



An analysis of the doctorate career in Argentina. With some bias to the health sciences.

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of the academic degree of Doctor "

Definition of the doctorate:

The doctorate is formally defined in Resolution N° 168 of 1997 (Accreditation of Postgraduate Studies)¹, issued by the Ministry of Education : "It is aimed at obtaining real original findings in an area of knowledge, demonstrating universal endeavor, within a framework of academic excellence. This original contribution will be expressed in a doctoral thesis, of individual character, to be conducted under the supervision of a thesis director, and ends with evaluation by a jury, with a majority of members from outside the program, where at least one of these is external to the institution. The result is the granting

This definition has some flaws. The word "original" admits two interpretations:

- a) discovery or,
- b) the product of personal work (not a copy of another study).

If the doctoral student fails to produce a "real contribution" might failing to doctorate (unless the benevolence of the Jury qualify as such the product of their work). No objective definition of "academic excellence" is given. If the level of excellence is defined by comparison with the most advanced centers in the world, it means that only those schools that have a long career and receive significant academic and financial support could confer the title of doctor. It is hoped that the National Commission for Academic Evaluation and Accreditation (CONEAU) will contribute to raising the quality of doctorates.

A definition that seems superior was offered by Wikipedia in 2012²: "The doctoral degree is awarded in recognition that the candidate is capable of doing scientific research, which must be demonstrated by a research paper on a topic publishable (even if it is not published). The dissertation represents a modest contribution to human knowledge. It is evaluated with the defense of the thesis before a court, which hears an exhibition of work and then discuss with the candidate on the method used for research, sources or results." Currently, the definition provided by this source is less explicit: "the Doctorate is the latest and preeminent academic degree conferred by a university or other establishment authorized to do so."³

The dictionary of the Real Academia Española ⁴ gives a brief response, with three meanings. Doctorate: degree of doctor, studies necessary to obtain this degree and full and thorough knowledge in any subject. Other dictionaries agree in defining the doctorate as the highest academic degree from a university ⁴ and only differ in details such as the time involved: at least three years of graduate studies and a thesis ⁵, a two-year teaching and some years to research ^{6,7}, etc.

The structure of doctorates

The doctorate can be analyzed as a process that requires inputs and an operating mechanism that receive multiple influences connects three elements or areas of influence on the growth and development of graduate studies:

- **bureaucratic** defined by factors such as time and space required, duration, quality control, etc.,
- **academic** (defined by the quality, originality, creativity, rigor, clarity, courage, innovation etc. and
- **Economic** amount, source, persistent support in time, etc.

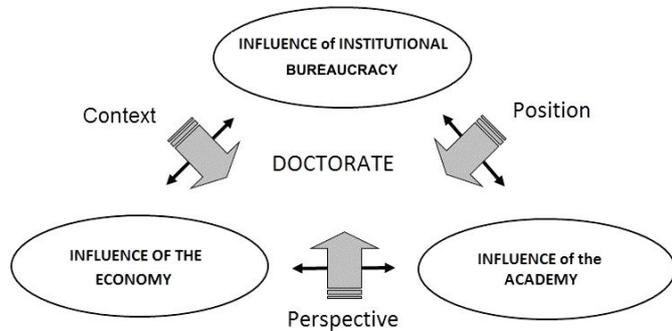


Figure 1.
Elements of the Institution that affect the operation of the Doctorate.

These three areas interact. Taken in pairs, economic and bureaucratic areas depend on the field of knowledge or historical, cultural or political influences. The economic and academic areas are affected by the view or perspective (national, international, values, beliefs, etc.) The academic and bureaucratic areas are affected by individuals, systems, institutions, etc. The quality of the academic community members, acting on each of the listed factors, affects the operation of the doctorate and the quality of the product.

The structure of doctorates is not uniform. The traditional structure require a more or less extensive studies as pre-processing steps to insure a successful thesis; others have a requirement for a Master's degree (preferably scientific) and in all, conducting an investigation culminating in a dissertation. A third type ("custom" or "structured"), where the trainee has a program of specific courses or seminars, consistent with the proposed topic for his thesis; the program must be approved by the Director of Thesis.

The operational definition adopted by the Commission of the Doctorate in Biomedical Sciences, School of Medicine, Rosario, states that a the doctorate is a postgraduate course designed to learn the profession of researcher in the area of experimental science. The area is chosen by the Director concerned. This definition is broad and of simple application The Director of Thesis (a key actor of the doctorate) is responsible for the selection and performance of the candidate. The operational definition enables appropriate decisions for any type of project and contingencies during its performance. For example, the reformulation of the thesis project of a candidate involved in a project that failed to obtain a grant by any agency. The product is the same as described above: thesis and its defense, publications, etc. The Doctorate thus becomes an optimal process or resource to produce teachers that will be required by medical schools in the future.

Laboral placement.

The University and other institutions. The Doctorate, the highest title awarded by the University, improves job prospects. The traditional structure that provides opportunities for academic research include a stable number of positions to be filled (though that number may decline or increase in the short term). There are other institutions that incorporate doctors to their scientific campuses: National Atomic Energy Commission (CONEA), National Commission on Space Activities (CONAE), National Institute of Agricultural Technology (INTA), National Institute of Industrial Technology (INTI), etc.

The National Council for Scientific and Technical Research (CONICET). To have a doctorate or to be incorporated into an accredited doctorate is one of the requirements of the National Agency for Scientific and Technological Promotion (ANPCyT) and CONICET fellows included in the projects presented in each call. CONICET's contribution to the production of doctors is very important because it provides the three aspects described above: contributes to the maintenance of doctoral and postdoctoral fellows, supports the financing of the project (operating expenses and equipment) and if the candidate would join the CONICET, this institution will provide a stable professional position with promotion prospects.

The Industry. An additional approach, not widespread and experimental in some universities seems to be the simultaneous acquisition of doctoral training and scientific and technological innovation. The professional doctorate highest level, taught in various Anglo-Saxon universities, and increasingly common in Europe, aims to generate a practical contribution in a professional field. According to industry officials of countries in the northern hemisphere ⁹, academic work does not take into account in its design the industry requirements for R & D and do not expose to doctoral candidates to the wide range of approaches needed to solve scientific problems. As a result a doctor whose thesis was focused on drug design, graduates without knowing what a clinical drug trial is. For them we would see that doctoral programs produce the interaction between chemists, biologists and bioengineers.

The prestige of a doctoral career is usually measured inside and outside the institution by the number and apparent importance of the thesis projects. This methodology has contributed to over produce doctors in developed countries ⁹. According to M.C. Taylor¹⁰ curricular and institutional changes must occur. One of the reasons why doctoral programs do not adequately serve graduates lie in the high degree of specialization of the required projects. These projects often require highly fragmented and/or curricular exigencies irrelevant in relation to the world outside the Faculty. The acquisition of experience in the practice of the scientific method is always essential but high specialization has led to doctoral candidates to become experts in such small areas of research, attractive only to researchers in the same area or subarea.

Prof. Matthew Might from the University of Utah ¹¹ has put into a sober perspective the product of the research of doctoral candidates, in connection with the advancement of universal knowledge. How the labor market will work with doctors is a problem that has not yet solved in most developed countries. Germany ⁹, for example, has reformulated in the last 20 years the doctoral program, approaching the solution of the problem of over-production of doctors. Slightly less than 6% of graduates in science access to full-

time academic positions. The long way to go to reach these positions of excellence and the low wages compared to that of industry, transform it into a good option after the doctorate.

In Argentina there are very few highly developed industries applying research and development at the universities. It is clear that doctoral graduates will find a satisfactory job opportunity with the clear definition of scientific and geographical areas requiring special support (because their development is absent or incipient). This would lead to an overall harmonious development and solve (temporarily, because this is a dynamic problem) the issue of full employment of doctors.

A homogeneously developed country should coordinate the production of doctors with job opportunities. Industry might not be the best option for all doctors. During my postdoc, I met doctors who had left his job in the industry, tired because his work was abruptly interrupted (when it was most interesting to them) because the industry targets had been met and had appeared other attractive issues for the company. For a researcher the freedom to guide their work often has more value than remuneration.

The view that the production of doctors is excessive and inconsistent with their employability is not unanimous¹² and ignores the magnitude of the problems that science should help to resolve in the near future. The list is extensive: environmental degradation, sustainable sources of energy, natural disasters such as earthquakes or fall of celestial objects, famine, violence, and in the field of medicine in our country: infectious and parasitic diseases (Chagas disease, tuberculosis, Leprosy, Leishmaniasis), sexually transmitted diseases and other infections that are much more serious in malnourished children. Then come the prevalent chronic non-infectious diseases, over which control or prevention measures should be emphasized (hypertension, diabetes), threats such as antibiotic resistance, etc. These problems are urgent and important and require a large cadre of researchers (and intelligent politicians) determined to improve the quality of life of the population.

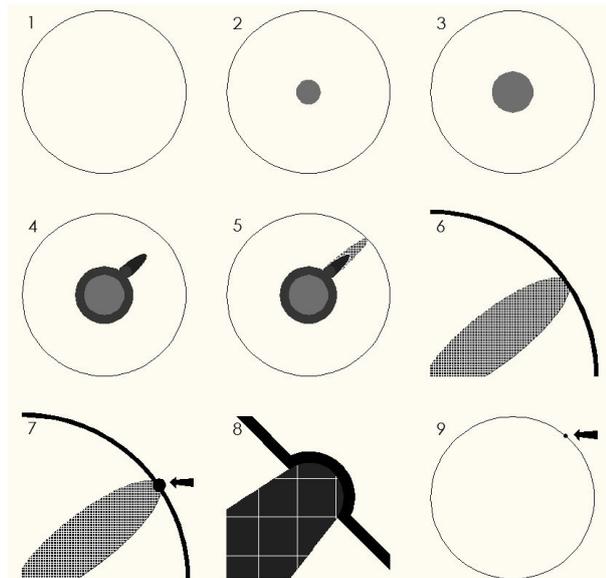


Figure 2.

(1) Imagine that the circle contains the human knowledge. (2) After completing primary school all the knowledge of a person may be represented by the central dark area. (3) Knowledge is widened after completing high school. (4) A college degree will be conferred with more specialized knowledge. (5) Outstanding student can approach the limit of what is known in a given area. The prosecution of the doctoral thesis could lead to the limits of knowledge of their area of expertise (6,7). At the conclusion of his thesis, his contribution can be represented by the dark spot projecting over the limit (7,8). At this time the student feels very happy to have changed the limits of knowledge. A few weeks after the defense of his thesis, the graduate appreciate that his contribution is a tiny aggregate (9) to universal knowledge, which will soon be surpassed by others.)

A general view of scientific growth

In 1956 Derek J. de Solla Price ¹³, proposed the "Law of exponential growth of science". To justify it, he resorted to quantitative observations concerning growth of scientific journals, authors, articles, number of universities, discoveries, etc. According to the variable analyzed, this stage can last a long time. For example the number of scientific journals grew exponentially between 1750 and 1956 ¹³. I did not find more recent data but the growth of scientific activity, commercial activity (drugs and instruments) associated with scientific growth along with the publishing-commercial activity in production magazines suggest that the exponential growth continues.

The law of exponential growth coincides only in the initial section with logistic growth curve. (Fig. 3 Scheme A). With living beings, indefinite growth is not known. The logistic curve is characterized by reaching an asymptote or level of saturation after which, if a new growth strategy appears (technical and social change, depending on the quality of the variable under study) growth will continue (Fig. 3 Scheme B). Such is the case of the number of known elements (chemical elements, gases and rare earths) that reached the asymptote of 60 towards 1850

and has had several steps with the advent of successive atomic particle accelerators (the number of "physical" elements reached 100 in 1950 ¹³). Another interesting example is the number of European universities which reached a maximum of 80 by 1600 and then increased by the social and cultural changes of the Renaissance and did so again by the impact of the Industrial Revolution (XVII and XVIII centuries).

Returning to the problem of job placement of young doctors, the data to investigate is number of researchers that the country needs (the value of the asymptote of the logistic curve). Since its creation in 1958, the growth of CONICET over half a century of activity is an experiment whose analysis would be highly revealing.

Over the past 50 years, I have been a participant and witness to the national scientific activity. The annual contributions from the National Treasury to scientific activity have not been consistent. It is easy to imagine that the number of researchers in activity may have fluctuated in different ways (Fig. 3 Scheme C), with serious damage in the perception young researchers toward the system stability. The trajectory of convergent oscillations (Fig. 3 Scheme D) would be achieved with a state policy with clear tendency to reach the asymptotic growth.

There are national universities and provincial governments that have adopted the position of not to make contributions because the ANPCyT and CONICET (main bodies

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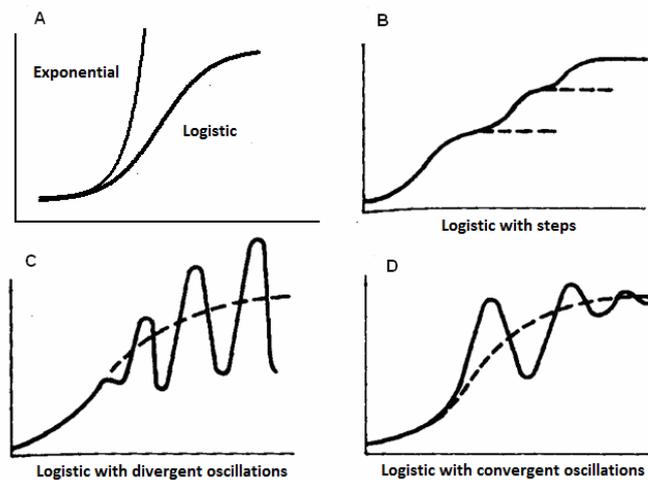


Figure 3. Schemes A, B, C y D

Examples of growth curves. For all the schemes, the unit of the abscissa is time and the ordinate is the number of researchers.

for the national promotion of science and technology) make all necessary contributions to scientific development. When those provincial governments and universities make such contributions, they are usually of negligible amount (with noteworthy exceptions), indicating the absence of their own scientific policy.

Growth and development of the doctorate.

The scientific growth Argentina depends on the number of investigators and its researchers' based system. The scientific system can be assimilated to an inverted pyramid, which rests precariously at its apex, i.e. in the process of formation and inclusion of graduates to the system. The emergence of research managers, a key element of the system depends on the flow of new blood.

How is the birth and growth of a doctorate? My experience indicates that an "initial critical mass" of dedicated researchers (future teachers and potential doctoral thesis supervisors) is required to provide the working schema and to produce the initial decisions that end in the draft of Regulation, the proposed Curriculum offered and operational characteristics of the doctorate. To operate with natural authority the future doctoral thesis shall be consistent with the areas in which the members of the "initial critical mass" are experts.

The Doctorate will growth if the Institution provides the basis for retaining their highly qualified graduates, thus initiating the "inbreeding" process. Further growth can also occur by incorporating a researcher outside the institution (because he gained a competitive academic position or by the creation of new academic positions through the decision of the authorities of the institution). To learn about the relative position of the institutions within the academic universe or their contribution to general knowledge, the authorities may find actualized information in the Scimagopage <http://www.scimagojr.com>, (buttons "compare" and "map generator").

As the doctorate goal is academic and not professional, the absence of "critical initial mass" of preferably full-time researchers, explains the distribution of Doctorates in the institutions listed in Table 1. The table also includes the number of doctorates projects, indicating the intention of institutions to implement them in the future.

An analysis of the doctorate career in Argentina.
With some bias towards health sciences.

Geographic Area	A	B	C	Ns	Total	Projects
Universities with accredited Doctorates						
Great Buenos Aires						
Universidad de Buenos Aires	19	6	1		26	1
U. Arg. John F. Kennedy			1	2	3	
U. Católica Santa María de los Bs. As.	1	1		11	13	
U. de Belgrano			1	2	3	
U. de Ciencias Empresariales y Sociales			1		1	2
U. Favaloro		1		1	2	
U. de Flores				1	1	
U. de Palermo		2	1		3	1
U. del Salvador		3	7	5	15	
U. Maimónides				1	1	1
U. Torcuato di Tella		1			1	2
U. del Museo Social Argentino				2	2	
U. del CEMA				1		2
Facultad Latinoamericana de Cs. Sociales		2				
Instituto Tecnológico Buenos Aires				1		
U. Nac. de Morón				1	1	
U. de San Andrés				2	2	2
U. Nac. Gral San Martín	4	3		1	8	1
U. Nac. Gral. Sarmiento	4	4		1	9	2
U. Nac. 3 de Febrero		1			1	1
U. Nac. de Quilmes		3			3	
U. Nac. de Lanus	1				1	2
U. Nac. de Lujan				1		
U. Nac. de La Matanza				1	1	
U. Austral	1		2	2	5	
					Total: 102	
Rest of the Buenos Aires province + La Pampa province						
U. Nac. La Plata	13	9	4	1	27	2
U. Nac. Mar del Plata	3	2	3		8	
U. Nac. Centro de la Pcia. de Bs. As.	3	2			5	1
U. Nac. del Sur	11	5	3		19	
					Total: 491	
NOA (Northwestern Argentina)						
U. Nac. Tucumán	5	3	8	1	17	1
U. Nac. Jujuy				1	1	
U. Nac. Salta	2	1	1		4	
U. Nac. Catamarca			3	2	5	
					Total: 27	
NEA (Northeastern Argentina)						
U. Nac. Nordeste	1	2	4	2	9	1
U. Nac. Misiones	1	1		1	3	1
U. Nac. Santiago del Estero		1			1	
					Total: 13	
Central Region of Argentina						
U. Nac. Córdoba	17	17	3	4	41	2
Universidad Tecnológica Nacional	1	4			5	
Un. Católica de Córdoba		1		1	2	7
U. Nac. del Litoral	6				6	
U. Nac. Rosario	4	4	10		18	4
U. Nac. Río Cuarto	2	2			4	
U. Nac. Entre Ríos				1	1	
U. Adventista del Plata				1	1	

Geographic Area	A	B	C	Ns	Total	Projects
Universities with accredited Doctorates						
Instituto Universitario Italiano de Rosario			1		1	
U. Católica de Santa Fe			4		4	1
Total: 79						
Cuyo Region						
U. Nac. de Cuyo	3	3	3		9	1
U. de Mendoza				4	4	
U. Nac. de San Juan	3	2	3	1	9	
U. Nac. de San Luis	5	4	6		15	
Total: 37						
Patagonia						
U. Nac. del Comahue	2				2	
U. Nac. de la Patagonia San Juan Bosco			3		3	
Total: 5						
Totals	112	90	73	56	326	

Table 1.
Number of accredited doctorates in six geographic areas and their qualifications according to CONEAU

Distribution of Doctorates in the Argentina

Table 1 shows the number of accredited doctorates (CONEAU until January 2011), in 14 different subject areas of knowledge, in seven regions that I have arbitrarily divided the country Greater Buenos Aires (Buenos Aires city plus 24 parties that surround it), provinces of Bs. As. + La Pampa, Northeast of Argentina, Northwest of Argentina, Center of Argentina, Cuyo and Patagonia (Figure 4). To calculate the population density of selected regions I have taken the data of the National Census 2010¹⁵. The Table shows the number of doctorates based on the ratings assigned by peer reviewers: A (excellent), B (very good) C (good) and NS (credited but not requested rating).

Table 1 lists the names of universities with accredited doctoral programs in each region.) Shows the positive relationship between the number of accredited doctorates as a function of the population density (thousands of inhabitants/km²) of the area of influence of the universities. I admit that it is difficult to interpret the ratio of the number of doctorates with respect to the population density of the area of influence. At the left of the figure, six areas gives a regression slope of 2.3 ± 0.6 (mean ± standard error) doctorates per unit of population density (1,000 inhabitants/km²; R² = 0.8472; P = 0.0044). Based on their high statistical significance I assume that the slope value defines the number of doctorates that cover the needs of the population of a given area. It seems unnecessary to demonstrate that a Doctorate is a living organism in close relation with its habitat. Such relation is highlighted by defining two terms of ecology: "habitat" (place where the organism lives) and "ecological niche" (role as part of the ecosystem). The ecological niche is not physically demarcated space, but an abstraction which includes all the factors that need a doctorate to live and grow. I leave this area of research to experts in ecology.

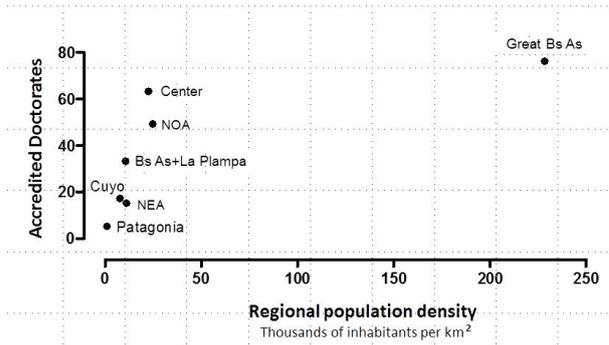


Figure 5. Relationship between the number of accredited doctorates up to February 2012 (all areas of knowledge considered) in seven regions of Argentina, as a function of the population density of those regions.

I have considered separately the number of doctorates in Greater Buenos Aires (Buenos Aires City and its surrounding area), whose population density is 10 times higher than the other geographical areas and outside the confidence interval of 95% from the previous regression. I leave the reader to ponder the causes and consequences of this difference.

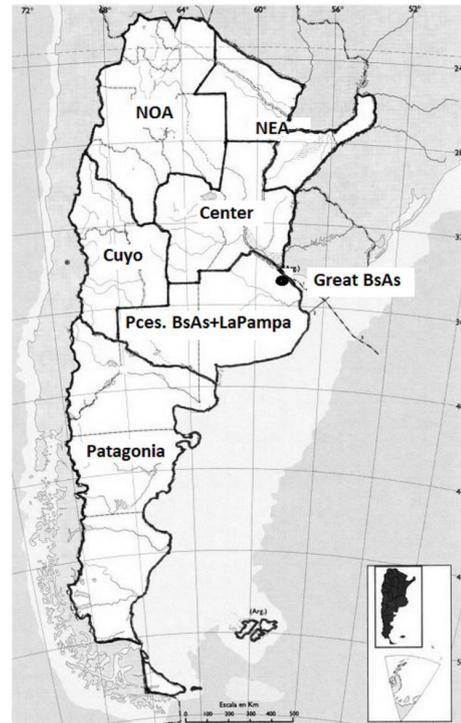


Figure 4. Map of continental Argentina, arbitrarily divided into 7 regions.

About the Research Directors

A small proportion of undergraduate students "feel" that academic activity (teaching and research) could be the activity to fill his vocation, complementing employment with job gratification. In my experience this proportion is 1 to 3% of the population. Those who feel strongly inclined to research typically offer themselves to work with a researcher who caught his attention. These small fractions of students spontaneously stand out by its ability, commitment, discipline, knowledge or other personal virtues. Occasionally, a vacancy may allow this student to occupy a position in the academic ladder.

- The director of the thesis is a key factor in the training of future doctors. In my experience, successful directors are those that establish an emotional relationship with the doctoral student, have teaching vocation and are willing to teach the art in its many facets, start working on the issue of competence or expertise, and establish with the candidate's the implicit contract of mutual interest: the student will contribute to advance the Director's topic of interest and the Director will teach the craft working together to end with obtaining the posgraduate degree. The "meeting" of wills and trusts alluded to above need time to fructify.
- In the area of health sciences the student can consider two alternatives: clinical or experimental research. The basic difference is the investigated

subjects: humans or animals. The research topic is secondary to learning the craft of research. For the future clinical researcher, elements of the search for scientific evidence is acquired much faster starting research in animals, which have far fewer ethical constraints in implementation.

- The choice of topic is a complex matter. Young graduates would like to enjoy the exceptional situation of Mr. Charles Best, a medical student, collaborator Prof. Frederick G. Banting in the discovery of insulin and co-author of the historic article "Pancreatic extracts in the treatment of diabetes mellitus" published in 1922 in the Canadian Medical Association Journal. The election of the theme is decided by the Director who shall advise the doctoral candidate that a) research is a risk venture (it cannot ensure in advance its success) and b) that the main objective is to achieve the degree of doctor (and not his/her national or international personal projection).

The money cost of the Doctorate

- Solved the research topic, the next consideration is the cost of to the Doctorate. Technological advances have urged the completion of doctoral theses, sometimes at the expense of learning the trade. Several factors, described in Figure 1 affect this matter: a clear definition of the objectives of the doctorate in each institution, clear and explicit definition of the dissertation contents, science policy of the institution, desires and fantasies of the director and the doctoral student, etc.
- Clearly, the alternatives are:
 - a) that the director is a beneficiary of a grant that would meet the costs of research,
 - b) the doctoral student is a beneficiary of a grant or a doctoral scholarship,
 - c) the doctoral student takes over research expenses. The first option allows the director to advance knowledge of the subject involving the doctoral student whose personal expenditures should be covered by his/her family or part-time work (which would affect adversely their concentration in the thesis). The second option frequently occurs when the candidate and the director know and appreciate each other and the director supports the application of the candidate to an institution that provides doctoral scholarships.
- Some doctorates are becoming inaccessible to students, which in most cases live with a doctoral fellowship from CONICET. The Doctorate in Biomedical Sciences, Faculty of Medicine (UNR) monthly consumes 5% of the scholarship. In other doctorates it can reach 15%.
- The third option is of exceptional occurrence and availability of laboratories, space and dedication of the applicant are key factors to the development and happy ending of the doctorate.

It is sad to note that the number of candidates to undertake doctoral studies in order to respond to its vocation is decreasing. This circumstance should be appreciated and settled by the authorities of the institutions, since as discussed above, the production of doctors is directly related with elevation of the scientific level of the teaching staff.

Expectations and possibilities.

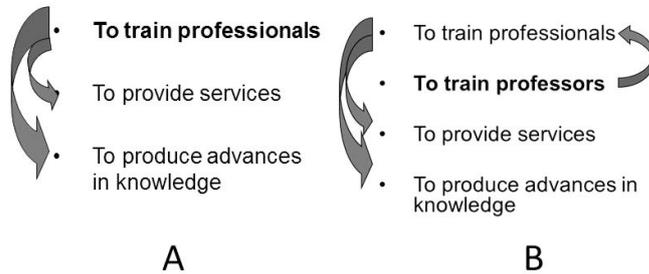


Figure 6.
Two models focused on the activity/academic conduct of our faculties.
Panel A: emphasis on the training of professionals.
Panel B: training of professionals with particular care in the in the training of future professors..

The academic development of graduate doctorate candidates should be considered as the basis of generational change of teachers in activity. I do not see that adequate importance is given to this issue. I see more often that Faculties put exclusive emphasis on the model of Figure 6A: training professionals to provide services and if possible, produce some progress in knowledge. If emphasis is put on the care and feeding of the small group of students alluded to above

(model B), I'm sure it would improve a) the training quality of professionals, b) the production of advances in knowledge and c) the quality of future teachers. To progress in the academic career requires:

1. to know oneself,
2. to have clearly identified the objective to be achieved,
3. to prepare and await the opportunity and
4. to access the desired position when it comes close.

The problem faced by each candidate is the timing with which the stages occur. Stages 1 and 2 are resolved along undergraduate studies. If they are sure of their vocation and have known and were accepted by a director during the studied, it is very likely to be able to enroll in an accredited doctoral immediately upon graduation and finally enter in step 3. The third stage is an opportunity that is renewed annually. But whose resolution (registration, evaluation and resolution of the project) will consume one year (or more). This process can successfully conclude at the first try or not be produced. If not given, the development of the thesis can still pass, with greater or lesser difficulty, and conclude with a successful thesis. If so, the graduate will work during the scheduled duration of the project on developing his thesis. Then the candidate can attempt to get a postdoctoral fellowship. If successful, this will extend for two or three years the time to decide his/her future.

Applicants often ignore the stages of evaluation of the projects that have been proposed as fellows and pin their hopes on the ability and experience of its directors. The latter usually do not explain the details of the process because, I guess, to not discourage the expectations of applicants.

The System for Evaluating Scientific and Technological Projects (SEPCyT) is organized into 16 areas covering different disciplinary fields and / or theme. Each of these areas is run by a committee composed of Coordinators 3 members appointed

by the Board of the Agency which is renewed annually. When research projects are presented to the ANPCyT, evaluators qualify the intrinsic quality of the submitted project, which is made from the analysis of the project by national peers and abroad and consideration of the relevance, which is determined from the appropriateness of the project to the terms spelled out in the notice. This instance is assessed by the ad-hoc committees.

Do we produce doctors in excess?

The factories of doctors are the universities. The Doctorate is a very rewarding experience for all who assume it: they are better prepared to investigate and have a concrete idea of applying the scientific method to solve problems. They will live a unique, quite different to those experienced during graduate school experience, professional quality work, passionate and exciting, committed to scientific truth. A fraction of what we would like for the whole Argentina, every day.

A further reason why we should have more researchers was exposed to us years ago by Dr. Sol Rabasa. He stated that the fate of an investigator was to become director of a group with consequent reduction in their time of personal research, dealing with administrative tasks that helping to improve the growth and development of the group, enhancing the working platform for young new entrants. The increased production of doctors raises the likelihood that they will eventually have access to executive positions in the scientific field and benefit system operation with their experience.

The limitation occurs by defects in the quality of projects or insufficient budget forecast? Is money available the factor that defines the number of projects that become funded?

The selection process conducted by SEPCyT concludes with the assignment of a score that defines the chances of receiving funding. As stated above no country can finance all projects submitted to it. But it seems clear that the receipt of funding depends on the quality of the project. This approach improves the chances of the incorporation of fellows proposed by senior researchers at the expense of those proposed by young directors. This raises a disturbing question: We will not be losing creative candidates because their directors are young? The answer to this question would be the subject of an action plan of the National Institutes of Health ^{16, 17} which aims to reduce the age at which a researcher receives its first grant.

Has the national scientific apparatus reached its maximum size or capacity in relation to the country's needs? Answering this question would require the results of an investigation into the scientific and technological demand and supply in Argentina, whose existence is not known. By the number and magnitude of problems requiring research set out above, it appears imperative to formulate of a plan incorporated into a state policy. According to Dr. Alejandro Fainstein, deputy

director of the Instituto Balseiro, "The bottleneck today is the availability of a critical mass of highly qualified human resources." ¹⁸

Research is a risk venture, so that aspiring doctors should have the mystique that allow them to persist, despite setbacks in its attempt to join the academy, scientific system or the domestic industry.

Finally, three short answers to three pertinent questions.

For whom is it important the doctorate?

- a) For the Faculty: because it is an efficient mechanism to produce highly qualified scientists and teachers and
- b) For undergraduate students willing to join the academic staff of the Faculty.

Why is it important for the institution? Because it extends the merely professional view of undergraduate studies.

How to transform a doctorate into an important component of the institution? The answer to this question depends on the joint efforts of the institutional authorities together with the investigators willing to accept the moral and technical responsibilities in the training of future investigators.

Acknowledgement

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