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## Quality Assurance of Post-Graduate Education: The Case of CAPES, the Brazilian Agency for Support and Evaluation of Graduate Education

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**Abstract:** The authors discuss the CAPES Foundation, the Brazilian Agency for Support and Evaluation of Graduate Education. They also present and discuss the current data and status of the Brazilian venture for developing human resources and for the formation of an active community dedicated to Science and Technology, giving a general vision of its importance for the present and future development of the country.

**Keywords:** CAPES, post-graduate education, quality assurance of post-graduate programs, Brazilian science and education, Brazilian scientific production

### Introduction – A Short Brazilian History

Brazil was discovered by Portuguese sailors who landed in Porto Seguro, Bahia in April, 1500. It was maintained as a colony of Portugal until 1822. For three centuries, natural resources such as Brazil wood, sugar cane, coffee, gold and precious stones, were freely exploited. The wealthy and opulent natural resources also attracted foreign invasions (France and Holland, for instance). The first cultural and scientific institution – The Botanic Garden, was founded in Rio de Janeiro in 1808, when the Portuguese Royal Family was established in Rio de Janeiro. D. Pedro II was Emperor from 1840 to 1889, when Brazil became a Republic. Although a few professional faculties were created at the end of the XIX century, the first research university (USP, the University of São Paulo) was only created in 1934.

### The Brazilian Higher Education System

The Brazilian higher education system is entirely new. By the middle of last century, Brazil had only a few universities. The Federal University of Paraná (UFPr) was created in 1912. The University of São Paulo and University of Brazil, now Federal University of Rio de Janeiro (UFRJ), were formed in 1922 and 1934, respectively, including then-existing schools of medicine, engineering, law and others. In fact, the University of São Paulo (USP) was the first that included regularly the concept of research into the academic activities. Several other public universities were formed or created much later. The great majority of the post-graduate courses are within the public universities. Many, but not all of them, are recognized as having high educational standards in Brazil. Public universities are supported by either the federal or state governments, and hold most of the post-graduate courses: 80% and 90% of Masters and Ph.D. courses, respectively. Some exceptions among the private institutions do exist, especially within Catholic and other communitarian universities.

Today, this higher education system has grown to a quite multifaceted and uneven educational system, which generated actual challenges to Brazilian authorities in an attempt to better equilibrate the whole system. Thanks to poor regulatory procedures and through the belief that the market would take care of education quality, a deteriorating process for

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accreditation of new institutions progressed rapidly. On 2009, there were over 2,314 institutions, including both public and private ones, covering both universities and isolated faculties:

- a) 245 public universities at the three government levels: 94 Federal; 84 State (Länder) and 67 County (Statt), and
- b) 2,069 (89.4% of the total), including two types of private institutions: 1,779 profit oriented and 290 philanthropic.

The public system accounts for 11% of the higher education institutions, 37% of the teachers (ca 132,000) and about 27% out of 6.3 million students. Considering the ten largest universities in undergraduate and graduate students, only two public institutions (USP and UNESP) are included in both groups while none of the private ones is present in the second group (that of graduate studies). Furthermore, in the first group, the ten institutions account for 14% of the students while in the second group the ten universities enrolled 46% of the graduate students. This information allows some inference about the quality of the whole Brazilian higher education system.

The federal system has been facing several changes in the last years. The budget of the Ministry of Education (MEC) has increased three-fold since 2004 to US\$ 41 billion in 2010; an expressive expansion that the federal university system is under way: from 43 institutions in 2002 it is now 59 universities, increasing from 43 to 230 campuses covering 187 more cities not attended by federal institutions before. A similar expansion of the Technical Educational Institutes covers the whole country today. Enrollments at both group of federal institutions increased consistently. At undergraduate level, an evaluation procedure is underway: the National System for Evaluation of Higher Education (SINAES). It was established in 2005, and it has generated some consequent results. Through this process several courses and institutions are facing requirements to improve their educational output.

### **Some Notes on Brazilian Science and Technology (S&T) System**

The Brazilian Science and Technology (S&T) system is also quite new. Until World War II, Brazil had a very small number of scientists and little institutional base for research. Industry was incipient, mostly in traditional sectors. Grant support agencies were then created: CAPES and CNPq in 1951, FINEP in 1967 at the federal level, and FAPESP in 1962 at São Paulo State. Graduate programs and full-time faculty positions were established only in 1960s.

Since the 1970s CAPES, CNPq, FINEP, FAPESP and more recently several other state foundations have been strongly supporting the institutional as well as the individual basis for research. Today, S&T in Brazil comprises about 28,000 research groups with 129,000 researchers (63% Ph.Ds), working in 452 institutions. The budget for S&T has increased substantially in the last decade. The budget of the Ministry of Science, Technology and Innovation (MCTI) accounted to US\$ 6.5 billion in 2010, a six-fold increase when compared to the year 2000. Several projects are under progress with the National Institutes of Science and Technology (INCTs), which include 123 large projects supported by MCTI, State Foundations, CAPES and other federal organisms.

These agencies have their own objectives in supporting S&T and thus provide several kinds of fellowships for scientific training (especially CNPq and CAPES at a higher level, and FAPESP, other FAPES and organizations such as Petrobrás at a lower one). They also provide funds for operating expenses directly to the courses (CAPES) and/or fund competitive research grants on both an individual (CNPq, FAPESP, other FAPES) or institutional (FINEP) basis. As a result of their common mission, CAPES, FINEP, and CNPq share several activities.

### **The Case: Capes' History and Responsibilities**

CAPES Foundation is a federal agency within the Brazilian Ministry of Education. It was instituted in 1951, having as its main mission the support of capacity building through graduate education and scientific training of human resources in order to strengthen development of higher education, science, technology and innovation in Brazil. Its main actions were designed to evaluate, accredit and finance Brazilian post-graduate courses, thus to devise policies to enhance the qualification of professors and researchers. Specifically, these actions are developed through: a) institutional grants and scholarships for Financial support of graduate programs in Brazil; b) additional support through induced research projects on strategic fields with reduced scientific work force; c) provide access to scientific information (Virtual Library); and d) to promote international cooperation granting both scholarships abroad and joint research projects.

Due to six decades of accumulated experience and being recognized as having successfully conducted its assignment concerning the post-graduate system, in 2007 CAPES received from the Brazilian Government a new mission: the training and qualification of teachers for fundamental and secondary education. To cope with its expanded mission, today CAPES comprises seven Directories: Evaluation; Programs and Fellowships; International Cooperation; Information Technology; Administration; Basic education and Long Distance Education.

### **The Brazilian Post-Graduate Program (PNPG)**

A National Post-Graduate Program (Programa Nacional de Pós-Graduação, PNPG in Portuguese) was established in the mid-1960s (Guimarães & Humann, 1995) and had its first regulatory rules instituted in 1965 by an act of Conselho Federal de Educação (CFE) based in a document named *Parecer Newton Sucupira*. This act allowed well established and scientifically active research centers to offer post-graduate courses. At that time several young PhDs were coming back to Brazil from their studies abroad, especially from North American and European universities. There were also several foreign scientists that joined some Brazilian universities and research centers. CFE's act set up the rules and procedures for operation of PNPG, allowing both universities and research centers to be qualified to submit to CAPES their proposals of masters and doctorate courses. This act has been the basis for subsequent laws made compulsory for both public and private institutions -no matter their recognized autonomy- to submit to CAPES for its evaluation and approval of any proposal of a post-graduate course in Brazil. This means that no valid title can be granted by any institution without passing through this procedure first.

Today the post-graduate programs (under the responsibility of the Evaluation Directory) are distributed in nine areas and a total of 48 subareas. Each one has a scientific Coordinator, indicated by all the authorized courses of that subarea and comprising more than 900 consultants working for CAPES in a peer review manner.

Since the 1960s, PNPG has been growing progressively. In the last decade, it has grown at a rate of 10% per year (GEOCAPES, 2012) both in terms of new courses and in the number of Master's and Doctoral degrees conferred. The graduate programs are distributed in nine big areas of knowledge: Health Sciences, 17%; Human Sciences, 13%; Agriculture, 12%; Engineering, 11%; Social Sciences, 11%; Exact and Earth Sciences, 10%; Multidisciplinary, 10% and Linguistic, Literature and Arts, 6.0%.

In the year 2010, the entire system enrolled 180,000 students (2/3 Master and professional Master and 1/3 Ph.D. students), encompassing 55,000 professors and advisors. About 60% of the post-graduate students receive fellowships from CAPES (75%), CNPq (15%), state foundations (10%) and other sources (5%). Every year, the graduate programs attract many candidates, enrolling 60,000 new students per year. Table 1 summarizes the general data concerning the evolution of the post-graduate courses at both master and doctorate levels, including the crescent number of enrolled students and degrees awarded. A further view of the PNPG development and characteristics for an older period can be found in Guimarães and Humann, 1995.

Table 1. *Brazilian Post-Graduate System. General Data\**

Indicator	Master Level						Doctorate Level					
	1976	1985	1992	1998	2004	2011	1976	1985	1992	1998	2004	2011
<b>No. of Courses</b>	490	820	1,012	1,235	1,899	3,044	183	270	497	792	1,055	1,606
<b>Enrolled Students</b>	19,401	37,861	36,382	49,387	74,999	11,637	880	7,809	10,122	26,697	41,261	71,387
<b>Degrees Awarded</b>	2,171	3,931	6,861	12,351	26,658	42,830	138	716	1,504	3,915	8,093	12,217

\*Source: Data for years 1976, 1985 and 1992, are from Guimarães and Humann, 1995. Data for the years 1998, 2004, and 2011 are from GEOCAPES.

## Recommendation of New Courses

CAPES bears formal responsibility for evaluation of all post-graduate courses. The agency is responsible for recognition and approval of new courses proposed by the universities and research centers. Also, for recommending them to the Conselho Nacional de Educação (CNE, former CFE) for formal homologation and then to the Minister of Education for final approval, which allows the course to operate for five years. A new course can be proposed by a university, college or a research center. The great majority are public institutions, but there is a growing number of private universities applying for operation at the post-graduate level. Usually specific disciplines predominate among the proposition, however today's number of multi- and

interdisciplinary courses is growing in a fast motion. As reported before (Guimarães & Humann, 1995), “the basic requirements for new courses include the following backgrounds: (a) a nucleus of senior Ph.D.s who have had experience as advisors of post-graduate students and in the training of research personnel; (b) significant, regular and qualified scientific, artistic or technological production during at least the five previous years; (c) ability to obtain both individual and institutional research grants from both Brazilian and international agencies; (d) existence of adequate infrastructure, including library, laboratory and other physical space, supplies and equipment, and other general facilities applicable to each case. It is also required that the proposed course be recommended and approved by the academic governing bodies of the university or research institute and that these internal authorities and entities indicate their intention to support the new initiative”. The courses authorized to function receive a continuous follow up by CAPES where their outputs are collected annually, allowing unmistakable reevaluation of all courses every third year.

### **Evaluation of the Post-Graduate Courses**

Recognition and evaluation procedures under CAPES' responsibility are carried out through a peer review system. Once recognized by CAPES and accredited by CNE the course acquires formal status for five years, which can be renewed depending on the evaluation performance. Newly recognized courses are considered to apply for post-graduate fellowships (Master's and PhDs) from CAPES, CNPq, and Estate agencies.

Approved courses are annually monitored by CAPES. Their performance is reevaluated (peer review system) every three years, receiving grades from 1 to 7, where grades 1 or 2 disapprove the course which must be closed. In the 2010 evaluation (2007-2009 triennium), CAPES accounted for a total of 2,840 *stricto sensu* postgraduate programs submitted to the evaluating exercise. From this total, 321 programs (11.3% from the total) received grade 6 (204 programs) or grade 7 (117 programs). Final distribution of grades is as follows: Grade 3, 31.6%; Grade 4, 33.9%; Grade 5, 20.5%. In order to achieve those highest grades, the programs are required to perform at international level. For comparison, in the year 2000, the PNPQ had a total of 142 postgraduate programs out of 900 courses considered to be at international level. Additionally, in the last triennium's evaluation, 31,994 candidates received Doctoral degrees and produced 93,753 articles representing an average of 2.9 articles per thesis per year. Due to this effective evaluation system, some Brazilian scientific fields such as medicine have increased its performance to a significant international level (Guimarães, 2004).

The evaluation exercise is periodically performed by specialized, multi-member committees, composed of 15 to 30 researchers and professors for each subarea, comprising a total of 900 consultants in the last exercise (2007-2009). The evaluation process usually consists of the following steps:

1. Critical analysis of the course's performance and output for the three previous years. This analysis is based on the information presented in: a) The Course Coordinator's annual reports describing the most relevant information and b) Specialists' reports from periodic site visits;

2. Awarding preliminary grades (1 to 7) to each course in each specific subarea, usually in a comparative basis, made by a field-specific committee;
3. Re-evaluation and confirmation (or not) of the preliminary grades by an interdisciplinary larger committee named Comitê Técnico-Científico (CTC);
4. Generation of a national ranking of post-graduate courses for all fields.

### **The Annual Report**

As previously described (Guimarães & Humann, 1995), the basic information for each course presented in the annual report includes: number of concluded at the Master's and/or PhD level; subject area and titles of the dissertations thesis (master level) and thesis (doctorate level) as well as their author's and advisor's names; list of publications in specialized and qualified periodicals; participation of post-graduate students in the publications; a ratio of the number of thesis to the number of publications; average time for the conclusion of a dissertation or thesis; list of invited specialists as members of the examination boards; effort to increase the size of qualified faculty members (mainly of advisors); total number of students and ratio of students to advisors; curricula structure; description and level of disciplines administered; assignment of non-regular, advanced short- and long-term courses; effort to have visiting scientists and/or specialists invited for short periods as teachers and consultants and/or for long-term as advisors in specialized areas; extent of dependence from visiting advisors and consultants for teaching and output performance of the course; coherence of existing research projects with themes of thesis and publications as well as their integration; non-curricula though obligatory activities for the students such as journal clubs, seminars, teaching undergraduate courses, frequency and type of library use and online literature, field research and computational work. All of the items listed above are used by the committee, although not all are given the same weight of importance.

### **The role of CAPES**

Besides recognition and evaluation of all proposals and established post-graduate courses, CAPES finances the courses and grants induced projects in fields of high priority for the country. As the data for 2012, CAPES award a total of 75,000 masters, doctorate and post- doctorate fellowships in Brazil and 8,400 scholarships abroad.

### ***CAPES Virtual Library***

As part of its mission, an important component supporting the Brazilian Graduate Program is granted by CAPES' Portal of Periodicals, a virtual library created in the year 2000. The Portal's collection has grown significantly since 2004 (Almeida, 2010), which has made possible an augmented offering of up-to-date bibliography, allowing 320 Brazilian institutions - including universities and research centers (over three million users) - to access it through the Internet free of charge. The Portal includes, among others: 30,000 international scientific journals; 130 data bases including ISI, Scopus, Science Finder (ACS), six patent databases; 150,000 books of XVIIIth century and several other products. The Brazilian academic community gained free access to an extensive bibliography, thus impacting research production, and consequently,

the quality of the postgraduate programs. The cost of the complete virtual library covering all scientific fields accounted for US\$ 79 million in the current year.

### ***International Cooperation***

CAPES supports International Cooperation Programs through the following actions: Grant of scholarships abroad (*individual fellowships*); Joint Research Projects and University Partnerships; Bi-National Doctoral Colleges; Visiting Professorships; Outstanding Visiting Professorships and General International Cooperation Program. As a result of its previous and long term experience, CAPES maintains active international agreements with several institutions of the most developed European and North American countries. The agency also develops cooperation and share aims with Latino-American and African countries. Most recently, CAPES subscribed new agreements with the NSF, NIH, FIPSE, Fulbright Commission, and with some American Universities. Presently, the agency supports 700 joint research projects, university partnerships, and other modalities of cooperation with institutions from Germany, France, Spain, Holland, Portugal, Sweden, Argentine, Cuba and other countries.

In line with the country development objectives, in 2011, the Brazilian Government approved an Action Plan called *Science without Borders* to invest in expanding study-abroad scholarships at the higher education level. CAPES and CNPq are the agencies responsible for the implementation of the new program. The federal government will fund 75,000 scholarships up to 2015. Another 25,000 scholarships are to be granted through the private sector support and partnerships. Those 100,000 scholarships will allow an intense mobility of students and researchers to and from the most qualified universities in all countries. A total of about US\$ 2.5 billion is the estimated cost for the 4 years whole program. The main objectives of *Science without Borders* are:

1. Boost Brazilian science, technology, innovation and competitiveness through the expansion of international mobility;
2. Increase the presence of Brazilian researchers and students of various levels in institutions of excellence overseas; Brazilian institutions will open similar opportunities for foreign scientists and students;
3. Increase the innovative expertise of personnel from the technological industries;
4. Attract young scientific talents and highly qualified researchers to work in Brazil.

### ***CAPES Budget and Fellowships Award***

In order to cover all its assignments, CAPES budget have been increasing consistently, reaching US\$ 1.85 billion in 2011, six-fold the value of 2003. From this total, 77% was credited to grant 116,000 fellowships (at both basic and post-graduate education) in the country and 5,000 abroad. Two thirds of the budget is assigned to fellowships for post- graduate students.

## Impact of The Post-Graduate Program on the Development of the Country

Brazil is a fast changing country. As a developing nation, it is growing at an average rate of 4% throughout the past decades. Our sustainable growth has been achieved through a combination of fiscal and monetary measures with social policies designed to reduce our social inequalities, eliminate hunger and alleviate poverty. In addition, our democratic institutions are solid and stable. Despite of these improvements Brazil still faces several weaknesses to be overcome along the present decade, including: large economic, social, educational inequalities; poor children education in science and low innovation in many industrial sectors. Brazil has reached significant improvement in basic education in the last decades, making possible that every child has access to schooling guaranteed. Yet, there is much to be achieved and a major challenge nowadays concerns the effectiveness of teaching and learning in primary and secondary schools. An even higher challenge concerns to mathematics and science education.

Due to its territorial size, population and recent growth of GNP, Brazil faces the need to compete with countries of similar characteristics such as China, India, Russia and the United States of America. These challenges can only be confronted by investing in education and S&T development.

Brazil is a recent player in science and technology output, however most of the social and economic achievements mentioned above were based in S&T results attained by the country in the last four decades. As responsible for formation of new scientists and universities professors, PNPG played an important role in these developments. Despite of its young system of higher education and research, Brazil's scientific production has increased substantially in the last three decades, reaching an average growth rate of 10.7% per year. With that performance, Brazil has been growing at a pace five times greater than the world average. The country has moved up to 13<sup>th</sup> place in the international ranking and at the 21<sup>st</sup> place concerning the quality (impact factor) of its science among the 30 most productive countries in the world.

Since its beginning in 1951 the investment made to develop this plan has been worthwhile:

- 1) S&T activities were institutionalized as seen in more than 28,000 research groups presently established throughout the country.
- 2) Brazilian scientific output has increased continuously in both quality and quantity, where publications in the most acknowledged international journals and periodicals increased progressively, reaching today approximately 34,000 international articles per year, placing Brazil in 13<sup>th</sup> position in the world ranking. Added to this, another similar number of publications in subjects of more local concerns were published in a selected group of Brazilian periodicals and journals, also supported by the official funding agencies. Taking together the internal and external publications, accounts for 2.9 articles per thesis per year thus giving a rough idea of the students thesis' quality and significance.
- 3) Numerous technological advances in many fields have been achieved and continue now days throughout the country. The most impressive result of this effort is the acceleration

and improvement of a more productive and internationally competitive agriculture and agribusiness industry: i) established competence on deep water petroleum exploitation; ii) development of a robust metallurgical complex and metal-mechanic industry; iii) paper-cellulose complex production; iv) a most sophisticated bank automation system and v) foundation of a competitive aircraft industry.

The advances on the country's development were also based on the existence of an effective group of multi-funding agencies working together in financing the whole PNPGE. The information presented here illustrate the Brazilian venture for capacitating human resources and the formation of an active scientific and technological community giving a general vision of its importance for the present and future development of the country.

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