

The Role of Peruvian Universities in Research and Technological Development

El rol de las universidades peruanas frente a la investigación y el desarrollo tecnológico

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Summary

Within the framework of the current University Law 30220 and the processes involved in its implementation in search for quality of higher education, this article is written to introduce the reader to what Peruvian universities are and should be doing to fulfill one of their important roles: research and technological development. Different documentary sources are reviewed based on the components of the research work referred to in the Frascati Manual: scientific teaching and training, research and development and technological scientific services.

Keywords: Research work, scientific teaching and training, research and development, technological scientific services.

Resumen

En el marco de la actual Ley Universitaria 30220 y los procesos que implican su implementación en búsqueda de la calidad de la educación superior universitaria, surge el presente artículo, el que tiene como propósito brindar un acercamiento al lector sobre lo que deberían realizar y lo que vienen haciendo las universidades peruanas para el cumplimiento de una de sus funciones fundamentales, la investigación y el desarrollo tecnológico. Se realiza la revisión de diferentes fuentes documentales a partir de los componentes del quehacer investigativo que refiere el Manual de Frascati: la enseñanza y formación científica, la investigación y desarrollo y los servicios científicos tecnológicos.

Palabras clave: Quehacer investigativo, enseñanza y formación científica, investigación y desarrollo, servicios científicos tecnológicos.

Introduction

In the 19th century, England was the main space where several universities emerged, trend that spread to other countries of Europe and the United States under the humanist model of Wilhelm von Humboldt. The university of the contemporary period incorporates science and research as part of its functions. The same happened in Latin America, but the university was a space where only the dominant classes had access to (Báez, 2010).

To end elitism at university, the Cordoba movement arose in 1918 that resulted in the university reform in Argentina, movement that sought to democratize the university and gave it a scientific character, led by the middle and lower class since they wanted to have access to universities, and the recognition of the right to externalize its thoughts through its representatives and to participate in the government, establishing the university autonomy, promoting the participation in the university government of teachers and students, questioning the university as a factory of professional titles, showing concern about teaching innovation, seeking the academic freedom and length of term for chairs, free education and a relevant aspect of the social function of the university and commitment to change that gave rise to the university extension function (Fernández, 2014). In Peru, these reforms started in 1990 at the National University of Saint Anthony the Abbot in Cuzco and in 1919 and 1931 at the National University of San Marcos; José Antonio Encinas was one of its ideologists of the reform due to his democratizing ideas, as well as to questioning the professional education for individual profit not for social profit and he promoted the cultivation of ideas that safeguard the common good, society and the country between teachers and students. (Casalino, 2017).

This antecedents mentioned have laid the foundations of what is currently considered fundamental functions of the university in the university laws worldwide: teaching, university extension, research and technological development (Fabres, 2005; Sira, 2011). Teaching, as a teaching-learning

action of knowledge produced through scientific research in several fields of knowledge; university extension that seeks to solve problems and satisfy the needs of the context, from the existing relationship between teaching and research through specific actions. Then, the research function is a transversal axis in the university work; the university is the space where knowledge is produced, disseminated and applied, assimilating those already generated by humanity and producing new ones by means of research works carried out by teachers and students whose objective is the social transformation. (United Nations Organization for Education, Science and Culture, UNESCO, 2008).

Currently, it is impossible to think about solving the most outstanding problems of humanity without the use of technologies suitable to reality or without introducing innovation to all levels of society. To promote and disseminate the importance of research work, it is necessary to improve research teaching and generate institutional practices promoting the development of science and technology for the social good, involving several structures forming part of the innovation system. Without these considerations, society may remain underdeveloped. Within this general framework plus the licensing procedures that universities go through based on the University Law 30220, this article is written in order to show the activities that universities carry out and should carry out as part of the fulfillment of the function of research and technological development in Peru.

Research Work in the University

It is necessary to start with the conceptualization of the term research work. According to the OCDE's Frascati manual (2002), they are scientific and technical activities (STA) in universities that seek to promote science and innovation for social development and comprise three components: scientific and technical education and training (STET), research and development (R+D), and technical and scientific services (TSS).

Most universities in Europe, Asia and North America develop 3 STA components simultaneously and even focused on extension activities, while Latin America universities have been basically focused on scientific education and training in both undergraduate and postgraduate programs (STET), forgetting about the two other activities or otherwise, carry them out in a tangential manner in areas, institutes or departments, with few interface structures proposed in a general manner in the science and innovation systems of their countries, except for countries, mentioned in order of organization and contribution, such as Brazil, Argentina, Mexico and Chile.

Among the main reasons for the marked differences between universities from Europe, Asia and North America and universities from Latin America are the fact that the latter rarely take into account international standards in the evaluation of their procedures or results, have difficulties in the command of other languages mainly English, give little attention to the impact of the reforms of other systems, there are no state-level bodies that strictly regulate their functions, they are not related to other environments, there is no institutional will for investment, among other issues. (UNESCO, 2008).

In the case of Peru, in recent years, the government has been more concerned about strengthening its national innovation system, with initiatives in charge of the National Council for Science, Technology and Technological Innovation (CONCYTEC, by its Spanish initials) and the Ministry of Production, as well as of the same universities, to revitalize activities related to this function resulted from the State's actions to guarantee the quality of the universities, with procedures such as licensing and university accreditation that prioritize the academic production, the implementation of laboratories, among other aspects. As mentioned in the last Biennial Report of the National Superintendence for Higher Education (2017), despite it has been criticized for evaluating the quality of universities with a single indicator: scientific production, only 32 out of 132 universities show scientific publications. The Pontifical Catholic University of Peru excels in engineering and technology, natural sciences, social sciences and humanities; the National Agrarian

University- La Molina excels in agricultural sciences and the Cayetano Heredia University excels in medicine and health sciences.

Below there is concise information about what happens in the world and in Peru with respect to each one of the three STA components.

Scientific Education and Training (STET)

Universities from Europe, North America and some from Latin America use a system consisting in the fact that teachers do research according to the subjects they teach and the research lines of the program, which provides highly specialized professionals that advice and promote several academic communities, research projects with internal and external financing, but mainly the teaching of enriching and critical lessons, not only based on the literature or professional experience, but on empirical evidences of research works that serve to refute or confirm what was already been written. With respect to the Spanish reality, Romaña and Gros (2003, p.9) say that “the position achieved through the research is what allows legitimizing other practices (management and teaching), since it is the dominant practice.” They also say that Spanish teachers are increasingly more inclined to free themselves from teaching to perform more attractive activities such as research or management.

Although in Latin American universities, it is common to find a division between teaching faculty and research faculty, showing that they are different functions, the fact that teaching cannot exist without research is maintained. Nowadays, it is a tendency for universities to request, almost mandatorily, that teachers have publications resulting from their research works. However, hours are not assigned to do such task within their workload, or what is more serious, universities are not organized in a system that allows them to do research. It is supposed that teaching and research are not separate activities. According to Bok (1990), what is taught must be questioned, the class should function as a laboratory for the development of research in order to help to

solve several social and technical needs, thus also generating a space for the joint research work between teachers and students, making up academic communities (Rojas, 2011).

In the university life, two types of relationships between teaching and research can be differentiated, one is based on the curriculum, called *formative research* and the other one is related to institutional policies, usually managed by Vice-Rector's Offices for Research, called *research training* (Parra, 2004; Moreno, 2005; Guerrero, 2007; Miyahira, 2009).

Formative research, defined as the use of the research as a tool of teaching-learning process, seeks the dissemination of the existing information for the student to incorporate it as a knowledge, and is managed and guided by a teacher, as part of his function, who teaches subjects under training, who are not professional researchers using research methods (Miyahira, 2009). Rojas and Aguirre (2015) say that based on the material reviewed, it was possible to observe two alternatives of articulating formative research to the curriculum: the first one limited to teaching the research methodology and the second one as a transversal component of the curriculum" (p.211), that is, an option in which there are some courses related to research methods, and the other one in which throughout the program, subjects developing research skills progressively are studied.

In general, Latin American universities play more a professional role, in which research, as we have mentioned, from the curriculum is related to the professional education processes, dealing with "contents related to research methods and problems of the disciplines that support the professional knowledge" (Parra, 2004, p. 58), with little or almost no contribution, in some cases, to the exercise of the profession. Therefore, some universities, according to the area of knowledge, have decided that the professional title is not obtained with research works that involve the scientific method, but, for example, with business plans, market studies, among other ways of research.

On the other hand, the subjects aimed at giving certain research skills to students, in several Latin American countries, including Peru, are taught by teachers with little experience in doing research. If they are full-time teachers, their hours are focused mainly on teaching or administrative activities, so they have few hours for research (Parra, 2004). However, currently, as a result of the licensing procedure in charge of the National Superintendence for Higher Education, universities require their teachers to have at least a master's degree, as well as publications, which in certain way guarantees some familiarity with research methods, although in some cases, the conditions for research and publication are at the expense of the researcher.

As for *research training*, which is subject to the type of professional the university wants to train, seeks to train professionals who generate knowledge, other than only its use, always under the monitoring or leadership of a teacher.

In Peru, the main universities that have a structure and dynamics that allow them to train researcher students and that coincidentally are the ones that are listed in international rankings of scientific literature, are the Pontifical Catholic University of Peru (PUCP), Cayetano Heredia University (UPCH) and the National University of San Marcos (UNMSM) to mention the most outstanding universities. After checking the website of their Vice-Rector's Offices for Research, reference is made to the fact that these universities have several activities for the promotion of the so-called "research seedbeds", which seek to train undergraduate students in research work with activities such as monograph and dissertation competitions with cash prizes, competitive funds for financing the preparation of thesis or research works between teachers and students. In addition, the PUCP has a program that supports the introduction to research aimed at students who from the third year of studies and under the guidance of a faculty advisor can do research using the necessary resources.

The research seedbeds are a strategy that has a constructivist basis and active methods that allows their participants, students and teachers a real participation, prioritizing the freedom and innovation to develop learning in a more effective way than training work in the classroom, which enables the formation and development of groups and lines of research, as well as the teaching-research relationship, strengthening the academic spaces. Both teachers and students, in any of these two situations: teachers, who decide to advice and guide research works of their students or otherwise, to lead research works with the support of young researchers, will develop a series of competencies that will help them to be better professionals and to strengthen their research skills. However, it is worth clarifying that as we have seen in the above-mentioned universities, this strategy requires a great institutional support, since economic resources, hour assignment, infrastructure, among other aspects are required. (Villalba and Gonzáles, 2017)

Other universities such as the University of San Martín de Porres, San Ignacio de Loyola University, National University of Engineering, Catholic University of Santa María, University of Applied Sciences (UPC), to mention the most outstanding universities in this regard, with the most recent Vice-Rector's Offices for Research, are also currently promoting research seedbeds in some of their forms, providing the respective institutional support.

Research and Development (R+D)

Innovation and development activities are related to social development. The university as an autonomous institution could perform this task independently. However, there is a more important impact when there is a university-company-state relationship. In 1968, Sábato and Botana developed the first modern model of this relationship called Sábato's triangle, which mainly proposes the fact that universities should interact with their environment, with the State as a governing entity that proposes the necessary policies and resources for the development of the technical and scientific capacity of a country and companies, the engine for employment and development

of a country by offering new alternatives of consumption of products and services in order to improve their productivity and competitiveness to remain in the market. This first model was accepted in Latin America and within that framework, several centers for technological development were created with the support of the government. After this proposal, in 1998, the Triple Helix model proposed by Etzkowitz and Leydesdorff arose, which puts emphasis on the effects of the interrelationships of the Sábato triad, emerging the so-called spin offs, startups, spin outs, centers for technology transfers, among other forms of entrepreneurship of individuals, groups and organizations. According to the same authors, innovation should be linked to the science produced by the university and the business practice, generating the economic and technological development of societies. (Ramírez & García, 2010)

An example of this last model in Peru is the spin off “Yacu Tec” of the University of Lima, which won in the 2015 edition of Start Up Perú the prize of 50,000 soles as a business investment. This initiative was the result of a joint work with the Agricultural Innovation Institute (INIA, by its Spanish initials) of the Ministry of Agriculture and Irrigation and consists in an eco-friendly electrochemical system for the production of ferrate and the direct use of its ions in the treatment of contaminated water with different heavy materials. This project not only seeks the social good, but also has a commercial perspective, like every spin off, companies established based on the research in the university. (Universidad de Lima, 2016)

As observed, the starting point is always research. Researchers when doing their job based on the social demand or production sector, ensure the economic development and progress, becoming their works in something innovating, not only because of their originality, but mainly because they are functional, necessary and are accepted by a sector, generating development. Unfortunately, in Latin America, researchers who belong to the technical and scientific structure are usually related to structures outside their country of origin, since in these other spaces, they have the necessary resources to do research, they are recognized and better paid. Given this situation, the

universities interest in research and development have carried out a series of attractive campaigns to “repatriate” their professionals, for example, in the Peruvian case, the Cayetano Heredia University has a program called “Return Scholarship”, which finances the salaries of young professionals that already hold a PhD degree for two years in order to prepare research projects and to increase their scientific production. In addition, as an initiative of the government, it is worth mentioning the Program of Repatriation of Peruvian Researchers of Innóvate Perú of the Ministry of Production, which allows the incorporation of researchers to public research universities and institutions of the country.

Going back to the international outlook, in developed countries, much research and technological development take place in the private sector and in the government’s research institutions, while universities, whose main function is research, are focused on attracting and educating qualified researchers and producing academic knowledge. Generally, in these countries, strategic alliances are made between the private sector and universities to conduct technical and scientific activities. India, China, Japan and South Korea are an example of it, with a model focused on science and technology research in large private companies. However, in recent years, they have invested in universities as centers for research, having as a reference standards of North American and European universities. Japan universities are better than the European universities in terms of its ability to adapt to the market needs. (Altbach & Salmi, 2011).

Being aware of the impact of the research, development and innovation on the economy and society, the European states have been generating policies and investments for the promotion and dissemination of the R+D+I (research, development and innovation) in all Europe for many years, currently developed mainly by public bodies such as research institutes, technological centers and specially universities. (Jiménez & Teba, 2007)

The so-called Technological Parks are a space where the trinomial mentioned above converges: university-state-company. They are an

initiative, usually public aimed at the sustainable economic growth in the area where it is implemented. To that effect, a space, which “promotes and houses research institutions associated with surrounding universities and knowledge-intensive companies, among which internal and external transfer of knowledge are stimulated and generated”, is created (Gil, 2014, p.5). The concept goes back to the 1950s, with the Stanford Research Park created by Stanford University in the United States where General Electric and Hewlett Packard were established.

Silicon Valley was the main reference of a virtuous innovation system in terms of technological parks. This is mentioned since it is not easy to make this trinomial work, for example, in Europe, until the end of the 20th century, there were serious difficulties for the public R+D to become interested in the business cooperation, giving priority to scientific research without an approach to market. So in 1995 in the report about the book *Verde de la Innovación*, the European Union accepted the failure of its innovation system, and it considered the difficulty of converting knowledge into products and services as the main cause, except for countries like Ireland and Finland, unlike Japan and the United States, their direct competitors, whose policies and results showed a better adaptation to the market. (Romera, 2003)

In Latin America, countries that stand out with physical operating technological parks are Brazil with 22 and Mexico with 21 (Gil, 2014). In the Peruvian case, there are 10 projects in Arequipa, Piura, La Libertad, Huancayo, Huánuco and Tacna and 4 in Lima. These last ones are initiatives of the Cayetano Heredia University, the Pontifical Catholic University of Peru, the National University of Engineering and the National University of San Marcos (National Council for Science, Technology and Technological Innovation, 2014). Taking into account that the technological scientific parks are an important tool for the relationship between university, industry and society in order to increase the country competitiveness and improve life quality, CONCYTEC supports the development of these parks so that they leave the incubation period, according to the recent information of

their website. It would be important to review which specific actions the Peruvian government is taking to improve the implementation of these parks.

Conclusions

As a result of the teaching and research activity, the universities have diverse equipment and specialized personnel in their laboratories, research institutions and other facilities. In order to maximize the social use of these resources, to help keep the equipment, as well as to generate income for the university, there is an initiative to provide specialized services supporting activities of R+D+I for internal clients, as well as for diverse public and private entities. In the absence of studies reporting quantitative or qualitative data in this regard, some web pages were reviewed. American universities such as Stanford, Harvard, the Technological Institute of California; in case of Spain, the University of Oviedo, Polytechnic University of Valencia, Polytechnic University of Madrid, just to mention some of them, have this service. In Latin America, the University of Sao Paulo, the Autonomous University of Mexico, the Monterrey Institute of Technology and Higher Education and the University of Buenos Aires stand out. In case of Peru, the websites of the following most outstanding universities in terms of scientific activity and that have public information about the services they provide in their websites were checked: the Pontifical Catholic University of Peru, which offers solutions to problems of the production sector in order to make their products or services more competitive, with 40 programs, having around 20 organizations as a case of success. The National University of Engineering offers laboratory services for industrial, construction and energy sectors. The Agrarian University- La Molina offers training, extension and services in water resources.

Based on the review, it is inferred that Peruvian universities still have to analyze the potential of their human resources and infrastructure, even

more so taking into account that due to the quality assurance processes that all Peruvian universities are going through, since around 2016, they have implemented laboratories and workshops with the necessary infrastructure to develop a competency-based training. By making this analysis, this type of services can probably be expanded to organizations, depending on the programs of the university, generating additional resources.

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