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A hundred years of Córdoba: between techno-economic imperatives and the re-elaboration of knowledge

A cien años de Córdoba: entre imperativos tecno-económicos y la reelaboración de conocimientos

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Abstract
The Reform of Cordoba reinforced the social function of the university, allowing the development of its third mission (the Extension). In this article, urgent global socio-environmental problems and the situation of the productive structure of Latin America are discussed, and the most outstanding elements of the development of disruptive technologies and the emergence of the 4i are analyzed. All of them will have serious socio-economic implications for the region. The analysis of information from different sources shows that despite technological advances, unsustainable forms of production and consumption prevail. In this region, these problems are exacerbated by the predominance of an economic structure that still depends on the intensive exploitation of natural resources, which, if appropriate measures are not adopted, will worsen with the irruption of the new technological systems, this because it demands natural resources that abound in the region. An effective approach of socio-environmental problems requires the re-elaboration of generation forms of knowledge, assuming approaches that overcome the traditional ways of research incorporating diverse knowledge and social actors. It is proposed that the extension works as a conveyor belt for exchange information between communities and researchers to generate new agendas and contribute to develop spaces that allow the implementation of alternative ways of carrying out the activity. To this extent, the second mission of the university is also transformed

Keywords
Córdoba reform, socio-environmental crisis, extension, research.

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Resumen
Un elemento renovador de la Reforma de Córdoba fue el fortalecimiento de la función social de la universidad, dando cabida al desarrollo de su tercera misión (la extensión). Partiendo de ello, se discuten problemas socioambientales globales apremiantes, la situación de la estructura productiva de América Latina y se analizan los elementos más remarcables del desarrollo de las tecnologías disruptivas y la emergencia de la 4i, elementos que tendrán serias implicaciones socioeconómicas para la región. El análisis de la información de diversas fuentes evidencia que a pesar de los avances tecnológicos, prevalecen formas de producción y consumo no sustentables. En América Latina, los problemas se agudizan a consecuencia del predominio de una estructura económica que aún depende de la explotación intensiva de recursos naturales. De no adoptarse acciones adecuadas esta situación empeorará con la irrupción de los nuevos sistemas tecnológicos que demandan los recursos que posee la región. Abordar los problemas socioambientales de manera efectiva requiere reelaborar formas de generación de conocimientos, asumiendo enfoques que trasciendan los modos tradicionales de investigación e incorporando diversos conocimientos y actores sociales. Se propone, entonces, que la extensión, aparte de la proyección cultural, sirva de correaje de intercambio entre las comunidades y los investigadores para generar nuevas agendas y contribuir a la creación de espacios que permitan implantar formas alternativas de realizar la actividad. En esta medida, se transforma también la segunda misión de la universidad.

Palabras clave
Reforma, Córdoba, crisis socio-ambiental, extensión, investigación.

Introduction

The reform of Cordoba, apart from promoting transformations in the university that aimed at the autonomy and democratization of its forms of government, and from the academic point of view to the freedom in the subject and changes in the organization and teaching methods, it also meant the transformation of the relations with society, proposing a strengthening of its social function through which, in the end, was constituted in its third mission (the extension), and a greater concern for the national problems (Tünnermann, 2008).

After hundred years of this historic landmark of Latin American higher Education, the university comprises questions that mostly relate precisely to their scarce contributions to society on issues ranging from its low contribution to the economic-productive development to the scarce approach

of pressing problems like the social exclusion and the environmental degradation. Claims reflect a controversy about the nature and function that the university should have which confronts, with various nuances, two antagonistic positions: the one that considers it as a public and social good that must be counted among the priorities of the state (Hitner *et al*., 2017) and the one that conceives it as a private commodity (Williams, 2016) that is internationally tradable to such an extent that it has come to be discussed within the General Agreement on Trade and Services (AGCS) as a subject of its competence. It is clear that the guidelines adopted by the IES (Institutions of Higher Education) will have profound implications for the generation, transmission and ownership of knowledge. It is unquestionable that IES have an obligation to contribute to the economic development of their countries, especially when it is known that humans are moving towards a knowledge-based economy. But this constitutes one of several priorities and not —as it is intended to show in the model of entrepreneurial university— the main. So or more urgent is the approach of social participation and socio-environmental impacts derived from human activities.

It is recognized that after a century of the Reform of Cordoba, the Latin American University has played a decisive role in the social and cultural development of their countries. The extension of access to higher education has contributed to social inclusion, while allowing the conformation of important professional communities in the different areas of knowledge, especially traditional and —to a lesser extent— in the scientific and technological. But in a general way, it has not been able to accompany the international scientific and technological advances (Vessuri, 2004), contributing very little both to the transformation of an economic structure that presents a productive matrix strongly based on primary activities and marked conditions of dependence to propose solutions to important socio-environmental problems.

Such a situation presses for a review of its links with society. It is demanded that its functions exceed the disciplinary limits in the teaching-learning processes and research, for which, imperatively, it must transcend its "walls" actively engaging in the study and approach of social problems. However, it is in its slowness to adapt, both structurally and functionally, to the accelerated changes experienced in the various areas of society (Peñalver in Hitner *et al*., 2017). These include two for the IES: the acceleration of techno-scientific development —manifested in a series of disruptive technologies and the emergence of the fourth industrial revolution— and

recent movements of form re-elaboration of knowledge production that promote greater participation of communities, interculturality and the know-how dialogue (Hitner *et al*., 2017). The inescapable incorporation of both in their agendas will depend, to a large extent, on the willingness to introduce substantial changes in their nature and functions.

This article highlights briefly the orientations of the linkage with the society that raised the Reform of Cordoba, which serve as a fund to present a discussion on the most pressing global socio-environmental problems and the situation of the structure of the region, which make imperative their consideration by the IES. Subsequently, the most important elements of the development of disruptive technologies and the emergence of the fourth industrial revolution —which will have very significant socioeconomic implications— are analyzed and the redevelopment of the production forms of knowledge that press a review of the meanings and scope of the functions of these institutions. To conclude, changes in the orientation of outreach and research missions are suggested to confront the inescapable techno-economic challenges and new forms of knowledge production.

The social concern in the Reform

The Reform of Cordoba meant, first of all, an internal transformation of the university. Starting from questioning the traditional university model, it posed the obligation to bring the knowledge to the people. To contribute to the incipient process of social change that the region started to experience was the fundamental stimulus that established the guidelines of the Association of the University with the Society (Anuies, 1979 in Serna Alcántara, 2007).

In terms of interaction and social integration, the most important influence of the ideas of the reform was to open the possibilities of access to young people of less favored social strata: "To the children of the emerging social strata" (Tünnermann, 2008), especially during the 1960s, to the beat of the political events in the region; but this author points out that in the reform's manifestation, the social mission of the University is proclaimed and the university extension, whose function would be "the projection to the people of the university culture and the concern for the national problems" (Tünnermann, 2008).

This perspective is strongly rooted in these institutions. The extension as a means of projection (unidirectional) is the vision that has prevailed,

conceiving it as a socialization mechanism of the culture that is often limited to actions of cultural diffusion and extracurricular activities, and the provision of social assistance (Fresan, 2004). This situation would question the principle validity of the inseparable teaching-research-extension (Baptista and Kuenzer in Fresán Orozco, 2004), creating obstacles for a greater insertion of the university in the social area.

Nowadays, socio-environmental problems and the imperative of guiding societies towards more sustainable trajectories, pose a refocusing of linkages and a renewal of the extension that will have consequences on training and research. The university must overcome socialization strategies, promoting a more active citizen participation that serves as a leash to exchange information and knowledge that will help to focus these problems and contribute jointly to their resolution.

Socio-environmental crisis

The 2015-2017 triennials recorded the highest temperatures in history (WMO, 2018). The global warming scenarios projected by the IPCC for 2100 envisage that even decreasing the growth of greenhouse gas emissions (GHG) according to the commitments of the Paris Agreement (2015), this will not be less than 2 °C. The probable increment ranges are located between 2 and 4.9 °C, with an average of 3.2 °C and with only 5% probability that is less than 2 °C. The problem lies in the increase in the amount of GHG in the atmosphere from human activities (WMO, 2017).[1]

Increased temperature increases extreme environmental events. It is causing an increment in the level of the oceans and its acidification, which affects the biodiversity. The increase in the frequency of heavy rainfall, the net increase in rainfall, as well as the frequency and intensity of tropical hurricanes, are a verifiable effect of climate change. There is also evidence of an intensification of droughts and increases in desertification and the disappearance of glaciers (IPCC, 2012). Such a situation places hundreds of millions of people on the planet in extreme vulnerability, and most countries in Latin America and the Caribbean are vulnerable to these events.

1 In 2016 the concentration of CO2 reached historical records, ranking in 403 parts per million (ppm), 45% above the preindustrial levels. As methane reached 1 853 ppm (157% higher than pre-industrial concentration) and nitrous oxide at 329 ppm (22% higher) (WMO, 2017).

For its part, the growth of the exploitation of natural resources and the increase of the industrial production generate new xenobiotic substances that aggravate the pollution problem and the health of the living beings. For example, two million tons of wastewater and industrial and agricultural waste are discharged daily in the world's water courses and reservoirs, affecting the availability of drinking water. A significant percentage of solid wastes present low biodegradability and in some cases high toxicity. In 2015, approximately 6 300 million tons of plastic waste were generated, from which 9% were recycled, 12% were incinerated and 79% were dumped; about 13 million tons go annually to the oceans, producing the increasing affectation of the marine biota (Salleh, 2015). The projections estimate that by 2050 the generation of plastic waste will reach 12 000 million tons. Its ubiquity in the environment has caused this accumulation to be suggested as a geological indicator of the Anthropocene era (Geyer *et al*., 2017).

The main cause of these problems lies in the sustained expansion of traditional productive sectors and the emergence of new technological systems[2] under the paradigm of continuous growth, because they maintain —and even aggravate— the impact of exploitation and use of resources, and the consequent environmental degradation by pollution. For example, the obtaining of basic metals associated with the techno-economic paradigm based on the intensive use of materials and energy grew rapidly in this century, even above the economy in general. The production of iron grew 180% between 2002 and 2014, while the primary aluminum 108%. Similarly, the production of fossil fuels, although attenuated its growth rate, remains in extraordinary scales.The production of coal grew 66%, oil in 28% and the natural gas in 41%. Proportionately, the increase in GHG emissions is recorded, exacerbating, as indicated, the problems of global warming. Additionally, the development of disruptive technologies stimulates the production of new devices and new services that will broaden the demand for new materials (new commodities), especially in developed countries, exacerbating the exploitation of natural resources. Three chemical elements (lithium, niobium and tantalum) stand out for their functionality in the elaboration of the aforementioned devices, determining that the exploitation

2 The definition made by Hughes (1987) is used; it establishes that the technological systems are integrated by technical components (devices and production processes) and organizational (manufacturing companies, technical and financial assistance). It also integrates scientific and educational components, and even elements of legislation such as regulatory norms.

of the natural materials that contain them grows steadily. Between 2006 and 2014 (just eight years), the equivalent lithium production increased 86%, much higher than that of the economy (52%), while in niobium was 76%.

These results show that far from a rationalization of the exploitation of resources inherent to the previous techno-economic paradigm, this accelerates adding the sustained growth of the exploitation of new commodities inherent in the new paradigm. In this way, one of the main arguments of the thesis of advancing towards the "knowledge economy" can be refuted: the decoupling between economic growth and the exploitation of resources. This may be taking place in few developed economies, but a mass balance prevents confirming that it is being carried out at the global level. More paradoxical, despite the extraordinary increase in the exploitation of natural resources and the sustained growth of the financial economy, the maintenance or increase of the exclusion and poverty constitute other symptoms of the socio-environmental crisis. A recent World Bank report estimated that global wealth —measured as the sum of produced capital, natural capital, human capital, and net assets abroad— grew 66% between 1995 and 2014.

The report notes that this was accompanied by a significant reduction in the concentration of wealth in high-income countries. But in those with low income, which hold only 1% of the global wealth (based on its natural heritage), with few exceptions, there was little progress, with a reduction of the wealth per capita in a significant number of them (WB, 2018). It is worth noting that the figures of wealth per capita allow dimensioning the global differences of inequality. In 2014, in the OCDE countries, a person at birth, on average, had an equivalent wealth of 708 389 dollars, while the average person at birth in a low-income country was 13 629.52 times lower (WB, 2018). If considering the internal differences which, as indicated, are higher in low-income countries, these gaps become immeasurable. Thus, the data about the wealth of the eight wealthiest people on the planet are much more illustrative, a richness that is equivalent to the goods owned by the world's 3 600 million poorest (Hope, 2017).

Latin America: a knowledge economy?

This global panorama of severe socio-environmental crisis is clearly evident in Latin America. The persistent levels of poverty and exclusion,

as well as important situations of environmental deterioration measured by economic patterns in which the exploitation of natural resources prevails or has been accentuated, highlight as the most pressing issues.

The integration of Latin America into the global economy is given in an asymmetric way, mainly as a supplier of raw materials, hence the problems described acquire particular intensity and the enjoyment of the possible benefits is substantially lower. Thus, given the almost impossibility of evading the global dynamics of technological transformations, it is imperative the contribution of its scientific-technical structures to overcome the primary productive patterns, an elemental condition to advance in the transition to more sustainable forms of life.

Economic profile

After the stagnation experienced in the last two decades of the twentieth century, Latin America recorded positive growth rates. Between 2000 and 2014 the economy increased by 110% (CEPAL, 2014) [3]. This period showed a contraction in 2009 as a result of the global crisis and in the years 2015 and 2016 (-0.4% and-0.1%, respectively) associated with what has been called "the end of the commodities super cycle".

The impact of the fall in commodity prices on Latin American economies reinforces the debate over the structural stagnation of the region, accentuating the controversy over its economic structure, sustained more and more in services and primary activities that base their asymmetric insertion in the global economy. In fact, the evolution of GDP by type of activity in the region shows an alignment with the global trend of a growing share of services in GDP, "dematerialization", but in many cases associated with the exploitation and export of natural resources.

In the aforementioned period, basic services and trade, transport, communications and finance were the activities that recorded the greatest growth. There is also a relation in the loss of manufacturing importance, the line that records the greatest decrease in growth (Table 1).

3 Estimated at constant prices in U$ of 2010 (CEPAL).

Table 1
Annual GDP for the economic activity at constant dollar prices *

Item	1990	2014	Variation
Agriculture, livestock, hunting, forestry and fishing	136 901	262 613.3	91.8%
Mining and quarrying	187 546.8	324 289.6	72.9%
Manufacturing Industries	437 645.3	734 586.9	67.8%
Basic Services **	54 052.8	132 284.6	144.7%
Construction	178 950.8	347 050.6	93.9%
Trade, transportation, communications and finance	860 992.3	2 061 576.4	139.4%
* Millions of USD ** Electricity, gas and water			

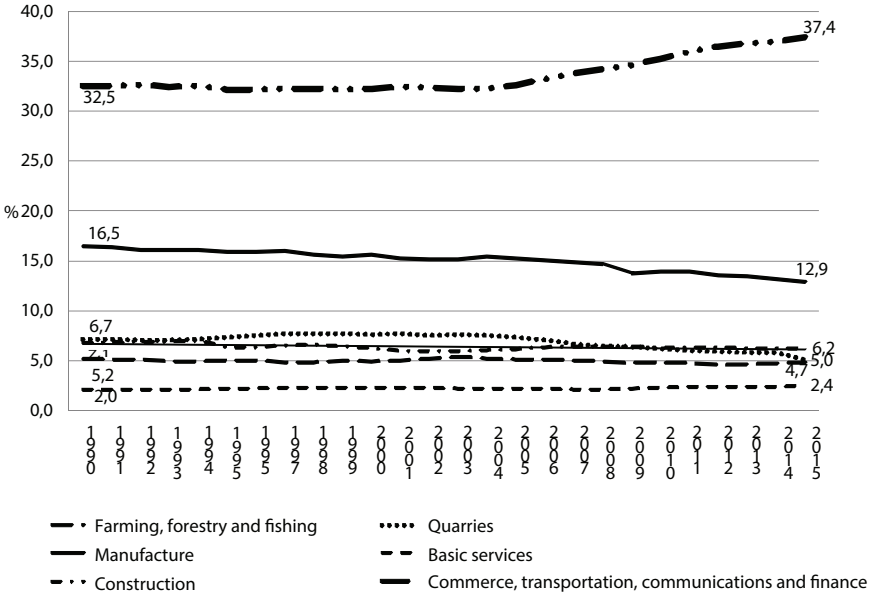
Source: CEPAL

The GDP of the construction almost doubles in the period. Agriculture, livestock, hunting, forestry and fishing, activities dependent on biodiversity, show similar growth, buttressed by the increase in agribusiness, which consolidated Brazil and Argentina, as big exporters of cereals. Finally, mines and quarries registered a somewhat inferior growth, closely linked to the export activity.

The variation in the participation of these activities in the GDP allows to better appreciate their weight in the economic activity. Although basic services were the percentage that increased more in the period considered, their share in GDP remains marginal (from 2% to 2.4%). Also, the extraordinary deficit they presented, whose improvement and expansion of coverage were placed by various international agencies as a condition to improve the quality of life.[4]

4 For example, the United Nations established in the Millennium Goals the need to increase coverage of access to improved and drinking water and sanitation: For 2015, the percentage of people without sustainable access to drinking water should be halved as well as to basic sanitation services.

Figure 1
Participation of different economic activities in GDP in Latin America (1990-2015)



Source: CEPAL

The services (trade, transport, communications and finance) are consolidated as the sector of more weight in the economy of the region, significantly increasing their share of 32.5% to 37.4% (increase of 15%), while at the other end is located the manufacturing whose share goes from 16.5% to 12.9% (a decrease in its contribution of 22%), less than 15% of the European Union, which is aware of the importance of this activity in employment, and the generation of goods has proposed to reverse the trend and increase its share on 20% in 2020 (Bussines Europe, 2014). The rest of the activities vary little: construction (from 6.7% to 6.2%), agriculture (5.2% to 4.7%) and mines and quarries (including oil exploitation, from 7.1% to 6.2%) (Figure 1). Even if the latter activity has seen its share of GDP slightly diminished, the increase in the exploitation of resources in the

present century is significant. The three main metal mineral commodities (iron, copper and aluminum-bauxite) show a sustained growth up to 2008, registering a fall in the following year product of the economic crisis, but taking it in the following decade despite the fall of prices (Table 2).

In 2001, the extraction of copper was slightly more than six million tons. It grew slowly but steadily reached 8 433 000 tons in 2015, representing an increase close to 40%. In just six years, the exploitation of iron experienced a growth of 64%. After the reflux of the 2008 crisis, it resumed the growth rate reaching a maximum of 521 million tons in 2011, an increase of 110% compared to 2001. Bauxite also experienced a high growth rate between 2001 and 2008, close to 50%, falling significantly in 2009 and from 2010 it resumed a slow but sustained growth of its production, approaching 53 million tons in 2015.

The strategic materials

Even when there is no precise data on the exploitation of new commodities and although their current pace of exploitation is not —yet— important, it is likely to intensify in the coming years. This is because Latin America owns 97% of world reserves of niobium, 96% lithium and 54% of Tantalum (Bruckmann, 2015). In other words, it holds the heritage of key resources for the development of new technological systems.

It is necessary to point out that the processes of extraction and transformation of these elements will be increasingly based on convergent technologies (nanotechnology, biotechnology, information technologies and knowledge sciences), techno-scientific areas in which the region, in general, presents meager research capacities, so that if no effort is made to overcome this situation, the extraction will become more acute.

This increase in resource exploitation would aggravate environmental degradation. New impacts are already beginning to be generated, evident in forest and forest deforestation and the contamination of water courses and reservoirs. For example, the extraction of lithium carbonate requires a large amount of non-brackish water. Salt reservoirs that contain the immense reserves of the resource are located in desert areas, so water of prehistoric underground aquifers is being used, resource that from the ecological point of view has an inestimable value.

It shows that the productive structure of Latin America continues to be anchored to the activities inherent to the previous techno-economic paradigm. The global consolidation of disruptive technology systems will make more pressure on their natural resources, exacerbating the phenomenon of "neo-extraction". If this is added to a manufacturing industry which in most cases has limited technological capacities (Westphal *et al*., 1985) and which loses importance in the composition of GDP, it is almost inevitable to increase the gap with respect to the developed countries and the worsening of asymmetries. For this reason, it is worth asking: do they compensate for the costs, in terms of negative socio-environmental and cultural impacts of this whole new phase of extractivism? The maintenance of the social deficit and exclusion, scarce technological advances, and environmental degradation suggest that it does not.

It is clear that the socio-environmental crisis and the deep technological transformations create huge challenges to the technological and scientific structure of the region, and to its productive structure. In this scenario it must be reviewed the role that the IES should play in addressing these problems and meeting their requirements.

Technological disruptions and the fourth industrial revolution

Much of the research in techno-science that takes place in universities in the global field —especially in the areas of chemistry and materials science, mathematics, science of the computing and engineering— aim for the development of disruptive technologies (Thomsom Reuters, 2014a, and b). In this way, these institutions are created to promote the transformations currently experienced by various technological systems. It is such the impact of these technologies that, apart from modifying the conceptions of production, distribution and consumption, alter the kinesthetic habits of human beings[5]. Table 2 presents the technologies that are considered to have more socioeconomic impacts.

5 On the use of technology, for example of the automobile, radical modifications are envisioned: will it be necessary to learn how to drive a car, understanding it as the control process of the device and the regulations or will these skills be delegated to autonomous devices?

Table 2
Disruptive technologies that will drive to deep socio-technical transformations

Area	Disruptive technology
ICT	Internet Cloud computing Portable devices Quantum computation
New Materials	Nano materials graphene Nano materials for battery electrodes
Mechatronics	New generation of industrial robots
Medicine	Next generation of genomic sequencing
Transportation	Electric vehicles Self-assisted vehicles
Advanced Energy Storage	Lithium ion batteries oxygen Sodium ion batteries Domestic storage systems

Source: own elaboration

As can be seen, they affect the technological systems that are virtually associated to all socioeconomic activities: industrial production, energy and, practically, all services (transportation, finance, communications, etc.). An important characteristic of these transformations is that they do not occur independently, but through deep interrelationships and interdependences, implying the emergence of a technological revolution (Pérez, 2002) or, probably, of several technological revolutions that are opening the path to a fourth industrial revolution.

One of the most important changes in the techno-productive structure is related to the introduction of the "Cyber-physical" systems in the production. They are networks of interactive elements that consider sensors, machines, tools, assembly systems and parts, all connected through digital communication networks (the cloud), processes that can be controlled remotely. Some of its components can act independently, making a fundamental difference with the traditional distributed control systems that, until now, were the nucleus of industrial automation and control (VDI, 2015). But a key question arises in the current socio-environmental crisis: Will all these technological transformations affect the irrational consumption of resources and the generation of pollution?

Some disruptive technologies can contribute to the GHG reduction, mitigate pressure on natural resources by enabling the design of more efficient processes and increase the development of reuse and recycling techniques. However, the revision of trends in various productive and service sectors reveals the consolidation of what has been called technological gigantism (Mercado y Córdova, 2005), which is inherent to the economic paradigm of continuous growth, making insignificant savings for improvements in efficiency.

Reelaboration of ways of producing knowledge

The severity of socio-environmental problems and the apparent inability to address them from the mainstream of research and technological development demand a review of ways of producing and use knowledge. Thus, parallel to the imperative development of techno-science is the role that other forms of production and transmission of knowledge (ancestral and/or traditional wisdom) should play, capable of promoting alternative forms of production and consumption aimed at satisfying the basic needs of the population and, therefore, more consistent with the postulates of sustainability. In addition to the possibilities of offering solutions that are accessible to the problems and requirements of the communities, what should be the role that universities must play in the face of these alternative forms of production and use of knowledge? Is it possible to establish a dialogue of knowledge that allows the creation of spaces for the co-creation of skills?

One particular case is that of the science, technology and higher education policies of Ecuador, which have established the need to combine or at least harmonize, as far as possible, the technologies developed from the mainstream of techno-science with the Ancestral knowledge, and between science and other knowledge. The Social Knowledge Economy (PESC) Plan (SENESCYT, 2017) explores possible interrelationships that would point to what Vessuri (2004) stands out as the "hybridization of knowledge".

The above provides better interaction with the society. The dialogue and exchange of knowledge leads to rethinking the roles of research in higher education. In the same way, it also requires redefining some aspects of the university's role in the scientific, technological and economic development, until it retakes its place not only as an individual trainer, but as a development sphere of culture, citizenship and democracy (Zgaga, 2005). In other words, there is a re-elaboration of ways of producing knowledge.

To expand the research practices

Several movements of the production of knowledge have emerged. "Open Science" promotes a scientific praxis that includes free access to scientific data and publications, the possibility of sharing research platforms and developing broader collaborations in scientific projects that can include the participation of professionals (scientists) and non-specialized practitioners (Barandiaran *et al*., 2015). Several authors point out that these forms of organization and development of research do not imply the creation of a new type of science separate from the existing system, but the creation of a semi-institutionalized form that releases the results of the research. Even if new modes of knowledge generation are not explicitly raised, these forms of organization can make circulation more fluent, beyond the communities of specialists, enabling more interaction between these and not specialized practitioners. This inevitably induces multidirectionality in the exchange of information and knowledge, so that these spaces can contribute effectively to the hybridization of the know-how (Hitner *et al*., 2017).

"Citizen science" promotes the active involvement of non-professional practitioners in research, considering a wide range of activities that can go from projects carried out by small groups with common interests, to international projects with the participation of research institutions on topics of interest for the society (LERU, 2016). The main traits that would shape this praxis would be: interdisciplinary collaboration, the structuring of widely distributed open collaborative networks and the stimulus to initiatives that motivate citizens to have more active roles in projects (LERU, 2016).

A third movement (participatory research) goes further, providing methods and tools for effective incorporation of communities, based on the establishment of mutually beneficial relationships between universities and citizens. It considers the co-creation and application of knowledge that increases in both actors the capacity to identify topics and propose solutions. It differs from traditional research in its purpose, seeking the benefit of the community in a broad sense that can be considered by the public, local, national and global spheres (Stanton, 2012). It also presents important differences in methods, by paying attention to the democratic nature that collaboration must have, by including all participants in all phases of the projects: data formulation, collection and analysis and application of the results. This last phase, apart

from making advances in knowledge, should also generate contributions that improve living conditions in the communities (Stanton, 2012).

By adopting these practices it cannot be ignored that techno-science and other ways of knowing are incompatible in their conception and purposes. Confronting and integrating these tendencies imply tensions that need to be considered for the adequate management of the production of knowledge. On the one hand, the unstoppable global socio-technical transformation makes the region imperative for the development of techno-science, seeking to orient it towards the end of more social benefit and sovereignty. The strengthening of the technological capacity of the industry, and the aggregation of value to the strategic resources by reducing the socio-environmental impacts of their exploitation are also a priority. Also, the development of local productive vocations that promote and rescue traditional and ancestral knowledge that empower communities, constitute spaces to build through these new forms of organization and production of knowledge (for example: citizen science, participatory science).

There is no doubt that all of these are great challenges for research and outreach missions. Relevance, relationship with society and increased participation are outstanding issues in the agenda of the Latin American university.

Redefining the extension

The repositioning of the issues of social inclusion and participation of citizens in education, science and technology has begun to recover the validity of the university extension, being this mission the one that allows the establishment of links between IES and other actors in society with more fluency (Hitner *et al*., 2017).

Thiollent (1994), based on experiences in Brazil, proposes extension and research to be conceived as social construction processes that count with the participation of actors oriented towards achieving specific objectives. In this perspective, the methodology and the instruments of work acquire participatory, critical and reflective dimensions that favor the emancipation purposes in the university projects.

It is even seen the emergence of movements that make important questions to the "renewed" third mission of the university (to contribute to the economic development). Trencher *et al*., (2014), based on the analysis of experiences in North America, Europe and Asia points out that the global

socio-environmental crisis is inducing many IES to divert attention from the almost exclusive interest to income generation and economic growth to become social transformers and co-creators. This blurs the boundaries between the members of a community (society, local governments and industry) and academics, thanks to the instrumentation of collaborative mechanisms aimed at the physical and sustainable transformation of a locality determined to meet the requirements of a specific group of the society.

Although many of the methods and instruments used prove to be practically the same as the "established paradigms" —such as agricultural extension, participatory research and action, technology transfer and transdisciplinarity— what is new lies in the emergence of the co-creative function, which consists in the combination of these various models of social commitment actions to respond to socio-environmental problems. To this end, it is necessary to internalize the values of sustainable development (Trencher *et al*., 2014).

Recently in the United States a significant number of universities have made efforts to revitalize civic and community participation in their localities. In an attempt that bears similarity to Latin American outreach activities, they underline the importance of community participation in the orientation and development of their functions, using institutional resources to identify and solve the problems that the community faces (Stanton, 2012). Considering that mode 2 of knowledge generation raises that its production should take into account the application contexts, these universities propose that part of the effort caters the problems of the communities, which would place criteria that would validate the academic work in their localities (Stanton, 2012). This assigns important responsibilities to the extension functions, as the universities must constitute the connection between the communities and the second mission of the IES (the research), opening up spaces to new ways of developing this activity (open science, citizen or participatory research) under a relevance perspective.

The worsening of socio-environmental problems and the imperative to orient life forms by more sustainable trajectories seem to be a convergence point in the refocusing of the university extension. The IES, being key factors in citizen participation to focus these problems, propose solutions and participate in their resolution, have the great challenge of rethinking, in part, their other major objectives (training and research) to renew its social contract and validity.

Conclusions

A very important renewing element of the Reform of Cordoba was the valuation of the relations with the society. It was proposed to open the university by means of the projection of the culture and the assistance, traits that formed and have characterized until today its third mission: the extension.

The current global techno-economic structure is, to a large extent, responsible for many of the serious socio-environmental problems facing the world and placing a high percentage of the world's population at severe risk. Addressing issues such as global warming, pollution, and social problems such as poverty and exclusion are unavoidable for IES, but to do so more effectively universities must undertake research approaches that transcend traditional "intramural" forms, by incorporating through the dialogue the diverse knowledge and the know-how of different social actors.

At the same time, big technological transformations are occurring, which affect the established conceptions of production and services, with important consequences on the organization and division of labor, the social structure and even on each individual, opening the path to the fourth industrial revolution. But when developing in the logic of continuous growth it does not pose alternatives to the current pattern of development.

This means a double challenge to Latin American IES. To answer, on the one hand, the tax for the aforementioned technological transformations, starting from a notable lag in its productive structure, based on primary activities and the exploitation of natural resources, with severe environmental consequences. This through the development of a techno-science oriented towards a greater social benefit and sovereignty; on the other, the demands of participation and inclusion that would have implied the re-elaboration of the forms of knowledge production.

All this proposes to redefine the extension by constituting this the unbeatable interaction space with society. Besides the cultural projection and the assistance work, the university will have to develop the harnessing mechanisms for the transmission and exchange of information and knowledge between the communities and the researchers, in order to enable new agendas of projects and contribute to create the spaces that allow the implantation of the alternative forms to carry out the activity (open science, citizen or participatory research). At this extend, the second mission of the university is also transformed.

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