



article review

Trends in postgraduate and doctoral training. Impact on sustainable development

Tendencias de la formación postgraduada y doctoral. Incidencia en el desarrollo sostenible

Tendências na formação pós-graduada e doutoral. Impacto no desenvolvimento sustentável

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ABSTRACT

The vision on the relevance of higher education materialized in the projection towards sustainable development and the ability to respond to the demands and needs of the country is of particular importance. International experience indicates that the creation of capacities and, particularly, the training of human talent, is a key element for promoting sustainable development. So, the objective of this article is to determine the trends that characterize postgraduate training, in particular, doctoral training and its impact on sustainable development, until the beginning of 2020. Methods such as documentary analysis, content analysis and analysis were used. complementary methods such as analysis, synthesis, deduction, induction, and comparative education. Among the most notable results were the essential changes in postgraduate and doctoral education, the challenges of postgraduate studies at the international level, especially in Latin America and the Caribbean, the generic competencies of postgraduate and doctoral training, the types of training programs doctoral studies and the characterization of doctoral training and its impact on sustainable development.

Keywords: sustainable development; doctoral training; postgraduate training.

RESUMEN

La visión sobre la pertinencia de la educación superior concretada en la proyección hacia el desarrollo sostenible y la capacidad de responder a las demandas y necesidades del país es de particular importancia. La experiencia internacional indica que la creación de capacidades y, particularmente, la formación de talento humano, es un elemento clave para el impulso al desarrollo sostenible. De modo que el objetivo de este artículo es determinar las tendencias que caracterizan la formación postgraduada, en particular, la formación doctoral y su incidencia en el desarrollo sostenible, hasta

principios de 2020. Se emplearon métodos como el análisis documental, el análisis de contenido y métodos complementarios como análisis, la síntesis, deducción inducción y la educación comparada. Entre los resultados más notables se encontraron los cambios esenciales en la educación postgraduada y de doctorado, los retos del postgrado a nivel internacional, especialmente en América Latina y el Caribe, las competencias genéricas de la formación postgraduada y doctoral, las tipologías de programa de formación doctoral y la caracterización de la formación doctoral y su incidencia en el desarrollo sostenible.

Palabras clave: desarrollo sostenible; formación doctoral; formación postgraduada.

RESUMO

A visão sobre a relevância do ensino superior materializada na projeção para o desenvolvimento sustentável e a capacidade de resposta às exigências e necessidades do país assume particular importância. A experiência internacional indica que a criação de capacidades e, em particular, a formação do talento humano, é um elemento chave para a promoção do desenvolvimento sustentável. Assim, o objetivo deste artigo é determinar as tendências que caracterizam a formação pós-graduada, em particular, a formação doutoral e o seu impacto no desenvolvimento sustentável, até ao início de 2020. Foram utilizados métodos como análise documental, análise de conteúdo e análise. como análise, síntese, dedução, indução e educação comparada. Entre os resultados mais notáveis estão as mudanças essenciais na educação de pós-graduação e doutorado, os desafios da pós-graduação em nível internacional, especialmente na América Latina e no Caribe, as competências genéricas da formação de pós-graduação e doutorado, os tipos de programas de formação de doutorado e a caracterização da

formação doutoral e o seu impacto no desenvolvimento sustentável.

Palavras-chave: desenvolvimento sustentável; formação doutoral; formação de pós-graduação.

INTRODUCTION

The university-society relationship has been transformed as a result of social development that has conditioned the existence of various university models. Currently, those distinguished by social demands in favor of sustainable development predominate.

In this regard, Díaz-Canel and Fernández (2020) point out:

Higher education has been positioning itself as a relevant actor in the processes of production, dissemination and use of knowledge that local development demands and has increasingly become a key ally of governments in the strategic management of local development. (p.27)

This vision is especially important as it strengthens the relevance of higher education and its ability to respond to the needs and demands of the country (Díaz-Canel and Fernández, 2020). In this regard, international experience indicates that the creation of capacities, and particularly, the training of human talent, is a key element for promoting local development (Díaz-Canel and Fernández, 2020).

Saborido (2018), when addressing the characteristics of the contemporary university, points out:

In the current century, the paradigm is projected towards the union of teaching, research, practice and networking. So that research and doctoral training form a main part of the core of this paradigm. (p.6)

Thus, the influence of research and doctoral training in university paradigms have led to the establishment of a type of classification of university models referring to research, scientific and technological and professional universities, say colleges and institutes (Saborido, 2018).

Europe is positioned at the forefront of leadership in addressing the Sustainable Development Goals (SDGs) in relation to education and research. This is how Hasgall (2019) puts it:

As a place where education and research meet, doctoral education is key to advancing the challenging agenda of completing the goals by 2030. Doctoral education, organized through doctoral schools or doctoral programs in the vast majority of universities, contributes to the formation of highly qualified academics, knowledge workers for many different areas of society. They provide scientific and transversal skills, as well as a unique system of participation and exchange.

However, such advances are not homogeneous. In Latin America and, particularly, in Cuba, situating higher education and, especially, doctoral training in terms of achieving the SDGs, continues to be a challenge. In this article we intend to determine the trends that characterize postgraduate training, particularly doctoral training, and its impact on development until the beginning of 2020, as it is at this time that the COVID-19 pandemic begins its

devastating impact, which has caused important changes in the behavior of such trends whose significance remains to be seen.

To determine the trends, documentary analysis was used, mainly content analysis, in order to establish the internal structure of the information from the inference, that is, the deduction of data that, in this investigation, are not quantifiable. Content analysis involves the use of complementary methods such as analysis, synthesis, deduction, induction, and comparative education.

The descriptive approach used assumed as investigative tasks:

- Identify as data, texts related to postgraduate training, doctoral training, the SDGs and sustainable development.
- Determine as a unit of analysis: written texts related to postgraduate training, doctoral training, the SDGs and sustainable development.
- Determine as a unit of context: texts of authors and national and international legal provisions referring to postgraduate training, doctoral training, the SDGs and sustainable development.

DEVELOPING

Postgraduate training. Characteristics, transformations and trends

- Contextual features

- Exhaustion, as of the 1970s, of the pattern of relations between State and society, or sociopolitical matrix, in force since the 1930s Central State Matrix (MEC) that differentially affects the different countries of America

Latin and implies a series of interrelated processes of decomposition and recomposition of the MEC (Garretón, 2000).

- Technological changes that have motivated transformations at the level of production systems and pose a redefinition of work processes, which increasingly require access to higher levels of education.
- Greater extension of educational trajectories up to the postgraduate level and offer of training throughout life, through the so-called continuing education systems (*lifelong learning systems*).
- Greater articulation between education and the world of work.
- Relevance of research and innovation in development. Greater intervention state with resources for this purpose.
- Increased participation of the productive sectors, both in financing and in the generation of scientific and technological knowledge.
- Emergence of a new knowledge production model based on application contexts, starting from problems as a guide and organized in a transdisciplinary way (Gibbons, 1997). The complexity that problems acquire requires solutions from various disciplines. It goes from an investigation focused on disciplinary areas to another focused on problems.

- Changes in postgraduate training

Cruz (2014) synthesizes the changes that take place in postgraduate training:

- The organization and operation schemes of the collegiate bodies, on whom falls the responsibility of training professors and doctors (for example, the elimination of Departments and Schools and the creation of Doctoral Schools and multi

and interdisciplinary Centers and Institutes).

- The type of skills that professors and doctoral students must appropriate and demonstrate, not only as qualification requirements, but as a sine qua non condition to ensure employability (ie ability to integrate easily into academic, scientific or work environments and groups; ability to solve problems creatively and innovatively, among others).
- The way of conceiving and managing knowledge production processes (ie generation and transfer of codified knowledge and codification of tacit knowledge).
- How to deal with complexity and uncertainty.
- The use of communication and information technologies, characterized by diversity, speed and connectivity.
- The teaching and learning strategies to ensure that those changes eventually occur.
- Postgraduate training focused on innovation, which is a real challenge, if neither students nor teachers are trained to think creatively.
- The need to make strategic decisions of a curricular nature to assume a strategic paradigm of postgraduate training that redefines a type of knowledge that allows the student to: (a) be informed (know what), (b) understand and understand cause-effect relationships (know why), (c) achieve results (know how), (d) join knowledge networks (know who) and, (e) appreciate new possibilities and innovate (know beyond).

- The challenges of postgraduate studies worldwide

According to the Association of American Universities (Nyquist & Woodford, 2000) the main challenges of postgraduate studies at a global level are the decrease in duration and

increase in variety, the increase in the skills of graduates to achieve high performance in diverse environments and with a global vision supported by ICT and capacity building to work interdisciplinary.

- **The generic skills of postgraduate training**

In the opinion of Cruz (2014), a new paradigm of postgraduate training must ensure that students develop skills or sustainable, lasting, irreplaceable or difficult to imitate advantages that, in conditions of scarcity and external demand, can effectively contribute to the construction of a society of knowledge, an issue that becomes a high priority in the context of the pandemic caused by the SarsCov2 virus at a global level. At this point, advanced postgraduate training, particularly doctoral, is key in the processes of generating and transferring new knowledge (Carvajal, *et al.*, 2020).

Regarding the contents of postgraduate training, Walker *et al.* (2009) suggests that in all disciplines, graduates must exhibit unmistakable and lasting generic competencies, manifested in their ability to think critically and creatively, broaden, deepen and generate new knowledge, interact with people from other disciplines, teach and act responsibly. ethical and social.

- **Internationally recognized advanced higher education trends**

Worldwide, several trends in advanced higher education are recognized (Aguirre *et al.*, 2019; Assbring and Nuur, 2017; Cruz, 2014; Teichler, 2017; Walker *et al.*, 2009) that reflect the implementation of transition processes:

- The growing number of applicants to receive postgraduate training, as well as the manifest diversification of that potential population of applicants;

- The emphasis on personalization and the student experience;
- The strengthening of the link between universities and companies;
- The role and function that scientific and applied research plays in the so-called knowledge economy;
- The internationalization of the academic offer; mobility and internationalization and financing models;
- The more active role of postgraduate policies, given by the state's concern for this level of higher education;
- The relevance.

- **Postgraduate trends in Ibero-America**

Cruz (2014) identifies some of the most relevant postgraduate trends in Ibero-America:

- Postgraduate studies as a strategic instrument for development (see examples in Brazil and Mexico) and as a regional priority, to the extent that economic growth, well-being and social cohesion depend on the ability to generate, transfer and apply knowledge in a responsible, pertinent and innovative way.
- The advanced higher education of specialists in the different areas of professional, labor and productive practice, as well as the training of university professors and researchers in the different fields of scientific and technological knowledge, has become an urgent priority that all Latin American countries should commit to.
- The existence of a common main challenge: The adoption of a new training paradigm that makes it easier for the student to develop skills to reason analytically, critically, practically and creatively, conceptualize a problem or an object of study, integrate and synthesize information, make judgments

reasoned values, argue with academic rigor, create and interpret new knowledge, research, teach, learn autonomously, self-motivate, self-regulate, communicate (express oneself in persuasive and coherent prose), persevere in the face of frustration, tolerate ambiguity, take risks, understand academic and commercial exploitation processes, use information technologies, demonstrate flexibility and impartiality, work as a team, in networks, adjust to change, make decisions in complex, unpredictable situations with a high level of uncertainty, assume personal, social, ethical and environment, as well as develop academic management and administrative tive.

Aguirre *et al.* (2019) offer a group of trends in terms of accreditation and quality of the best universities in Latin America, identified based on criteria of relevance, context and implementation possibilities:

- Emerging trends oriented to impact and relevance

- Loyalty (*grow and adapt*): identification and capture of unconventional target audiences in universities for postgraduate courses (vulnerable audiences, minorities, demographic and gender considerations in admission); multi-tutorials and support networks. presents a strong growth in some countries.
- Globalization (*identity and diversity*): Balance between internationalization, interculturality and local relevance in the skills of graduates and the business and administrative models of universities. Environments for creativity and teamwork. Multidisciplinary and inter-institutional postgraduate courses.

- Training in T (*breadth and depth*): Recurring paradigm in all countries, in which a rigorous training is sought in the specific area of the postgraduate course (training of guardians of the disciplines), while the student achieves a broad general culture and contextualized. Creation of Research Training Groups and/or Communities of Practice.
- Articulation (*transcend*): Establishment of a strong link between postgraduate courses with their research component for the impact on society, based on academic strengthening and the business sector. Postgraduate courses as generators of cutting-edge industries in frontier research, in coordination with the priority sectors of science, technology and society (CTI). Online research and in the face of social needs.

- Emerging trends oriented to accompaniment and support

- Degrees (*flexibility*): Expansion of the possibilities of obtaining recognized degrees according to different levels and training approaches in postgraduate courses, to meet the specific interests and needs of the public and the countries, which includes new types of postgraduate courses and new routes, certifications from extension or with recognized accreditations, degrees between institutions or with companies and distance postgraduate courses in concentrated or virtual times.
- Management (*optimization and impact*): Increase in the demand for quality control of academic processes and harmonious integration with the administrative ones to favor the academic community and comply with the standards required for accreditations. Accompaniment to professional performance and impact

monitoring. Strengthening of the collegiate bodies of postgraduate courses. Articulation of different pedagogical models for new skills. Self-assessments and accreditation with dynamic and open approaches.

- Well-being (proximity): Design and implementation of support strategies and actions aimed at improving the quality of life of the student and postgraduate graduate in their relationship with the university. Increased enrollment analysis vs. long-term projections for growth.

On the other hand, the trend associated with the *social responsibility of the university* has been emphasized in the III Regional Conference on Higher Education for Latin America and the Caribbean (Gazzola and Didriksson, 2008) and referred to by various authors, including Navarro *et al.*, (2017); Valleys and Carrizo (2018) and Cruz (2018) in relation to continuous training and the promotion of sustainable development.

Doctoral training. Characterization and trends

Doctoral training is evolving towards a combined set of geoeconomic conditions (interculturality, internationalization, among others) and pertinent contextualization with the social and productive environment (Abreu *et al.*, 2014; Dávila, 2012).

In Latin America, although the postgraduate course has experienced an accelerated development, as far as doctoral training is concerned, it has been uneven (Cruz, 2018). Very few countries have the capacity to train doctors and researchers. At a first level are Argentina, Brazil, Chile, Cuba and Mexico, followed by Colombia and Venezuela.

Below are some findings at the international level and in the Latin American context, especially.

- Global issues around doctoral training

It was found that American higher education institutions, more than 20 years ago, summarized the global concerns about postgraduate education (Nyquist & Woodford, 2000) that are still valid today: determine the true essence of postgraduate training and, in reference to doctoral training, the urgency of shortening the duration of the programs; ensure a greater variety of doctoral students; guarantee that the new doctors are more competent in handling information and communication technologies; train new doctors so that they can work in different and varied environments; ensure that new doctors appropriate a better and greater understanding of the global economic and productive environment and ensure that interdisciplinary work is an integral part of doctoral training.

- Purposes of doctoral training models

The European and Anglo-Saxon models of doctoral training establish five purposes (Cruz, 2014): (1) The advancement and displacement of the frontiers of knowledge; (2) Intensive research training; (3) Highly specialized training and education in a professional field, although master's degrees are supposed to serve that purpose; (4) The general, personal and intellectual training so that the doctoral student adopts a more open and flexible attitude towards an object of knowledge, communicates better, beyond the borders of his own discipline and demonstrates being intellectually autonomous; (5) The response to the needs of the labor market. This purpose, relatively new in the European environment, tends to modify the traditional point of view that postgraduate studies should preferably respond to the needs of doctoral students.

- Typologies of doctoral training programs

- There is recognition of the need for alternative doctoral training programs to the traditional PhD (Huisman & Naidoo, 2006), although this is maintained as an original and significant contribution to scientific knowledge.
- Currently, there is a coexistence of the Professional Doctorate PD (Servage, 2009) whose differences were already reported, in 1999, by the Australian Council of Deans and Directors of Graduate Studies, which contributes to the advancement of knowledge and has application in professional practice (MacLachlan, 2019).
- Huisman & Naidoo (2006) differentiate at least three more types of doctorates:

(a) The New Route PhD., which has been developed in ten universities in the United Kingdom for more than a decade, characterized by an intense schooling process for doctoral students (Cruz, 2009); (b) The doctorate based on professional or artistic practice and (c) The doctorate for publications, in which the doctoral student presents publications refereed by the international scientific community in a field of knowledge.

- In the United States, doctoral degrees are offered in fields of professional practice such as Doctor of Education (EdD), Engineering Doctorate (EngD) and Doctor of Business Administration (DBA) alternatives to the traditional PhD. and Professional Doctor (PD), all with a more professional orientation unlike the Doctor of Sciences (DSc.) with a more academic character (Germain -Alamartine & Moghadam -Saman, 2020).

As for access to the doctorate, in the European Union a master's degree or similar studies are required. In the United States, a master's degree is required, although there are exceptions, and in Latin America there are differences between countries, given that in some a previous master's degree is required and in others access to the doctorate is direct.

Regarding the doctoral curriculum, in the European Union it is flexible and focused on doctoral students; in the United States it is educated and flexible and in Latin America it is generally educated.

- Change of paradigm in doctoral training

For Cruz (2014) doctoral training, essentially inter, multi and transdisciplinary, must assume a paradigm shift. Manathunga *et al.* (2006) propose a "pedagogy" for interdisciplinary doctoral training in four dimensions. The first deals with the teaching and learning processes through which it is possible to create spaces for dialogue, so that people from different disciplines can interact using different methods and tools and can create and exchange new knowledge. The second is as an intercultural experience through which people from different disciplines can re-evaluate their own concepts and practices in the light of other disciplines. The third is the possibility of encouraging people from different disciplines to use their capacity for analytical and creative thinking to reorganize knowledge in such a way that not only innovative solutions to a problem can be generated, but it is also possible for them to evaluate the effectiveness of those solutions. The fourth is the possibility that students can understand how new knowledge is naturally generated in their own discipline (epistemology) and how this new knowledge can be related or conflict with that generated in other disciplines.

This new paradigm is also based on the development of social skills, as opposed to traditional independent work, which allow them to learn to work and interact with others, in a friendly environment of cooperation and camaraderie (Cruz, 2014).

- **The basic skills to be trained in doctoral students**

In 2014, Cruz pointed out the following: Think analytically (ability to analyze, synthesize and make reasoned value judgments about an object of knowledge); action (ability to integrate knowledge, address complex problems and ability to adapt to different environments), learn alone (without the help of a teacher or tutor), self-control and motivation, approach an object of knowledge with academic and scientific rigor and assume ethical and social responsibility for academic and scientific actions (Cruz, 2014), all of them transversal skills that typify doctoral training (Carvajal *et al.*, 2020).

In 2018, Cruz proposes the competencies of a new strategic paradigm for doctoral training: solve problems, deal with complexity and uncertainty, conceive and manage knowledge production processes, generate tangible results, understand the social, economic and productive environment, interact with other disciplines and use ICTs (Cruz, 2018).

- **Tutorials**

Transformations can be seen in terms of the context and the relationships between the participants in the process. De la Cruz and Abreu (2008) state that they must be restructured to operate beyond the school environment, in an open way, in practice environments and knowledge located and articulated with innovation processes. The need to implement tutor training programs is recognized (Carvajal, *et al.*, 2020).

Tutoring Challenges:

- Avoid the tendency to focus exclusively on the acquisition of explicit knowledge in order to assess the relevance of tacit knowledge in the same way.
- Transition from tutoring focused on closed school environments to open systems located in the real world.
- Integrate students with communities of high-level professionals oriented towards innovation.
- Exercise tutoring in such a way that it guides the activities of the students and also promotes the progressive transfer of control, self-regulation and the increasing transfer of responsibility to doctoral students.
- Overcome the vision of tutoring as a two-person relationship to open spaces for multi- tutoring carried out by communities of practice that allow the construction of professional networks.
- Develop three types of interactions: vertical (between tutor and doctoral student); horizontal (among doctoral students) and diagonal (with other experts).
- Develop multi-tutoring or collegiate tutoring, which implies: overcoming the vision of tutoring as a two-person relationship; groups of tutors with various approaches and fields of expertise; promote interdisciplinary work and the diversity of approaches and consider the objective of favoring reflection in action and on action.
- Ensuring support for doctoral students, the most valued quality, according to Nesterowicz *et al.* (2019).

- **Trends in doctoral training**

At the beginning of the 21st century, Nyquist & Woodford (2000) identify the following:

- Reduction of the duration of doctoral programs, in order to achieve better employability.
- Training of graduates so that they can work in various environments to expand employability to areas other than academics.
- Ensuring greater variety in the profile of doctoral students, making room for students who come from other disciplines to thus stimulate interdisciplinary work.
- Regarding the study plans: reinforcement of interdisciplinary work, so that it becomes an integral part of doctoral training so that future doctors can interact with people from other disciplines; greater understanding of the economic, productive and social environment at the national and global levels; it is considered essential to broaden, deepen and generate new knowledge; more management of information and communication technologies. A trend towards a process of disciplinarization is also observed in some doctoral training programs (López, 2017). Recent changes have also brought with them new varieties in the forms of presentation of the final research report. The traditional thesis is maintained; the publication of a series of articles joined by an introduction and conclusions is included; in the arts, creative results are presented, among others, according to the characteristics of the training systems (Working Group 2, 2019).

Others trends relevant are:

- The internationalization of higher education through postgraduate and doctoral training (Chigisheva *et al.*, 2017; Davila, 2012; Gacel-Ávila and Rodríguez-Rodríguez, 2018; Hasgall

et al., 2019; Sebastian and Barrere, 2018).

- The production of knowledge in application contexts (Gibbons, 1997).
- The social relevance of doctoral training, which implies linking doctoral training to the solution of sustainable development problems (Cruz, 2018) and the doctoral training-company relationship (Assbring and Nuur, 2017).
- Among the strategic priorities are the need for funding for doctoral training, ethics and integrity in research as a central point in training, inequity in internationalization in the various regions, and the need to sustain the quality of training (Hasgall *et al.*, 2019; Löfström & Pyhältö, 2017).

Doctoral training and its impact on development

- Characterization

Various studies allow us to characterize the state of doctoral training and its impact on development in Ibero-America:

- The recognition that it no longer seems feasible to offer postgraduate training to a student who must ensure their employability in the 21st century, in a University that is still governed by 19th century canons with professors who have remained in the 20th century (Cruz, 2014).
- As a regularity, the national development plans do not establish as a priority the training of university professors and researchers with a doctoral level and the generation of a critical mass that allows the creation, in the long term, of their own training programs for doctors and researchers, especially in areas of lesser importance. or incipient development (ie, applied sciences, medical sciences) (Cruz, 2018).

- Needs existing:

- Greater development and transformations, at the expense of state policies for financing advanced higher education and science and technology (R+D+i) that manage to improve investment rates (CRES, 2008).

- Investment in R & D & i by the productive and business sectors (Cruz, 2018).

- Institutional strategic decisions to ensure the social relevance of training programs, closely related to the expectations and needs of their social environment by universities (Cruz, 2018).

- Consideration of doctoral training as a priority for universities, to the extent that economic development, welfare and social cohesion depend on the ability to generate, transfer and apply knowledge in a responsible, relevant and innovative manner (Arocena, 2015).

- Flexibility and contextualization of the university, so that business and territorial demands become strategic objectives (Arcos, 2019).

- The ambition to increase the quality assurance of doctoral training, with the purpose of providing society with new generations of well-trained and inspired professionals, as a factor that unites educational institutions around the world (Barnett *et al.*, 2017).

- Implications

Among the main ones are the training of doctors and researchers as a state priority; ensuring the social relevance of doctoral training as a strategic decision of universities and linking doctoral training to the solution of sustainable development problems.

- Challenges of doctoral training and its impact on the achievement of the SDGs in Ibero-America (Cruz, 2018):

- The University is obliged to reinforce and consolidate efforts to link with its environment, with social and economic actors and produce and transfer pertinent knowledge of social value.
- Doctoral training programs will have to make a significant effort to define strategic priorities in their lines of research, aimed at solving the most urgent sustainable development problems in their immediate geographical environment.
- Doctoral training, apart from ensuring the appropriation of the skills of a researcher (intellectual autonomy, discipline of academic work, rigour) must also seek to develop capacities to assume ethical, social and environmental responsibility.

- Changes in the doctoral training curricula for sustainable development

Ends and purposes : (a) Articulate science, knowledge transfer and innovation with the requirements of the social and economic environment; (b) Develop skills related to a new strategic training paradigm: solve problems, conceive and manage knowledge production processes, generate tangible results, understand the social, economic and productive environment, interact with other disciplines, use ICTs and address the complexity and uncertainty, according to Rizzo (2017) from various communication platforms.

Approaches: (a) Reinforcement of observable behaviors, say, social, ethical and environmental responsibility; (b) Higher education and advanced higher education curricula that promote socio- humanistic training, ethical values, a complex and holistic view of reality, environmental

education, an understanding of the social nature of science, technology and innovation (Nunez, 2017).

Impact:

- In actions aimed at the identification, protection and cooperation in the exploitation of the tacit strategic knowledge of local, regional and national communities, the symbiosis between the global and local (glocal) dimensions. Doctoral programs must think locally to act globally (Cruz, 2018).
- In the *Glocal environment*: improvement of the competitive capacity of social groups for the identification, protection and cooperation in the exploitation of the strategic knowledge of the communities.
- In the knowledge society: consideration of the added value of socially generated, transformed, transferred, applied and shared knowledge; as well as the use of knowledge for training, integration, participation, solidarity, justice, peace and security.

Implications for doctoral training programs

These changes imply that doctoral training programs need to: Define strategic priorities in lines of research; aim to solve more urgent local development problems; provide preparation for original research that generates significant contributions to knowledge to move or increase the frontiers of knowledge in one or several disciplines (Cruz, 2018); ensure the appropriation of the skills of a researcher; ensure that the new doctor accepts the ability to assume ethical, social and environmental responsibility.

CONCLUSIONS

The results obtained ratify the importance of postgraduate courses given that the substantive functions of Higher Education Institutions (HEIs) are not limited only to professional training and scientific research, they also include the transfer of the results of these processes in a pertinent and contextualized with its environment, according to Bueno and Casani (2007). This is interpreted as the influence of trends associated with the social responsibility of the university and training for sustainable development, hence the need to reinforce the generic skills that the postgraduate student can exhibit as a tangible result of the training process.

Europe and the United States set postgraduate trends in the world, Latin America shows progress, but it is still insufficient. The recommendation of Aguirre *et al.* (2019) that Latin American universities should consolidate a postgraduate portfolio based on the two emerging trends of articulation and new degree modalities to achieve greater quantity, diversity and quality of students and, therefore, more favorable repercussions for scientific production, technological development and visibility.

Postgraduate training trends have an impact on doctoral training. The opinion of Altbach (2010) is shared when recognizing the need for a strategic paradigm of doctoral training that ensures that new doctors can perform and easily integrate into academic, scientific or work environments and groups; solve problems creatively and innovatively; generate tangible results; conceive and manage knowledge production processes; address complexity and uncertainty; use information and communication technologies; ensure that interdisciplinary work becomes an integral part of their doctoral training and appropriate a better

and greater understanding of their social, economic and productive environment.

In general, more flexibility is observed in admission, greater incidence of teamwork, semi-school curricula and more open approaches in tutorials, that is, a more personalized training process. Among the most used strategies are the processing and transfer of information, critical analysis, the formation of concepts, the interpretation of data and the application of tutorial principles. The importance of interdisciplinary training is recognized, although a conflicting vision reflects the emphasis on disciplinarity (López, 2017). In our opinion, it can only be trained interdisciplinary, from the base of a situated disciplinary approach.

Internalization processes and doctoral training linked to the solution of sustainable development problems seem to be the most relevant trends. The results found in this article coincide with Hasgall (2019) in stating that Doctoral Schools are the places where the necessary skills are obtained to achieve the Sustainable Development Goals, to operate inside and outside the academy. The responsibility of universities in research and innovation requires creating and sustaining spaces within doctoral training in which awareness is exercised and new generations of researchers have what they need to face and create a sustainable future (Hasgall, 2019).

Determining the trends in postgraduate training and, particularly, doctoral training and its impact on development until the beginning of 2020 makes it possible to establish a theoretical-methodological framework for the orientation of this training. The changes that take place show a context characterized by the need for a projection towards a future with guarantees of transformation of higher education. Training must be seen as a response to the demands of the glocal context and social relevance, based on sustainable development.

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The authors have participated in the design and writing of the work, and analysis of the documents.



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