively new and recent phenomenon, and an organisation cannot be considered to have reached a final state of maturity in this area or to have managed to define it in its entirety. Considered as a new paradigm, digitalisation, as a new way of doing things, has a great impact on the way universities carry out their main missions and functions (Juanes and Rodríguez, 2020).

Universities must also provide students with the skills and knowledge they need for a very different future. In this new educational landscape, the digital transformation of higher education is essential (Tamer, 2022).

Of this conception, very few intend to create 4.0 university models, which suggests that they continue to rely on the current university model in terms of organisational form. It is therefore important to understand that the process of digital transformation implicitly involves a change in the organisational model. Digital transformation represents new opportunities for business strategies, integrating technology, streamlining processes, preparing teams to work and collaborate with digital tools and establishing business logic or processes with the digital economy, thus achieving better performance.

According to Garcia, (2018), it can then be deduced that, digital transformation allows institutions to adapt a socially responsible and ethical business model, allowing them to apply a scalable development model, without forgetting that they influence to reduce environmental impact by streamlining processes and reducing consumption of non-renewable materials.

According to Gaibor, (2020), Digitalisation is the great driver of wealth creation, an important point in this analysis is that digital transformation brings greater productivity, agility, quality, innovation, cost efficiency, as well as many other aspects, both for digital and offline businesses, where the key is to understand how digital techniques and tools can impact and grow a traditional business or institution, but in a joint and strategic way. Digital transformation is not just a technological problem that is solved by an injection of technology.

According to Barro (2018), the digitalisation of a university requires first and foremost an investment effort in ICT infrastructure and resources. However, to make it a 4.0 university, the relationship between teachers and new students (millennials, generation Z) also needs to be reformulated, where traditional channels are no longer a priority but complementary. As explained in the article, the simple use of technology is not enough to take the step towards digital transformation. According to Gaibor, (2020), it is necessary to raise awareness and train the whole team, so that they can make the most of digital tools in their daily work. Looking at the issue from different angles, it is clear that the current rigid educational structures need to be changed, barriers need to be broken down and technology needs to be used to provide educational content at all times. We need to promote a more fluid and flexible education to better adapt to different needs, as the current rigidity of university structures does not, in some cases, promote adequate education (Gaibor, 2020).

From University 1.0 to University 4.0

The university has played, and must continue to play with greater intensity, an important role in the development of innovation in any advanced economy. After all, it is the natural space in which knowledge is developed and

promoted and, as such, must be transferred to society. Globalisation, new processes and, consequently, new working methods and rapid technological changes define the changing environment in which the University operates. In this permanent challenge, it is necessary to adapt to the new times and, in particular, to strengthen the role of resilience and adaptation to change in the university context. It is no longer just about the agility with which the organisation evolves in the present moment, but the ability to anticipate the future era, for which we must always be vigilant and constantly reflect.

In this context, this vigilance implies the vision of a digital world, to which the University has already opened its doors but where there is still a long way to go. We are talking about a disruptive era that is changing the world around us or, in global terms, the 4.0 era, which applied to any field denotes a commitment to the digital world, to the digitalisation of processes or to what is known as digital transformation.

The regular use of the internet by millions of people around the world has led to the development of the internet of things, which is a growing advance in connecting digital devices and objects to each other, interacting in such a way that there are no temporal or spatial boundaries. We are witnessing a new industrial revolution that affects the intellectual-intensive jobs of the 21st century, whereas in previous industrial revolutions it was mainly manual activities that were affected. This is the fourth Industrial Revolution, that of the fusion of technologies, where the combination of advances in the development of robotics and artificial intelligence, the collection and processing of massive information or Big Data have and will have an impact on the economy and therefore on the qualification needs of jobs in all productive sectors. The digital transformation implies focusing the development of the university, higher education institutions, on the application of technology, as is happening in other sectors (Tamer, 2022).

Dewar, (2017), defines the 4.0 university as a university that is other-oriented, primarily to serve students, outward-looking, engaged and connected with the surrounding productive environment, which refers to the interconnection of the university with various ecosystems. Specifically, to fit into a logical sequence until reaching version 4.0, Barnett, (2014), describes the evolution of the university in different phases: a university 1.0 which would be the university developed in the medieval period (the main European universities date back to the 11th century), with a strong presence and dominance of spiritual and religious beliefs and which evolved towards liberal arts type education. Version 2.0 appears in the sphere of post-industrial societies, more focused on the deployment of research within the university as a driver of technological progress oriented towards economic development. It would correspond to the universities created from the 15th century onwards, with teaching that was increasingly open to different approaches to thought. A few centuries later, version 3.0, which could be described as the entrepreneurial university, defined by Barnett, (2014), as a university for its own sake, serving many diverse functions and communities, but above all concerned with optimising its own interest or strategy in an increasingly competitive world. This University 3.0 is also defined by Pulido, (2019) as an advanced and social university, developing in Europe in the 19th century, combining the teaching function with the research function, with self-governance and institutional autonomy.

Dewar, (2017), argues that University 4.0 will provide on-demand learning in multiple formats, with continuous transfer between different modalities, with more intense collaboration between universities and the productive fabric in a digitised environment. In this context, Pulido, (2019), interprets University 4.0 as a university that undergoes such a disruptive change that it requires a radically new university (4.0) in organisation, technology and education-research strategy that responds to the needs of a profoundly evolved society. Indeed, digital technologies are leading to digital transformation, a new form of organisation and increasing and unpredictable changes, generating a wide range of new challenges. It is therefore University 4.0 that corresponds to a modern university, as a metamorphosis of previous versions in a technological environment that is progressing in the digital age and that must respond to the demands and commitments of a globalised society.

According to Barth, Rieckmann, (2016), the major changes we are seeing with information and communication technologies make traditional approaches to classical pedagogy and its conventional credentials obsolete. Among the soft skills that will soon be indispensable are higher-order cognitive thinking, innovative adaptive thinking, cognitive load management, multiple literacy, complex situation solving, social skills, elastic skills and cross-curricular skills to accomplish tasks of a changing nature. Barth, Rieckmann, (2016), add that digital skills will also lead to a diversity of synaptic and social connections that will become increasingly flexible and adaptive. According to Deward, (2017), the typology of universities provided by Professor Emeritus Barnett, (2014), from the Institute of Education at the University of London presents us with the following classification:

University 1.0: This would be the university, in the service of God, which appeared in medieval times. The first stages of this university were structured around specialised communities that eventually evolved into the tradition of liberal arts education (Le Goff, 2008).

University 2.0: could be seen as the research university that has emerged in post-industrial societies, where universities have become the focal point of research-led technological progress. The great post-war expansion is clearly focused on research for economic development. Based on the massification of education, with the teacher as the main provider of knowledge and the student as a passive receiver who absorbs the content (Shchedrovitskii, 2011).

University 3.0: is described as the entrepreneurial

university, functioning, in Barnett's, (2014), terms, as a university 'for itself', serving many diverse functions and communities, but primarily concerned with maximising its own self-interest. Based on the integration of computers and the internet into teaching and learning, thereby increasing access and equity (Li, 2020).

University 4.0: refers to the green, outward-looking university, deeply connected to industry and the communities around it. It is committed to meeting the needs of its students. It relies on high-speed internet, mobile devices, technology platforms and digital applications, which facilitate personalised learning anytime, anywhere and change the transmission roles of teachers (Efimov, and Lapteva, 2017).

University 4.0 is an apt description of how universities around the world must respond to the new economy and associated trends such as digital disruption and changing labour markets. If universities want to remain relevant, they must undertake revolutionary changes at the organisational, operational, structural, pedagogical, socio-cultural and cognitive levels today (Aladyshkin, Odinokaya, Safonova, & Kalmykova, 2020). University 4.0 is fully in line with the fourth Industrial Revolution. We are talking about new platforms that will use artificial intelligence algorithms in combination with the Internet of Things (IoT) to personalise student learning. This will force traditional professors to take on new teaching roles that transcend the delivery of declarative content (Aladyshkin, Odinokaya, Safonova, & Kalmykova, 2020). This revolution is centred on the development of new information and communication technologies in education incorporating robotics, automated systems, blockchain, fintech, bots, deep learning, 5G technology and cybersecurity systems. All of these will impact our daily lives, social relationships, work and learning experiences for life.

Today's student is not just limited by a teacher-led educational model, but draws learning from a variety of information sources at a personalised pace. They do not only expect academic excellence, but also desire personalised excellence by expanding their horizons of possibilities. We cannot be satisfied with a university that adapts to new circumstances and tries to integrate emerging technologies (Kazimirov, 2018). We need a radical change and this requires: ending the problems of massification, adopting the procedures for professional promotion, softening the relationship with the social environment, strengthening student engagement, implementing realistic strategic plans (Antonio Pulido, 2019).

For James, (2019), one of the contemporary methodologies is accelerated distance learning, i.e. the idea that students learn theoretical knowledge at a distance through digital means, while ensuring that practical skills are acquired in physical environments. It is a flexible form of learning that requires responsibility and good time management to develop skills based on an increasing economy of autonomy.

At this point, it is a matter of building and investing more in a robust educational ecosystem, not to replace or displace it, but as a form of flexibility and adaptability. According to Aladyshkin, *et al*, (2020), What is required of education today is not a solid classical education, not because of the modality, but because of the social diversity of the modern world. Higher education institutions are moving towards a more personalised form of learning. Aladyshkin, *et al*, (2020), add that by using data and tracking student performance, universities will be able to identify students who are struggling and provide them with learning strategies optimised to meet their needs. Data analysis will be used to treat each student, understanding that each student's learning needs and desired outcomes will be different.

According to Villalobos, and Pedroza (2019), the central idea supported in this article is that there is no element of the university that is not undergoing profound changes with the use of new communication and learning technologies. University life is being renewed with its productions, processes and tasks; training, teaching, learning, research, curriculum, etc., are all being changed by the integration of information and communication technologies for teaching. Thus, various documents from universities in different parts of the world have been worked on and creativity has been used to give shape to University 4.0 (Villalobos, and Pedroza 2019).

The virtuous circle of innovation in the university in the transition to the future. The debate on the future of the university cannot be postponed in the face of the challenges of 4th industrial revolution, where developments in technology, physics and biology converge. The archetypal monolithic university, composed of disciplinary islands focused on essentially theoretical teaching, with atomised contents disconnected from real problems and with informational pedagogical practices that favour repetitive and contemplative learning, which is also of little impact in making contributions to the future (Gueye, and Exposito, 2020).

According to Gueye, and Exposito, (2020), the university in the knowledge society is obliged to reinvent itself because otherwise, with its traditional model, it will be unable to meet the needs and challenges of an increasingly dynamic world. Recent experience shows a historical truth: universities that work hand in hand with technological advances are best placed. By investing in research and development, they are creating innovations and acquiring a leading role in the current new technological configuration.

According to Madaliyeva, *et al*., (2020), it is the faculty that enables the university to develop, to participate in opening up and solving the challenges present in the new fields of knowledge. In order to reinvent itself, the university must implement and encourage the integration of new information and communication technologies for teaching in teaching and learning, always on the basis of scientific research, while promoting new forms of organisation, new methods.

Indeed, according to Lapteva, and Efimov, (2016), the trend of university education in Industry 4.0 is moving towards the innovative research-based university. Lapteva, and Efimov, (2016), indicated that the innovative university is the one that makes research its main development axis. On the one hand, new knowledge is provided and, on the other hand, the learning and teaching system is redefined. The result is a university model characterised by dynamic feedback between these two aspects. The best ranked universities are those that encourage this kind of flow (Lapteva, and Efimov, 2016).

According to, Madaliyeva, *et al*, (2020), with the upgrading of traditional industries and the advent of Industry 4.0, the economic structure and industrial mode have undergone unprecedented changes, which means that universities have to adapt to the demand and provide responses. Madaliyeva, *et al*, (2020), add that the construction and exploration of new information and communication technologies for education, on the one hand, actively adapt to the changing demand for profiles in the context of industrial production and technological innovation, and on the other hand, promote institutional reform and internal development of universities.

Today, the university is changing, there is no country that does not rethink the change of the model and function of its university. We can even say that the country that resists change is endangering the existence of this thousand-year-old institution (Madaliyeva, *et al*., 2020). Various factors require a change in the university, the most representative being technological development, what society expects from the university and that it responds to economic, social and political development, which implies an internal renovation of university processes (Lapteva, and Efimov, 2016).

The university is challenged because technological advances are not always born within it, the dominant dynamic is that of an academic science and technology, that is, it is formed only to reproduce, not to generate new advances (Gueye, and Exposito, 2020). With the fourth Industrial Revolution, the university has to deal in a different way with its dynamics in the training of professions, moving towards teaching and intelligent learning, devoting itself more to scientific research and technological development, with this, its vision is transformed and its model is mobilised towards open and flexible forms. Not all universities are taking the shift in the same way (Lapteva, and Efimov, 2016).

The best-placed universities are at the forefront of change, while others are slow and lagging behind. The best-placed universities are those dedicated to research with models linked to the economic and social development of the country (Gueye, and Exposito, 2020). They generate technological advances and produce economic resources. This is in contrast to poorly positioned universities, which maintain the stagnant practices of the past, dedicated to training based more on academic discipline than on the generation of new knowledge and technical and technological resources. There is an uneven development of the university in the world that coincides with the economic, political and social situation of each country (Gueye, and Exposito, 2020). Therefore, the transformation of the university represents the transformation of the country or vice versa, as there is a reciprocal relationship between the university and national development.

In general, the transformations of the university in the world have an accelerated dynamic, which requires addressing the dimensions that need to change in the direction of progress. Villalobos, and Flores (2019), have identified some axes of university transformation:

- Diversification of university modalities, nowadays pluriversity is a fact, they coexist with face-to-face mobility, alternative and complementary distance, open, digital and mixed modalities that are increasingly positioned.
- With the development and application of information and communication technologies (ICT), curricular modalities are being transformed into flexible, open, networked, integral and individualised itineraries, combined with platforms such as Coursera, Udacyt, Scolartic, Mooc courses and standard university credits.
- With artificial intelligence, pedagogical relationships are being transformed, as there is now a relationship between teachers, robots and students and learning is an unprecedented experience, generating a ramification of learning types: adaptive (Big Data with Learning Analytics), 3D, gamified, flipped learning, adaptive, with virtual reality, multimodal, storytelling-based learning, and so on.
- There is a new academic ecosystem of training, learning and management based on the technology trend of 5G (fifth-generation 5G mobile networks), digital assistants, robots, augmented reality, global educational platforms, communities of practice and the use of blockchain (Schwab, 2017).
- Rethinking the training of professions by strengthening the themes of humanities and human development tending towards the connection and expression of smart, sustainable and coexisting cities.

The building blocks of university transformation are many, the university 4.0 model is super-connected in an interactive environment between humans and new technological species creating a new university ecosystem of teaching co-existence for the continuous development of learning for disruption (Giesenbauer, det Müller-Christ, 2020).

According to Colombo, *et al*, (2020), The use of hard technological applications derived from intelligent computing allows for the superconnection of knowledge at previously unsuspected levels, artificial intelligence stands out, starting from the use of simple artefacts to the use of machine learning, we observe how in universities the use of apps, robots and virtual intelligence increases its application. At the same time, the forms of learning with soft technologies are multiplying, they are abandoning their traditional form of being secondary in the training processes, they are now the central character, we are in

the era of augmented learning acquired by our human skills and simultaneously powered by nanotechnological artificial bodies, for this reason we speak today of a trend towards nano-credentials and no longer of the old university references of diplomas and degrees (Colombo, *et al*., 2020). Flores, (2018), note that we are living in a time of crisis that requires the university to move to where the people are, not that the people move to the physical address of the university. Flores, (2018), adds if administrators, faculty and non-teaching staff resist the demands of the millennial society, they will begin to feel the effects of the erosion caused by the proliferation of emerging educational agencies that will launch their attractive academic offerings.

These conventional institutions will not only face the challenge of placement rates or employability of their graduates, but will also have to deal with the socio-cultural challenges and emerging crises of our time (Colombo, *et al*., 2020). The educational community will have to work together to find solutions to crises on and off campus. According to Colombo, *et al.* (2020), before long we will see the academic offerings of departments lose their footprint, as social demand will dictate what people want to learn, how to learn it, when, where and with what resources.

Duc, *et al*., (2018), suggest that universities should partner with the local community, industry and society at large to co-design and co-implement a stronger higher education system. Duc, *et al*, (2018), add that their operational and pedagogical business model is incompatible with the times we live in. We are now living under the threat of a micro-organism that has crippled the entire world. The initial solution was to save the semester with any video-conferencing technology that would be used for remote academic continuity. As the summer holidays approach, higher education institutions will have to prepare for longer periods of remote administrative support and online teaching. What we know as the physical space for working and learning will never be the same again (Duc, *et al*., 2018). According to Giesenbauer, det Müller-Christ, (2020), University 4.0 is not the one that improves on what other universities do, but the one that dares to do things differently. It is the one that looks at the segments that other institutions are unable to look at. An agile educational organisation is one that looks at different latitudes, looking for new learning niches that society needs.

It is very clear that no single technology will replace administrators, teachers and non-teaching staff. Those who will replace them will be the expert users of cyber-human interfaces (Gueye, and Exposito, 2020). They will take them out of their fragile safety and comfort zones. Technology is not just about the digital gadgets we acquire in our workplaces and homes. Real technology is about effectively connecting our brains to devices to create new solutions to the emerging crises of our time (Gueye, and Exposito, 2020).

Creative University

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We are now living in a unique time where the digital revolution is changing the way most people live on the planet. Central to this change is the development of digital universities. It has already become a driver of the economy. Digitalisation improves the conditions for doing business, increases the level of education and computer literacy of the population and, in general, the level of competitiveness of the nation. Digital technology has such a profound effect on the competitiveness of countries that nations around the world are looking to modernize the industry. The changes brought about by technology, which are redesigning production processes, are helping to increase the efficiency and quality of services. As the experience of the rest of the world shows, digital technologies make a tangible contribution to GDP growth. This is why some countries have adopted entire national programs for in universities. The whole world is now embracing digital transformation.

To date, Morocco country is implementing national digitalisation programs. A first approximation of the state of innovation in the world can be found in the recent report Global Innovation Index 2021 (GII), indeed Morocco occupies the 77th place with a score of 29.3 (Table 1).

The ranking is dominated by Switzerland, Sweden, the United States, the United Kingdom, and South Korea in these top five positions (Table 2). As noted, the performance in investment and digital transformation in Moroccan universities, there is a deficit of innovation at the national level. Moreover, change or improvement towards advanced positions is difficult and slow for a country such as Morocco. It is also interesting to note the reference to the most important regional science and technology clusters in the world, with the understanding that innovation activities tend to be geographically concentrated. In this regard, the United States remains the country with the largest number of innovation clusters (26). Another source for assessing which countries have the most innovative universities is the Reuters ranking: The World's most innovative universities, which identifies and ranks the educational institutions around the world with the best results in innovation, understood as the best performance in advancing science, inventing new

Table 1 : Global Innovation Index Ranking 2021

Gii Rang	Economy	Score	Group Rank	Region Rank
76	OMAN	29.4	47	11
77	MOROCCO	29.3	8	12
78	BAHRAIN	28.8	48	13

Table 2 : Global Innovation Index Ranking 2021

Gii Rang	Economy	Score	Group Rank	Region Rank
1	Switzerland	65.5	1	1
2	Sweden	63.1	2	2
3	United States Of America	61.3	3	1

technologies and stimulating new markets and industries. Another source for assessing which countries have the most innovative universities is the Reuters ranking: The World's most innovative universities, which identifies and ranks the educational institutions around the world with the best results in innovation, understood as the best performance in advancing science, inventing new technologies and stimulating new markets and industries. In its latest edition, referring to 2021, Stanford University in the United States leads the ranking of leading universities in scientific and technological innovation, Stanford maintains its top spot year after year because it produces a steady stream of innovations that are cited by other researchers in academia and private industry. This type of influence is a key measure in the ranking of the world's most innovative universities, which was compiled in partnership with Clarivate Analytics and is based on proprietary data and analytics, including patent filings and research paper citations. Followed by Massachusetts Institute of Technology (MIT), and Harvard, all of which have held their positions for seven consecutive years since Reuters began producing the rankings. In fact, no Moroccan university has made it into the top 70 universities, so these results show that Morocco continues to have a low R&D investment effort compared to other economies of similar size, and this circumstance conditions any effective progress. Barnett, (2017) points out that universities are not living up to their potential and responsibilities in a constantly changing and challenging environment. The truth is that in the age of knowledge and globalization, the university must constantly reinvent itself from becoming an obsolete institution, so that it can better respond to the needs and challenges of a changing world. This reinvention implies paying attention to scientific and technological advances, developing them, integrating them and being more active in the innovation strategy.

Theoretical and Managerial Implications

From our study we can recommend Moroccan universities to consider adopting the following practices:

as a first link, blockchain which is gradually being implemented not only in all areas of business, but also in higher education, as the interaction between business and science contributes enormously to the growth of innovative products and services. In higher education, the demand for innovation, the possibilities offered by digital technology, are very relevant today. Their necessity is associated with objective processes such as the volume of information that is increasing at an enormous rate, and the capacity of students to absorb it (Vasilieva, 2017). In Morocco, the transition to digital media is progressing; especially in higher education institutions which are increasingly moving away from paper-based media. Indeed, the collection of information on paper creates an additional workload also for administrative staff and allows for changes in documents; reporting forms on the results obtained in the different educational institutions may not match, which reduces the efficiency of the staff; the lack of a comprehensive database on graduates with specific skills makes it difficult for employers to find the right specialists; the lack of an open database on the employment of graduates and their transfer to other jobs does not allow higher education institutions. In order to solve all these problems and increase the efficiency of universities in Morocco, it is necessary to introduce modern technologies, blockchain technology, into the sphere of universities (Tamer, 20.

Secondly, the technologies of augmented reality and virtual reality which constitute fundamentally new means and methods of interaction between teachers and students, which guarantee the effective realization of pedagogical activities in the sphere of higher education. The analysis carried out allows us to conclude that the application of innovative technologies in the educational process contributes not only to the progress of students, but also to their interest in the learning process. In Morocco, the application of augmented reality and virtual reality technologies in the student learning process will, on the one hand, facilitate the task of the teaching staff and, on the other hand, will significantly help students to master knowledge, form their skills and abilities and, overall, will have a positive effect on the training of graduates (Tamer, 2019).

Thirdly, chatbots in higher education, which are conversational assistants or better known as bot or chatbot or chatterbot, which can be defined as a virtual assistant, are a set of computer programs that possess the ability to maintain a conversation with a human being through natural language. Similarly, a conversational agent can be understood as an automatic system capable of emulating a human being in a dialogue with another person, with the aim that the system provides certain information or performs a certain task. The objective of chatbots in higher education is always to achieve interaction based on models similar to those used by humans, which is achieved through dialogues, as they are programmed to have the capacity to analyse the environment and propose solutions to problems, interpreting emotions and contributing to the teaching-learning process to the maximum extent possible.

fourthly, artificial intelligence, which is defined as a technology whose value on the market is incalculable, both in the present and in the future, but we should not only refer to the monetary value, but also analyse the value it has for the optimisation of non-commercial processes, as in the higher education sector, Artificial intelligence to

be a turning point in the changes of traditional higher education paradigms, although the pedagogical modalities at all levels of education systems are being adapted, given the current technological tools, virtual teaching modalities are becoming more common in the education policies of developed countries. Finally, artificial intelligence can optimise the use of these valuable resources, as one of the main problems today is the under-use of technological tools or their use in isolation and out of context.

CONCLUSION

The landscape of contemporary education is diverse. Higher education systems are now developing as institutionally complex structures that align learning with the organisations of different professional spheres of society and digital transformation (Aladyshkin, *et al.*, 2020; Karpov, 2013). Socially The most important and economically significant element of this structure is the higher education sector. Its institutional base is composed of scientific institutions, high-tech companies, innovative enterprises, industrial consortia, innovative growth institutes giving rise to University 4.0 (Aladyshkin, *et al.*, 2020). Ecosystems become the place where favourable conditions for the efficient transfer of technologies and scientific and technical innovations are created. University 4.0 becomes the basis of global competitiveness of national economies, and its ecosystem forms new fast-growing industries, promising technological markets, economically advanced administrative-territorial spaces.

Finally, based on the recommendations of our research, universities in Morocco can promote active, constructive and real learning, while provoking a process of innovation. This requires the involvement of all stakeholders in the process of changing the design of the higher education process in Morocco, which was based on the practical application of the content covered in the subject and on the integration and didactic use of digital technologies.

REFERENCES

Aladyshkin, I.V., Kulik, S.V., Odinokaya, M.A., Safonova, A.S., & Kalmykova, S.V. (2020). Development of Electronic Information and Educational Environment of the University 4.0 and Prospects of Integration of Engineering Education and Humanities. Integrating Engineering Education and Humanities for Global Intercultural Perspectives. IEEHGIP 2022. *Lecture Notes in Networks and Systems, 131*, Springer, Cham. https://doi.org/10.1007/978-3-030-47415-7_70

Barnett, R. (2017). The ecological university: *A feasible utopia. Routledge*. https://doi.org/10.4324/9781315194899

Barro, S. (2018). De la digitalización de las universidades a las universidades digitales.

Cerezo, P., Magro, C., & Salvatella, J. (2017). On digital transformation and its socioeconomic impact.

Colombo, A. W., Veltink, G. J., Roa, J., & Caliusco, M. L. (2020). Learning industrial cyber-physical systems and industry 4.0-compliant solutions. *In 2020 IEEE Conference on Industrial Cyberphysical Systems (ICPS) 1,* 384-390. *IEEE*. https://doi.org/10.1109/ICPS48405.2020.9274738

Cueva Gaibor, D. A. (2020). La tecnología educativa en tiempos de crisis. *Conrado, 16*(74), 341-348.

Cueva Gaibor, D. A. (2020). Transformación digital en la universidad actual. *Conrado, 16*(77), 483-489

Duc, N. H., Chung, N. H. T., Huy, N. X., Lan, M. T. Q., Lieu, T. T. B., Thuy, H. Q., & Loc, N. (2018). Towards the Higher Education 4.0–Characteristics and Criteria. *VNU Journal of Science: Policy and Management Studies, 34*(4). https://doi.org/10.25073/2588-1116/vnupam.4160.

Efimov, V., & Lapteva, A. (2017, November). University 4.0: philosophical analysis. *In Proceedings of the 10th Annual International Conference of Education, Research and Innovation, Seville, Spain*, 16-18. https://doi.org/10.21125/iceri.2017.0242

Flores, M. A. (2018). Linking teaching and research in initial teacher education: knowledge mobilisation and research-informed practice. *Journal of Education for Teaching, 44*(5), 621-636. https://doi.org/10.1080/02607476.2018.1516351

James, F. (2019). Everything you need to know about Education 4.0. Quacquarelli Symonds.

García, M. M. (2018). El impacto de la transformación digital en las empresas sociales. https://www.iebschool.com/blog/impacto-transformacion-digital-empresas-sociales-digital-business.

Giesenbauer, B., & Müller-Christ, G. (2020). University 4.0: Promoting the transformation of higher education institutions toward sustainable development. *Sustainability, 12*(8), 3371. https://doi.org/10.3390/su12083371

Gueye, M. L., & Exposito, E. (2020). University 4.0: The industry 4.0 paradigm applied to education. In IX Congreso Nacional de Tecnologías en la Educación. https://hal-univ-pau.archives-ouvertes.fr/hal-02957371

Hammershoj L. G. (2009). Creativity as a question of Bildung. *Journal of Philosophy of Education, 43*(4), 545—557. https://doi.org/10.1111/j.1467-9752.2009.00703.x

Dewar, J. (2017). University 4.0: Redefining the role of universities in the modern era. *Higher Education Review, 8*.

James, S., Freese, M., & Davison, A. J. (2019). Pyrep: Bringing v-rep to deep robot learning. arXiv preprint arXiv:1906.11176. https://doi.org/10.48550 arXiv.1906.11176

Juanes Giraud, B. Y., & Rodríguez Hernández, C. (2020). La formación dual. Elementos de análisis para implementación en una universidad ecuatoriana. *Revista Conrado, 16*(74), 354-363.

Карпов А. (2012). Engineering platform for the transfer of technologies. *Voprosy Ekonomiki, 7,* 47—65.

Kazimirov, A. N. (2018, November). Education at university and industry 4.0. In 2018 Global Smart Industry Conference (GloSIC)*IEEE.,* 1-6. https://doi.org/10.1109/GloSIC.2018.8570076

Mounaim, L., Knidiri, Z., & Tamer, H. (2021). Omnichannel retailing, from the focus on consumer

behavior through organizational and retailer impact: A systematic review from a marketing perspective. *International Journal of Accounting, Finance, Auditing, Management and Economics, 2*(4), 302-322. https://doi.org/10.5281/zenodo.5133323

Lapteva, A. V., & Efimov, V. S. (2016). New generation of universities. University 4.0

Le Goff, A. (2008). The National Archives and the History of Education. *Education History, 119,* 82-87.

Li, J. (2020). Autonomy, Governance and the Chinese University 3.0: A zhong–yong Model from Comparative, Cultural and Contemporary Perspectives. T*he China Quarterly, 244,* 988-1012. https://doi.org/10.1017/S0305741020001071

Li, M. A Systematic Review of the Research on Chinese Character Teaching and Learning. *Front Educ China 15,* 39–7. https://doi.org/10.1007/s11516-020-0003-y

Madaliyeva, Z., Kassen, G., Sadykova, N., Baimoldina, L., & Zakaryanova, S. (2020). Resources and competencies as major determinants of university models 4.0. *In E3S Web of Conferences 159,* 09001. EDP Sciences. https://doi.org/10.1051/e3sconf/202015909001

Martin P., Morris R., Rogers A., Kilgallon S. (2010). What are creative spaces? In: P. Martin (ed.). Making space for creativity. Brighton: University of Brighton, 23—26.

Pedroza Flores, R. (2018). A university 4.0 with an intelligent curriculum 1.0 in the fourth industrial revolution. RIDE. *Ibero american Journal for Educational Research and Development, 9*(17), 168-194. https://doi.org/10.23913/ride.v9i17.377.

Schwab K., (2017). The Fourth Industrial Revolution, Penguin Random House, New York.

Schwab, K. (2017). La cuarta revolución industrial. México: Penguin Random House.

Shchedrovitskii, P.G. (2011). Povestka dnia 2010-kh [The agenda of the 2010's]. *Lecture series.* https://doi.org/10.17516/1997-1370-2016-9-11-2681-2696

Strazzieri-Pulido, K. C., S. González, C. V., Nogueira, P. C., Padilha, K. G., & G. Santos, V. L. (2019). Pressure injuries in critical patients: Incidence, patient-associated factors, and nursing workload. *Journal of nursing management, 27*(2), 301-310. https://doi.org/10.1111/jonm.12671

TAMER, H., LEBZAR, B., & ABAAOUKIDE, K. (2019). L'impact de la digitalisation des universités sur la motivation des usagers: Revue de littérature. *Revue Internationale des Sciences de Gestion, 2*(3).

TAMER, H., LEBZAR, B., & KNIDIRI, Z. (2022). Marketing Practices in Higher Education: Case of the Cadi Ayyad University of Marrakech in Morocco. *International Journal of Accounting, Finance, Auditing, Management and Economics, 3*(4-1), 477-490. https://doi.org/10.5281/zenodo.6614930

Hind, TAMER, & Zakaria, KNIDIRI, The Effect of ICT Use on Student Engagement in Moroccan Universities: An Exploratory Qualitative Study. *Social influence, 72*(4), 44.

Verlag Barbara Budrich. (2015). Empirische forschung zur bildung für nachhaltige entwicklung - themen methoden und trends. Retrieved March 8 2023 from https://content-select.com/portal/media/cover_image/55102352-9b64-46a1-aae0-0f44b0dd2d03/500.

Vasilieva, E. V. (2018). Developing the creative abilities and competencies of future digital professionals. *Automatic documentation and mathematical linguistics, 52*(5), 248-256. https://doi.org/10.3103/S0005105518050060