La universidad 4.0 con currículo inteligente 1.0 en la cuarta revolución industrial

The university 4.0 with intelligent curriculum 1.0 in the fourth industrial revolution

A universidade 4.0 com currículo inteligente 1.0 na quarta revolução industrial

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Resumen

Escribir del futuro de la universidad es una tarea apasionante porque estamos en un punto de inflexión entre el pasado y el futuro: una universidad entre la tradición de los ladrillos y la emergencia digital. Las certezas se desvanecen con la manera en que fluyen los conocimientos y las producciones académicas; y lo nuevo sorprende en cuanto a la forma y la dinámica de conexión entre las fuentes de conocimiento incorporadas en el currículo. En este documento se aborda el presente y la transición hacia el futuro de la universidad. Tres puntos son los ejes de la argumentación, los cuales se desarrollan cada uno en un apartado distinto de este documento: el círculo virtuoso de la innovación de la universidad 4.0, la cuarta revolución industrial (4RI) como contexto de la universidad 4.0 y el currículo inteligente 1.0 de la universidad 4.0. Una de las conclusiones a las que se llega es que la universidad es un organismo natural y digital que genera innovaciones inteligentes blandas y duras.

Palabras clave: currículo, innovación, inteligencia, revolución industrial, universidad.

Abstract

Writing about the future of the university is an exciting task because we are at the point of inflection between past and future, a known past and an uncertain future. A university between the bricks tradition and the digital emergency, certainties vanish with the way knowledge and academic productions flow, and the new surprises the form and dynamics of the connection between the sources of knowledge incorporated in the curriculum This document addresses the present and the transition to the future of the university, three points are the axes of the argument that are developed in the three sections of the document: the virtuous circle of innovation of the university 4.0, the fourth industrial revolution as context of the university 4.0 and the intelligent curriculum 1.0 of the university 4.0. One of the conclusions is that the university is a natural and digital organism that generates soft and hard intelligent innovations.

Keywords: curriculum, innovation, intelligence, industrial revolution, university.

Resumo

Escrever sobre o futuro da universidade é uma tarefa empolgante porque estamos em um ponto de virada entre o passado e o futuro: uma universidade entre a tradição dos tijolos e a emergência digital. As certezas desaparecem com o modo como o conhecimento e as produções acadêmicas fluem; e o que é novo é surpreendente em termos da forma e dinâmica de conexão entre as fontes de conhecimento incorporadas no currículo. Este documento aborda o presente e a transição para o futuro da universidade. Três pontos são os eixos do argumento, que são cada um desenvolvido em uma seção separada deste documento: o círculo virtuoso de inovação da universidade 4.0, a quarta revolução industrial (4RI) como contexto da universidade 4.0 e o currículo Smart 1.0 da universidade 4.0. Uma das conclusões é que a universidade é um organismo natural e digital que gera inovações inteligentes suaves e duras.

Palavras-chave: currículo, inovação, inteligência, revolução industrial, universidade.

Introduction

From the digital transformation, the university ceased to be what it was before. No doubt this change has a slight parallel with the Kafkaesque metamorphosis. Recall that in the Metamorphosis of Franz Kafka, Gregory Samsa dawns one day turned into a monstrous insect, into a living being totally different from what it was before sleeping. In a matter of a few hours of sleep, Samsa had changed completely. So it is with the university, it has undergone a metamorphosis overnight; It has been transformed into something different from what it used to be. The university has become an intelligent organism, in university 4.0.

The 4.0 university in the world has a variety of experiences that are underway; On all continents there are documents about the future of university studies. There is also a widespread concern: Can the university survive the intelligent world as a result of the advances in digital technology brought about by the fourth industrial revolution (4RI)? Is it possible to think of the university of the future as a smart one that has started its emergence at the 4.0 university? Now there are more doubts than certainties, although, yes, the answers can be found in the actions that are to come.

In the university context a watershed of striking dimensions is drawn. The central idea that is maintained in this text is that there is no corner of the university that does not undergo profound changes with the use of new communication technologies and new learning technologies. Academic life is renewed along with its productions, processes and tasks; training, teaching, learning, research, curriculum, etc., everything is being disrupted by innovation. When you read the documents of the future of the university you will find innovations everywhere.

To give an account of this future, an expositive text was chosen, since it allows a composite narration between empirical evidence and imaginative freedom to visualize a possible future. A dose of reality and another of science fiction. Thus, several documents from universities around the world were worked on and the creativity was strengthened to give form to the university 4.0 in which the intelligent curriculum 1.0 is promoted.

Among the experiences of these universities that are offered in the development of the text are those of Stanford, the Massachusetts Institute of Technology (MIT, for its

acronym in English) and the University of Sydney, leading academic institutions that are preparing strongly for exist in the future. It is known that these are moving from the virtuous circle of innovation to the virtuous circle of intelligent innovation. It should be specified that these circles maintain a different formula: the first circle promotes the $I + D + i$ formula (where I is equal to research, D to development of innovation), and when it comes to professional training the formula is $F + I + D + i$ (where F is added, which is equal to training); the second circle, on the other hand, generates the formula $ia + I + D + ii$ (where ia is added, equal to real and artificial intelligence, and ii which corresponds to intelligent innovation).

Later, when reaching the conclusions, a mixture is made between interpretation of the documents of the future of the consulted universities and imaginative entertainment: the visualization of the university environment in a near future. The representative conclusion of the work is that the university is an intelligent organism that resembles a Matrix composed of human intelligence and artificial intelligence and that is articulated from two elements: 1) the intelligent curriculum that offers freedom in the formations and in the academic innovations and 2) scientific and technological innovations. Finally, this text is divided into three sections: the first addresses the virtuous circle of innovation; in the second, the context of the 4.0 university, and in the third, the intelligent curriculum 1.0 is worked.

The virtuous circle of innovation in the university in transition to the future

The debate about the future of the university can not be postponed before the challenges of the 4RI, where the developments of technology, physics and biology converge. The archetype of the monolithic university, conformed by disciplinary islands centered on essentially theoretical teaching, with atomized contents disconnected from real problems and with educational informational practices that encourage repetitive and contemplative learning, which are also of low impact in the elaboration of practical contributions and lack of linkage in the solution of factual, empirical and human enigmas, this archetype, as it was said, is on the way to extinction.

The university in the knowledge society is forced to reinvent itself because otherwise, with its traditional model, it will be unable to respond to the needs and challenges of an increasingly dynamic world. Recent experience shows a historical truth: universities that walk hand in hand with scientific and technological advances are the best positioned. By investing in research and development, they are creators of innovations and acquire prominence in the current innovative techno-scientific configuration.

When talking about reinvention, we talk about both the capacity for scientific development and the ability for technological innovation. It is the faculty that the university has to grow, be a participant in the opening and in the solution of the challenges present in the new fields of knowledge, such as cognotechnology, biotechnology, nanotechnology, photonics, optoelectronics, superconductors, artificial intelligence, augmented intelligence and robotics, among others. To achieve reinvention, the university must bring into play and encourage innovation in teaching and learning, always based on scientific research, while promoting new forms of organization, new methods, new information technologies and learning .

In effect, the trend of university education in the 4RI points towards the innovative university based on research. The innovative university is what makes research its main axis of development. From the above, it also appears that the research is promoted in a double plane: 1) research for scientific-technological innovation and 2) research for academic innovation. On the one hand, new knowledge is provided; and on the other hand, the learning-teaching system is redefined. This results in a university model characterized by a dynamism of feedback between these two aspects. The best ranked universities are those that promote precisely this flow.

The data support the fact that innovative research-based universities provide the most patents in the field of science and technology. In the world ranking Worl's Most Innovative Universities 2017, published by Reuters, the top 100 is made up of 51 universities in North America, 26 in Europe, 20 in Asia and 3 in the Middle East. The universities that are in the top 10 places, within the period of five years considered by Reuters, with more than 70 patents registered in the World Intellectual Property Organization (WIPO).

Tabla 1. Las 10 universidades más innovadoras

Lugar	Universidad	País
1	Universidad de Stanford	Estados Unidos
2	MIT	Estados Unidos
3	Universidad de Harvard	Estados Unidos
4	Universidad de Pensilvania	Estados Unidos
5	Ku Leuven	Bélgica
6	KAIST	Corea del Sur
7	Universidad de Washington	Estados Unidos
8	Sistema Universitario de Michigan	Estados Unidos
9	Sistema Universitario de Texas	Estados Unidos
10	Universidad de Vanderbilt	Estados Unidos

Fuente: Reuters (2017)

The North American universities -as can be seen in Table 1- are world leaders in scientific and technological innovation: they occupy eight places within the top ten; Representatives from Belgium and South Korea complete the summit (evidence of unequal development among the universities of the world). This leadership in the scientific-technological innovation would be unthinkable without the accompaniment of the academic innovations that they have made. Both, scientific and academic, make up the virtuous circle of innovation in the training of professionals and scientists.

In the case of North American universities, the virtuous circle of innovation has been part of its modern history. As proof of this, we find the report Reinventing Undergraduate Education: A Blueprint for America's Research Universities, published in 1993 by The Boayer Commission on Educating Undergraduates in the Research University. The research universities referred to in this publication have an international and interdisciplinary profile: they attract postgraduate students from various countries, incorporate them into research work and teaching at the undergraduate level; to these types of universities belong the eight leaders mentioned above.

The report, then, contained 10 recommendations for educational institutions of this type, among which were: promoting research-based learning, eliminating barriers that limited interdisciplinarity, developing reading and writing skills for research work, use information and communication technology creatively to provide new research experiences, involve graduate students in undergraduate teaching and create a sense of community.

These recommendations were elaborated based on successful experiences. For example, at Stanford University they had an interdisciplinary research-based program from the first year of training; MIT had the Research Opportunities Program for undergraduate students, who, thanks to this, could work as members of the faculty or as members of independent projects, and at Harvard University had learning techniques for discovery.

However, with the arrival of the 4RI, despite the achievements of the research universities, it was considered and still considered a priority to rethink the future of university organizations in the face of scientific and technological dynamics. With coinciding views, the North American universities propose to strengthen the virtuous circle of innovation by redimensioning the importance of academic initiatives in the generation of new knowledge, in the development of new technologies and in the revaluation of learning and teaching models.

In that sense, several initiatives have been launched that address the future of the university, not only from North America, but as a shared global action. The direction assumed by the world changes in the university coincides in aspects such as the following:

- Pedagogical transformations: the range of learning methods based on research-innovation and on dynamic and interactive teaching methods is widened.
- Innovation in the modalities: the offer is diversified with the opening of modalities, mixed, open, distance and virtual.
- Changes in learning technologies: the use and design of learning technologies is diversified when considering online learning, mobile learning, grammar and data intelligence.
- Curricular innovations: from the flexible curriculum to the interactive curriculum.

As can be seen, the emphasis is placed on the research-innovation binomial, which includes the renewal of processes and academic actions to respond to current and future challenges. For example: in Russia, since 2005, the 4.0 university model has been proposed. This model is aimed at capitalizing knowledge to renew the ecosystem of higher education through the promotion of basic and applied research and the strengthening of the infrastructure for innovation, as well as linking research-innovation with economic

development and efficient marketing. Engovatova (2016), a student at the 4.0 university in Russia, points out that universities are essential institutions for research-based innovation.

> The new role of universities in the knowledge society is their contribution to the development of the country's innovation (...). Universities not only fulfill the function of research and development, they also actively create their own technologies, establish technological companies and are leaders as centers of creation of new industrial technologies" (p. 5).

The 4.0 university is conceived as a source of knowledge and a provider of talents for the future. And as its name anticipates, it is based on four aspects: 1) in a new work model conceived as a source of knowledge in matrix and participant in the new markets, which also entails a new perception among university graduates with the industry; 2) to deepen international cooperation because the university is considered as an important actor that participates in the knowledge market and that can create international campuses to compete; 3) it tends to capitalize knowledge through acquiring intellectual property rights, and 4) it focuses on the transfer of new values, on creating new academic environments and on promoting ventures. As Laptev (2016) points out, the university constitutes a fundamental source of knowledge:

> The ability to commercialize scientific research - by the university - is directly connected to the competitiveness of global high-tech businesses. To preserve their competitive advantage, leading companies have to constantly design new innovative products in the market (p. 10).

In summary, the approach of the university of the future in Russia consists in promoting the research-teaching binomial for innovation with an impact on the market, as well as in consolidating international ventures, alliances and consortiums as sources of knowledge for the leading companies in high technology.

Not far from there, the university in China is reformed according to the changes of Industry 4.0 of the German model, replicating the success of American universities. On the one hand, the Made in China 2025 report identifies four key points for the future of the industry: 1) the industry should be strengthened with the innovation provided by the university; 2) achieve efficiency in an integral way of the industry with ecological development; 3) establish international standards to protect intellectual property rights as

part of its commercial strategy, and 4) the priority of developing 10 high technology sectors (new advanced information technology, automatic machines and robotics, aerospace and aeronautical equipment, maritime equipment and high-tech shipping, modern railway equipment, vehicles and new energy equipment, power equipment, agricultural equipment, new materials and biopharma and advanced medical products) (Gómez, 2016, p.5).

On the other, China established the Double World Class project for the renewal of the university sphere. Its goal is to build 42 world-class universities and centers of global specialties in 95 universities. In this way, China is oriented towards the future with the creation of a transnational university based on fusion and rationalization; the fusion of more than seven hundred technological institutes and the rationalization with the opening of more than a hundred new institutions. The objectives of the development of the university in China, on the other hand, are four: 1) international mobility of students to print the quality mark of the studies (Study in China); 2) improve the quality of cross-border education; 3) Raise the international standing of Chinese universities in the world by creating new university campuses and world-class disciplines and encouraging global alliances with leading universities in the world, and 4) strengthen international cooperation (Quality Assurance Agency for Higher Education [QAA], 2017, page 5).

However, a little further, the university in South Korea has focused on high technology with support in cooperation with industry. Currently, this country is a leader in research and development worldwide. To this leadership in the field of university science and technology, the intention to attend to educational innovation is now added. Consequently, the Futura University forum referred to the virtuous circle of innovation: introducing, together with advances in data intelligence and artificial intelligence, creative learning, problem-based learning and interdisciplinary studies.

In general terms, universities plan for the future a disruptive model based on the use and development of high technology in industrial sectors with competitive advantages, which transforms market relationships and social environment, as well as the way in which human beings relates to their technological productions. Likewise, reference is made to the complementation or overcoming of human capabilities, which has been named as posthumanism.

However, the disruption is also inward. By changing to new forms of use and development of new technologies for learning in their different expressions, within the practice of teaching in its various forms of academic training, soft technology acquires new tonalities to make way for a vision of complex thinking and open communication among the disciplines that make up the structure of the curriculum 4.0.

Thus, the disruptive university feeds back on the virtuous circle of innovation, transforming academic processes and practices into the training of human resources prepared to develop high technologies; This opens up the unprecedented market for hard technologies and soft technologies in the context of the 4RI.

The 4RI, context of the university 4.0

As is well known, the 4RI concept is used to express the disruption of new technologies, new processes and new relationships between people and technological advances. Although it was coined in Germany in 2011, it had to go through a journey through various institutions and authors to achieve the popularity it has today. In 2013, for example, it was resumed by the National Academy of Sciences and Engineering (ACATECH) of Germany in the dissemination of its strategy to implement the changes towards Industry 4.0. And in 2016, Schwab socialized and disseminated his ideas through a book called The Fourth Industrial Revolution.

Byung-Chul Han (2014) expresses that we are facing a radical change of paradigm; a change that is intoxicating and that, nevertheless, happens without grasping the consequences of drunkenness. A society is configured where there is no "we" or a soul or a collective spirit; just a multitude of isolated individuals that are part of the digital swarm. The digital is the extension of the human being, an individual absorbed, amazed and enchanted by the lights, the sounds, the unifying images; is a Homo electronicus, technology has become an extension of the body and nervous system. This is what McLuhan (1996) points out: "This power of technology to create its own demand is not independent of the fact that technology is in the first place an extension of the senses and the body" (p.88).

However, more than two decades of these words of McLuhan, technology now is not only an extension of the human being, but is on track to overcome women and men. New technological species are being created: cyborg (combination of evolved organism and machine), robot (electromechanical device), android (electromechanical device with anthropomorphic characteristics), humanoid (robot with human form), humborg (organic parts and technological parts), symborg (symbolic organisms), bio-orga (Homo sapiens modified proteinically), silorg (made of silicon).

There are different voices that consider that we are on the threshold of a new era characterized by the disruption of the human and the emergence of artificial forms of life. Fiction becomes reality with the tendency toward the artificial evolution of humanity. It is an undeniable fact that in the near future the coexistence of the human will be with new artificial and complementary species, human beings improved and artificially created: the Homo roboticus, Homo digitalis, Homo transistoricus, Homo artificialis, Homo sinteticus, Homo graphenus, Homo cyborgensis, Homo ciberneticus (Hérnandez, 2017, page 26), or Homo tecnologicus (Navajas, 2016, page 11) or with the generic name of Humanization-Cyborg (López Velarde, 2017, page 11).

Even some of these new forms are already a reality. Schwab (2017) points out the existence of inflection points in the megatrends; mentions that in the World Economic Forum [WEF, for its acronym in English] 2015, 21 disruptive technological changes were identified that have transformed and transformed the map of relationships in society, which include different areas and objects, such as connected clothing Internet, unlimited data storage, a billion sensors connected to the Internet, the first robotic pharmacist, the first glasses connected to the Internet, the increase in the digital presence of people, the first car printed in 3D, the population census in big data, mobile phones implanted in the bodies, the start of 3D printed products, the fact that practically everyone uses smart phones, the widespread use of the Internet, the beginning of the era of smart cars, the first liver transplant printed in 3D, corporate audits based on artificial intelligence, tax collection through blockchain , use of smart appliances, car sharing, the start of storage of gross domestic product (GDP) with blockhain and the start of artificial intelligence in executive meetings (pp. 43-44)

Two years later, in the WEF 2017, it was mentioned that the disruption of technological change is associated with the development of emerging technologies and the positive impacts and planetary challenges that they bring with them and that imply alterations in styles and ways of life. We also identified 12 emerging technologies, similar to those mentioned by Joyanes (2018), who takes them from The Boston Consulting Group report, namely: 3D printing, advanced materials and nanomaterials, artificial intelligence and robotics, biotechnologies, intelligent electrical networks, cryptographic systems, cyber-security and cybersecurity systems, geoengineering, the Internet of things and the Internet of everything, neurotechnologies, quantum and neural computing, space and drone technology and virtual reality , augmented or mixed reality (WEF, 2017, page 43, Joyanes, 2018, page 38).

The 4RI transforms the map of the professions; new ones of these associated to the high technology emerge to respond to the dynamics of work in the ecosystems of the Smart Factory or Industry 4.0. Professional relationships demand people versed in emerging technologies in all fields; Traditional professions tend to be updated by incorporating technological advances into their training and performance. Likewise, digitized professionals (PD 4.0) are required for the professional market. Consequently, the university of the future has to train scientists and technologists for the renewal of the virtuous circle of innovation; the traditional R & D formula is incomplete without innovation; the new formula that should be promoted in university 4.0 is R + D + i. Furthermore, adding the professional training of the future, the complete formula is F + R + D + i (training + research + development + innovation); Future professional training based on research to promote scientific and academic development and innovation.

The university of walls and borders is increasingly being questioned by its slow pace, by its heavy bureaucratic burden, by its excessive expenses in academic plants anchored in the meritocratic logic, by its practices of corruption and misappropriation of funds, because they are still located in the rationality of the evaluation, for its low investment in the R & D formula, for not considering innovation in its disruptive sense and for its scarce participation in the changes of the 4RI. On the other hand, the university according to the disruptive panorama tends to an unprecedented model with different practices. And while

the generic name is still not clear, Chistine Ortiz, MIT's ex-dean, for example, calls it the university without a chair; in Russia they talk about university 4.0, and others call it precisely disruptive university, here it is chosen to name it 4.0 university with intelligent components.

Independent of this diversity of names with which this new model is designated, there are coincidences in identifying its main academic innovations. Mintz (2014) highlights the following:

- New modalities: Hybrid models, synchronous and asynchronous virtual models, configurative models of on-demand training itineraries, Station 1 model and just in time model.

- • New certifications: Certificates in a short time, less than two years (badges, nanogrados and MicroMasters).

- • New pedagogical practices: Problem-based learning, research-based learning, project-based learning, grammar, personalized learning and flipped classroom (inverted learning).

- • New roles of the teacher: Innovative teacher, guide and facilitator and teacher learning architect.

- • Innovations in new educational technologies: virtual laboratories, digital neuro-learning laboratories, holographic simulations and presentations in seventh dimension (7D).

- • New assessment strategies: formative evaluation, performance-based evaluation, multiple intelligence assessment and innovation-based evaluation.

- • New student support models: proactive learning models, open tutorial model, feedback models and peer mentoring model.

- • Technological collaboration networks. More and more universities can share services and technologies with each other, in order to potentiate their processes and results of learning and scientific and technological contribution.

- • Curricular innovations: This is a key point for the disruptive change in the university because it upsets the entire university system, from the modalities for credits and competences to the design of disruptive curricula.

One aspect that stands out in these academic innovations is the redefinition of teaching-learning because it disrupts several points of the model, as well as university academic processes and practices. The tendency of teaching and learning is towards an adaptive model. Teachers are renewed by the increasingly assimilated use of mixed intelligence in the classroom and beyond. Many examples of this are underway. Stanford University, through the Howard Hughes Medical Institute, promotes a teacher program that consists of developing research skills in undergraduate students through the resolution of real problems that includes an intense exchange abroad. The University of Oregon develops adaptive learning in courses with high dropout rates; offers a proactive learning program overcoming remedial practices, uses technological tools. In the German university context, learning is linked to the strategy of promoting world-class science; in the Initiative of Excellence program, mention is made of guiding learning based on the development of creative potential. In England, the university develops blenden learning and inverted (fllipped), whose purpose is to encourage deep and active thinking based on problem solving.

Considering the global experiences of the renewal of the teaching-learning process and its connection with the virtuous circle of innovation, it is patented that the university of the future is a space that incubates solutions for the real challenges of the world. There is no recent renewal experience that excludes technology in the teaching-learning processes. In some more than others, there is contact with learning technologies; For the future of the university this trend will have to intensify and expand breaking the barriers of traditional campuses. The Report Horizon of 2017 highlights the trend and implementation of new learning technologies (see Table 2).

Tabla 2. La tecnología educativa en la universidad

Tendencia			Implementación		
Largo plazo. Cinco o más años	Mediano plazo. Tres a cinco años	Corto plazo. Uno a dos años	Largo plazo. Cuatro a cinco años	Mediano plazo. Dos a tres años	Corto plazo. Un año o menos
Avance de las culturas de innovación	Crecimiento del interés en la analítica del aprendizaje	Diseño de aprendizaje híbrido	Inteligencia artificial	Internet de las cosas	Tecnologías de aprendizaje adaptativo
Enfoques de aprendizaje más profundo	Rediseño de los espacios de aprendizaje	Aprendizaje colaborativo	La interfaz natural del usuario	La próxima generación de los sistemas de gestión de aprendizaje (LMS, por sus siglas en inglés)	Aprendizaje móvil

Fuente: The New Media Consortium [NMC] (2017, p.3)

As can be seen in table 2, there is no waiting time for the implementation of technologies in the teaching-learning process. In five years a new mosaic will be present because the options will be diversified with the consolidation of cultures of innovation through artificial intelligence and the Internet of things with redesigned, deep, adaptive, collaborative and mobile environments. The Millennium Project team performs a prospective, similar to the Report Horizon, of an intelligent university enrolled in the cutting-edge vision of highly technological teaching-learning; by 2050 an acceleration of technology and research is expected and with it a new generation of scientists (called enhanced geniuses) in the face of the growing mixed intelligence that will be part of cyborg humanism. The Millennium Project talks about the following:

Fundamental changes in education and learning will be critical as well as low costs, universal artificial intelligence, robotics and other technologies will transform the nature of work for the next generation or two. Some believe that without the fundamental changes in education and learning the world could face 50% technological unemployment by 2050. If intelligent technology replaces human labor then many argue that education and learning will only focus on creativity, problem solving, entrepreneurship, tolerance, compassion and the increase of intelligence. Meanwhile, as the technological requirements for employment are increasing, we need to dramatically increase our S & T programs (systems and telematics), engineering, mathematics and software.. (Glenn, 2015, p. 116)

The prospective is that globally it will move from the knowledge society to the mixed intelligence society: one between human intelligence and artificial intelligence that will impact the university to the degree of creating a positive and creative disruption of teaching and learning. Fiction made reality with the brain society, with super intelligence from genetically modified brains and with brain technological implants. In this regard, it is not free to bring the following quote here:

The functioning of the brain or intelligence could be increased by the combination of improved nutrition and reasoning exercises, believing that the increase of intelligence is possible (placebo effect), responding to feedback, consistency of love accompanied by the diversity of the environment , contact with smart people via Internet avatars, brain-improving drugs, software and games, memes (intelligence is sexy) and stimulating low-stress environments, with certain music, colors and fragrances that improve concentration and performance. The understanding of partial brain mapping and other methods could dramatically increase personal intelligence and longevity. In a more remote future, brains could be genetically improved and bacteria by designer via synthetic biology could repair brain damage and make brain cells work more efficiently. With the use of public communications to reinforce the search for knowledge and the use of these learning innovations and concepts, the intellectual and collective intelligence society could improve (Glenn, 2015, p. 117).

The university in this scenario will play an essential role as a constructor of highly technological brains to develop this super social intelligence. The future of the university, then, will reside in a short time in the formula F + I + D + i to prepare in three or perhaps in

two generations the formula ia + R + D + ii (intelligence + research + development + innovation intelligent). The basis of professional training and scientists will be intelligence and the result of research and development will be intelligent innovation. Although in the short term it is necessary to consolidate the virtuous circle of innovation, in the long term it will be fundamental to move to the virtuous circle of intelligence. So it's appropriate to say that we are at the intersection of the smart university with the 4.0 university

The 4.0 university represents the improvement of the university of bricks and of the university of paper, as already mentioned above. It is a superconnected university capable of generating intelligent communities in open, autonomous and dynamic learning environments. Undoubtedly, as in the economic system, there is no pure model but the coexistence between different models: the same will happen with the 4.0 university model that, although it will coexist with previous models, will be the predominant one.

As part of the advancement of the virtuous circle of intelligence is the curricular innovation that is oriented, similarly, towards the intelligent curriculum 1.0, characterized by the connectivity between virtual networks and physical space inside and outside the university campus. The curricular disruption consists of form and content: in the form, freedom and educational justice stand out in the conformation of curricular itineraries according to the needs and dispositions of the student, always in communication with the teachers as nodes of learning goal; and in the content, cross-border knowledge overcoming the artificial barriers of the disciplinary bodies, a complex thought that conceives reality as articulated in various aspects and processes that are independent and complementary to each other. The history of the intelligent curriculum 1.0 begins writing with the university 4.0.

Curriculum disruption towards intelligent curriculum 1.0 in university 4.0

The concept intelligent curriculum 1.0 describes the changes in the design, structure and curricular itineraries from computerization. With the development of information and communication technologies (ICT) and with the innovation of learning and knowledge technologies (TAC), the curricular and training trajectories of the university space are transformed. From the rigorous curricular prescription designed without or with little

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participation of the student, one moves towards unpublished forms where the student is protagonist of his curricular itinerary.

There are different ways of periodizing the history of the curriculum: from the history of the curricular codes classic, realistic, moral, rational and invisible (Lundgren, 1992); based on the history of the relationships between theory and practice and the relationships between education and society (Kemmis, 1993); in accordance with political and social change (Kliebard, 1992); according to the normative, technical-scientific, explanatory, critical, practical or research curricular theory (Arellano, 2006), or as a social history that integrates diverse perspectives according to the historical moment (Mora-García, 2013). In these classifications the prescribed curriculum has prevailed. The specialists in curriculum design and development and the teachers have been the essential actors, while the students have had a minor role.

There is another periodization that considers the freedom of choice on the part of the student to design his curricular itinerary based on his interests, dispositions, times, rhythms and competences. This periodization identifies three curricular models: rigid, semi-flexible and flexible (Pedroza, 2001). The freedom of choice on the part of the student becomes less to more in these types of curriculum. In the rigid one, the freedom of choice is reduced to the elective credits; in the semi-flexible, to the elective credits and to the exit of specialization, and in the flexible, the horizon is extended with internal and external mobility.

Now, with the development of ICT and the aforementioned TACs, we are opening up to a new curricular classification: the interactive curricula. Loveless and Williamson (2017) point out that a new curriculum based on digital interaction is underway, which they call neoprogresismo en red. They mention three experiences of this type of curricular model: Enquiring Minds (United Kingdom), The New Basic (Australia) and Quest to Learn [Q2L] (North America). These models have different features:

- Centrality in the student, because he has greater freedom of choice.
- They are dynamic and interactive systems between the human being and the computer.
- The contents are organized around complex problems and are structured with a specific scaffolding that offers the student a just in time learning.
- Represent a reflective project of self-improvement and self-realization on the part of the student.
- The school is considered as a node part of an interconnected system in networks.
- They are based on inquiry and creation of learning communities.
- The Q2L curriculum conceptualizes students as sociotechnical engineers with analytical and holistic thinking.
- Interactive curricula generate a hidden curriculum that encourages digitally mediated learning.

Other experiences in the world connect the interactive curriculum with the generation of a hybrid society where the digital and the real overlap. There is talk of an increased socialization (Reig, 2012): social spaces are now with ICT and TAC, wireless spaces, people are interconnected to their physical reality and their digital reality through social networks, videoconferences, mails, etcetera; subjects create offline and online relationships. This type of experience is already underway in England and Spain.

Fung (2017) is an author and proponent of the connected curriculum. He starts from the symbiosis between teaching-learning and research to create a more connected relationship between students, researchers and the real world from an interdisciplinary perspective. It proposes a learning based on research and inquiry, characterized by having six dimensions: 1) students connected with researchers and research spaces, 2) connection of each program with a line of research, 3) students connect the contents of learning with the real world, 4) students connect academic learning with the learning demanded in the world of work, 5) students learn to produce research results that are evaluated by the members of the faculty and 6) the students are connected to each other throughout their training and even once they graduate. With technology these dimensions are potentiated, they connect with online learning.

Fung also supports the English experience of the connected curriculum; accentuates student connections and potentiates interdisciplinary learning with the integration of educational technology. The London's Global University (LGU) contributes to this experience; He holds the degree The Arts and Sciences (BASc), an interdisciplinary curriculum that combines courses in science, humanities and social sciences, made up of central, main and secondary modules. The central modules articulate the different areas of knowledge, composed of the courses that provide skills and concepts to work multiple disciplines to the students and that are studied throughout the four years of the curriculum plan; the main modules include the specialty in one of the four options offered (Cultures, Health and Environment, Science and Engineering), composed in turn by three modules; and the modules correspond to one of the four options mentioned as complementary training.

Harvard University, meanwhile, makes an important curricular reform and comparable to that made in the post-war period when he published General Education in a free society. Now the curricular reform at the undergraduate level returns to strengthen the principle of free education and highlights attention in the humanities. The general education curriculum includes courses in eight categories: 1) aesthetic and interpretative understanding, 2) culture and belief, 3) empirical reasoning, 4) ethical reasoning, 5) science of living systems, 6) science of the physical universe, 7) societies of the world and 8) United States and the world. The purpose of this curriculum is to develop in the students the criticism and intellectualization of the world in its scientific, humanistic, artistic and cultural manifestations.

The universities of Oceania, like those of the rest of the world, also make curricular innovations. An example is the Wester Sydney University (WSU). In the year 2017, the WSU published some guidelines for its curricular reform in the document entitled Project Plan Overies: 21st Century Curriculum Project. In this document, it is foreseen that by 2020 alternative credentials will be offered, not necessarily from traditional degrees, since there will be new innovative degrees that meet the needs of future work. This on four axes: 1) strengthening existing grades, 2) creating new degrees with new curricula, 3) promoting new alternative credentials and 4) testing curricular renewal (WSU, 2017, p.2).

In general, the outline of the curricular disruption from the global experiences set in motion by the universities consists of a map of itineraries without the rigid disciplinary barriers (disciplinary dialogue: from the multidisciplinary to the transdisciplinary), open to creative participation of the students (curriculum partners or curricular co-creation) and aware of the modalities of disruptive learning (inclusive, open, ubiquitous and personalized).

Conclusion: University 4.0 with intelligent curriculum 1.0

The curricular disruption of the 21st century means a paradigmatic change in the training of professionals and scientists and technologists. It is the first version of curricular innovation based on intelligent technologies within the model of university 4.0, which has improved its technologies and digitalized practices. It is one of the many revolutionary innovations that will come in the future. For all the above, there is no doubt about the relevance of the idea of the intelligent curriculum 1.0. Equally undeniable is the fact that the beginning of the artificial age of learning, together with the undertaking of the intelligent curriculum 1.0, have disrupted in a disruptive way the curriculum dominated by human intelligence, centered on the thinking department and the teacher as sources storage and knowledge and information providers.

The 4.0 university is oriented, therefore, towards the creation of intelligent innovation in the field of science and technology and in the field of university academic life with the renewal of learning-teaching based on an intelligent curriculum 1.0, where the human intelligence and artificial intelligence acquire the prominence of being and the meaning of the university. The university 4.0 has a different version of its essence with respect to professional training: from the traditional vision anchored in the walls that protected the knowledge in libraries and classrooms, now it is transited to the unlimited vision of knowledge with the digitized reality. The remastering of knowledge accumulated in the past and the emergence of new knowledge is underway.

University 4.0 is an institution without walls. The future of the traditional university lies in opening up to the present reality boosted in the short, medium and long term; Free yourself from the linkage of neo-skill learning based on competencies and the promotion of evaluation as the only way to verify achievements. The university 4.0 is tending to become

an organizer of training and learning, which will design the complex architecture of the collaborative and participatory co-creation network between human nodes and intelligent nodes that will exchange and build teaching and learning.

No doubt it seems an approach from science fiction, with a high dose of imagination; Maybe it is because reality is surpassing this literary genre. For now, the future of the university incubates the formula ia + I + D + ii, where:

- *ia is a shared intelligence or mixed between the natural and the artificial. The boundaries between the two is a thing of the past. It is, on the contrary, interconnected in real time and inserted into the dynamics of co-creation, both in physical and artificial learning environments. Therefore, it comes from the subjects, cyborgs and robots that shape the 1.0 curriculum.*

- *I is research as exploration and concretization of the unknown in content and creative forms based on a re-functionalization of the scientific method with edupunk style epistemologies, that is, destroy the rules, create yours and then destroy them once again because they are solid forms of knowledge vanishing in an emergent way.*

- *D, on the other hand, is technological development. It has the plastic property, since, being soft or hard artifacts, they are permeable to disruption in progress, that is, technological advances are dynamic with a short duration before the dynamism of co-creation.*

- *ii is, finally, the intelligent innovation for a cyborg humanization that coexists with university spaces and scientific, technological, cultural and artistic co-creation, with Internet of things, mixed realities and objects in 7D.*

University 4.0 is a disruptive university that contains an intelligent curriculum 1.0: everything is related to everything, each part is independent of the whole and acquire senses once they flow with each other. It is not a play on words, the curriculum 1.0 is a Matrix because it is a global network of interactions composed between the natural and the artificial that form knowledge stations and that, with the flow of interconnected learning, open the way to new knowledge and technologies . Thus, the curriculum 1.0 has three properties: 1) it is a self-regulated learning organism to acquire a flexible profession with

unpublished certifications, 2) it is an open node where knowledge flows and 3) it is an interchangeable space between nodes from the orientation of the training established by the university 4.0. We reach the future.

References

Arellano, A. (abril del 2016). Concepción del currículo. Artículo publicado por la Universidad Pedagógica Nacional. Guerrero, México, abril del 2016. Recuperado de https://www.gestiopolis.com/antecedentes-historicos-del-origen-evolucion-del-curriculum/.

Engovatova, A. and Kuznetsov, E. (2016). A Plan for the Grow of the Knowledge Economy in Russia. In Russia Direct. From University 1.0 to Universuty 4.0. *Nurturing Innovation and Entrepreneurship in Russian Academia, 4*(8).

Fung, D. (2017). *A connected Curriculum for Higher Education*. London, England: UCL Press.

Glenn, J. (2015). *2015-16 Estado del futuro*. Nueva York, Estados Unidos: The Millennium Projet.

Gómez, E. (2016). *Plan Made in China 2025*. Madrid, España: Oficina Económica y Comercial de la Embajada de España en Pekín.

Han, Byung-Chull (2014). *En el enjambre*. Barcelona, España: Herder Editorial.

Hernández, G. (2017). Homo roboticus. Ensayos sobre creatividad científica en Biología. México: Siglo Veintiuno Editores.

Joyanes, L. (2018). *Industria 4.0. La cuarta revolución industrial*. México: Alfaomega Editorial.

Kemmis, S. (1993). *El curriculum: más allá de la teoría de la reproducción* (2.ª ed.). Madrid, España: Morata.

Kliebard, H. (1992). *Foring the American Curriculum: Essays in Curriculum History and Teory*. New York, United States: Routledge, Chapman and Hall, Inc.

Laptev, G. (2016). The Process of Russian Educational Reforms is Underway. In Russia Direct. From University 1.0 to Universuty 4.0. *Nurturing Innovation and Entrepreneurship in Russian Academia*, *4*(8).

López Velarde, V. (2017). *E-Corpus iCorpus (Arte y tecnología). Nuevos conceptos a las relaciones entre el cuerpo y la tecnología.* México: Editorial Fontamara.

Loveless, A. y Williamson, B. (2017). Nuevas identidades de aprendizaje en la Era digital. Madrid, España: Narcea.

Lundgren, U. P. (1992). *Teoría del curriculum y escolarización*. Madrid, España: Morata.

McLuhan, M. (1996). *Comprender los medios de comunicación. Las extensiones del ser humano*. Barcelona, España: Paidós.

Mintz, S. (2014). *The Future of Higher Education*. In INSIDE Higher ED. Recuperado de https://www.insidehighered.com.

Mora-García, J. (noviembre del 2013). Las reformas en la historia del currículo en Venezuela (El proceso de implantación de la Educación Básica 1980-1998). Artículo publicado por la Revista Historia de la Educación Latinoamericana. Tunja-Boyacá, Colombia, noviembre del 2013. Recuperado de https://revistas.uptc.edu.co/index.php/historia_educacion_latinamerican/article/view/2464

Navajas, S. (2016). El Hombre tecnológico y el síndrome Blade Runner. En la era del biorobot. Madrid, España: Editorial Berenice.

Pedroza, R. (enero-marzo del 2001). El curriculum flexible en el modelo de Universidad organizado en Escuelas y Facultades. Artículo publicado por la Asociación Nacional de Universidades e Instituciones de Educación Superior. D.F., México, enero-marzo del 2001. Recuperado de http://publicaciones.anuies.mx/revista/117/4/1/es/el-curriculum-flexible-en-el-modelo-de-universidad-organizado-en

The Quality Assurance Agency for Higher Education [QAA]. (2017). *Country Report: The People´s Republic of China*. United Kingdom: The Quality Assurance Agency for Higher Education.

The New Media Consortium [NMC]. (2017). *Horizon Report: 2017 Higher Education Edition*. Austin, United States: The New Media Consortium.

Reig, D. (2012). *Socionomía: ¿Vas a perder la revolución social?* Barcelona, España: Centro Libros PAPF.

Reuters. (2017). *The most Innovative Universities in the World*. Recuperado de https://www.reuters.com/article/us-amers-reuters-ranking-innovative-univ/reuters-top-100-the-worlds-most-innovative-universities-2017-idUSKCN1C209R.

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

Western Sydney University [WSU]. (2017). *Project Plan Overview: 21st Century Curriculum Projet*. Sydney, Australia: WSU.

World Economic Forum [WEF]. (2017). *Informe de los riesgos mundiales 2017* (12.ª ed.). Ginebra, Suiza: WEF.