Internationalization of graduate education in Brazil: rationale and mechanisms[1]

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Abstract

Along the past two or three decades, the international dimension has become an integral part of education activities and scientific research, giving rise to the notion of internationalization. In this article, the internationalization rationale and mechanisms implemented by the top graduate programs in Brazil those which have received scores 6 and 7 in the 2010 triennial evaluation of recognized graduate programs are examined. Graduate directors of 322 programs were asked to respond to a web questionnaire organized in three content sections that deal with different aspects of their internationalization efforts, namely: meaning(s) and justifications; strategies, initiatives and partners; and facilitating and inhibiting factors. After validation, 66 remained valid questionnaires and form the dataset used to develop the study. A prevalence of an activity-oriented conception of internationalization was detected amongst those programs. Outward mobility is seen as the main mechanism to boost international experience, network building and research collaboration. Albeit incipient, initiatives to attract foreign scholars and efforts towards "internationalization at home" are gaining momentum. The presence of faculty members who are trained abroad, and can mobilize their networks to establish scientific exchanges and partnerships, is considered a key condition for internationalization. However, the lack of a national strategy, appropriate administrative systems and institutional policies in most Brazilian higher education institutions hamper the development of those connections into more meaningful and sustained cooperation.

Keywords

Graduate education in Brazil - Research training - Internationalization of higher education.

Introduction

Brazil, alongside China and India, has been internationally recognized as an emerging scientific power (HILL, 2007; KING, 2009; WILSDON, 2011). In fact, the country has been able to increase dramatically its capacity of research training as well as its scientific output in the past 30 years.

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Between 2007 and 2011, Brazil contributed 2.59% (147,503 scientific articles) of world total of scientific output, number that placed the country in the 13th position in the global ranking (LETA; THIJS; GLÄNZEL, 2013). Around 43% of those are articles in science and engineering fields (NATIONAL..., 2014).

However, such impressive growth has not been accompanied by a similar increase in the intellectual, social and economic impact of Brazilian science, and that is a big concern for a nation aiming to integrate the knowledge economy. Discussions on the causes and possible solutions to this gap have recently incorporated the notion of internationalization of science. References to international student mobility, cooperation and visibility have become recurrent in the science policy leaders' speeches in the country.

Indeed, President Dilma Rousseff stated, in April 2011, that the Federal Government intended to grant 75 thousand scholarships for studies abroad until 2014 – number that could reach 101 thousand with financial support from the private sector. The President then alleged: "Brazil needs skilled labor to ensure the next development cycle" to justify such significant federal spending. A few months later, on July 26, during the meeting of the Economic and Social Development Council (CDES), President Rousseff launched the Science without Borders program (CsF, in Portuguese), explaining the criteria on which are based the allocation of those scholarships, as well as their objectives, targets, resources and nature. This is a program that "seeks to promote consolidation, expansion and internationalization of science and technology, innovation and competitiveness, through the exchange of undergraduate and graduate students and international mobility."[3] Therefore, it is an ambitious program of internationalization of Brazilian research and development (R&D) using the mobility of students, scholars and professionals for advanced training abroad as a central mechanism.[4]

On the other hand, experts alert that a diagnosis of how internationalization is implemented by Higher Education Institutions (HEIs) in the country is still to be established and this is a necessary input for the elaboration of a national plan that should articulate isolated initiatives into a systemic strategy (COMISSÃO..., 2013).

In fact, existing national and institutional data are incomplete and focused on the outward mobility of students funded by the main governmental agencies. In order to allow a better understanding of the inward/outward mobility from/to Brazil and have a real dimension of the processes underway in the country, some experts have recommended the implementation of systematic consultations or censuses with HEIs (MARIN; BRASIL, 2004; RAMOS; VELHO, 2011).

In order to help filling this gap, this study aims to offer an outlook of internationalization as conceived and practiced by the Brazilian graduate programs recognized as excellent henceforth referred to as EGPs.[5] It is organized in three sections, besides this introduction and concluding remarks. Section 1 details the analytical

3- This testimony was extracted from UOL News, available at http://noticias.uol.com.br/politica/2011/04/29, accessed on July 30, 2011. A search on the internet using the keywords "President Dilma" and "scholarships abroad", recovered thousands of results.

4- An examination of the CsF's model and performance compared to regular international academic mobility programs run by the Brazilian Government can be found in Velho; Ramos (2013).

5- As defined by CAPES, the federal agency in charge of graduate studies in Brazil, it means superior performance as regards doctorate degrees awarded and scientific output, internationalization and leadership.

framework supporting this study. Here the reader will find a brief analysis of some recent systemic developments in higher education and research that influence the emergence of the notion of internationalization, as well as models and mechanisms adopted in the sector. In section 2, the research design and methods are described. The approach is based on three assumptions: (1) this is an exploratory investigation; (2) it assumes that internationalization "meanings, rationales, strategies and approaches are constantly changing" (DE WIT, 2013, p. 13); and (3) these aspects vary for different stakeholders. The main findings derived from survey data are discussed in section 3, comprising a discussion on how Brazilian EGPs interpret the international dimension of higher education and research, how and with whom they implement it, and factors which facilitate or inhibit the achievement of their internationalization aims.

Analytical framework

In the midst of the global knowledge economy, countries are urged to improve students' performance in science, engineering and mathematics (STEM) fields and increase their access to higher education. Nations are called to invest in high-end R&D, promote enterprise and entrepreneurial skills, explore direct engagement with industry in order to promote knowledge flows across boundaries, and incentivize international collaborations amongst scientific groups.

Higher education has become a priority in policy agendas at local, regional, national and global levels. Universities, especially research-oriented universities, have turned into the focus as they are assumed to be the producers of human capital and complex ideas for innovation (BRENNAN; KING; LEBEAU, 2004). New players and demands have entered the sector, driving a new regime of global competitiveness in higher education. In the U.S. National Research Council's (2012, p. 4) words: "now, other nations recognize the importance of world-class research universities and are rapidly strengthening their institutions to compete for the best international students and for faculty, resources, and reputation."

In support of such rationale, a range of market-like mechanisms to codify, measure, and represent the scale, status and spatial organization of knowledge output and outcomes are developed and used. Knowledge-based products and services, whose most widespread examples are the bibliometrics and the global university rankings, are made available or sold globally so as to generate greater competition, efficiencies and excellence (MARGINSON, 2007; OLDS; ROBERTSON, 2014).

The competitive comparison rationale and tools are triggering important decisions by governments, HEIs and students. Governments have implemented selective immigration and funding policies to move up the positions of their countries and institutions in international rankings. HEIs are reshaping priorities, by focusing on research, changing the curriculum, attracting international students, and harmonizing programs. They are also making strategic choices of institutional policies, partners, and indicators to boost their international profile and reputation. Students, particularly competitive prospective graduates, seek highly-ranked universities wherever they are (HAZELKORN, 2008).

These decisions exemplify the increasing engagement of countries and institutions in a "process of integrating an international, intercultural or global dimension into the

purpose, functions or delivery of post-secondary education" (KNIGHT, 2008, p. 21) or, as is now widely known, in the internationalization of higher education.

Internationalization may assume different meanings and ways in the diverse higher education systems worldwide, as they face distinct challenges, have different policy perspectives, institutional capacities, and administrative systems. Nonetheless, some practices are widespread.

International student mobility is the popular internationalization strategy among HEIs worldwide, and a larger number of them have been devoting financial resources to study-abroad programs and international student recruitment. These student-centered strategies respond to the widespread idea that successful graduates must have "the ability to think critically and creatively to solve complex problems, as well as master the skills and disposition to engage globally." (THE U.S...., 2012, p. 2).

However, large-scale programs of international student mobility, such as the Erasmus Programme in Europe, have shown that this kind of strategy reaches a very little portion of the student population (DE WIT, 2013). Additional strategies would be necessary to achieve wider and meaningful impact from internationalization. In this sense, many countries have introduced new, reinforced or refocused existing strategies, including international curriculum and staff development, quality assurance, the use of information and communication technologies, a stronger link between international research and education, the establishment of consortia, etc. (WENDE, 2001).

A shift from the movement of students to the movement of programs and universities is being observed (DE WIT, 2013). Although difficulties are extreme, HEIs are increasingly engaging in formalized partnerships, dual or joint degrees, and branch campus ventures. These forms allow institutions to leverage an international profile and brand, besides establishing a convenient base of operations for study abroad, international research activities for faculties, and cooperation with foreign partner institutions (RUMBLEY; ALTBACH; REISBERG, 2012).

Policy-makers and leaders in higher education are now arguing for the need "to take measures to ensure that internationalization permeates the curriculum and that all students are exposed to international perspectives in the classroom and through co-curricular activities" (AMERICAN..., 2012, p. 24), thus enabling strategies of "internationalization at home" to flourish. In the hiring process, more institutions are giving preference to faculty candidates with international background, experience, or broaden interests.

It is the aim of the following sections to characterize how these global trends have shaped the internationalization efforts of the Brazilian EGPs.

Research design and methods

Unit of analysis

Around the globe, graduate education plays a key role in the internationalization of higher education and research (DE WIT, 2013; LAUS; MOROSINI, 2005; MIURA et al., 2008). This is also true in Brazil, where graduate education is delivered through programs composed by two training levels, Master and Doctorate degrees, the former usually being required of the candidates for moving on to the latter (BALBACHEVSKY, 2005). In most

cases, graduate programs are deployed across departments within HEIs. The dominant training model requires the completion of a number of specialized disciplines, qualification with a board of professors and public defence of a dissertation, in the case of the Master degree, or a thesis in the case of the Doctorate degree.

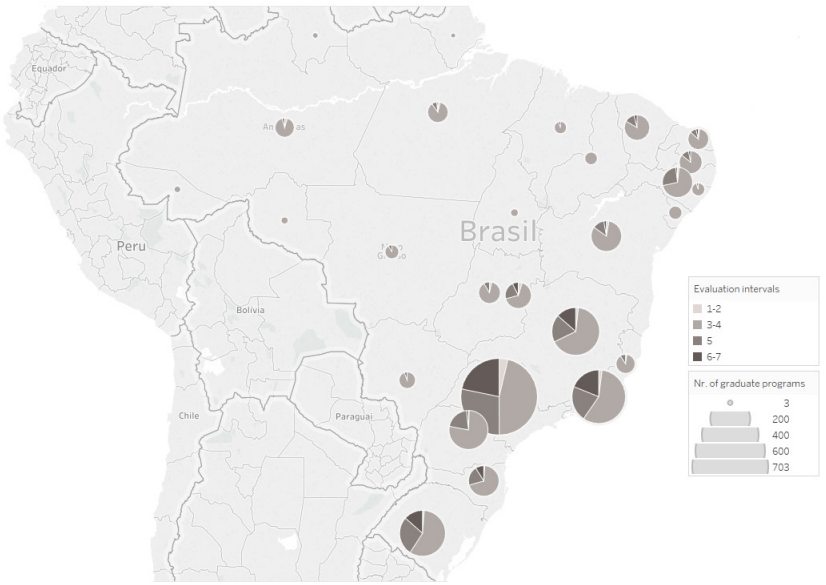
There are near 380 degree-granting HEIs in Brazil, where 3,500 graduate programs are based. Together, they award approximately 45 thousand Master degrees and 15 thousand Doctorate degrees annually (COORDENAÇÃO..., 2015a, 2015b).

The quality of the graduate programs is controlled by the federal agency CAPES through triennial evaluations and annual monitoring. One of the dimensions assessed in these processes, which differentiates the excellent graduate programs (EGPs, scores 6 and 7) from the very good ones (score 5), is precisely their international-level profile and performance. According to the scores obtained in the 2010 triennial evaluation, Brazilian graduate programs are distributed as shown in Figure 1.

Figure 1 - Distribution of Brazilian graduate programs – 2010.

Knowledge area	2010 evaluation score							
	1	2	3	4	5	6	7	All
Health sciences	5	14	109	154	109	42	16	**449**
Humanities		5	124	135	85	23	19	**391**
Applied social sciences		11	124	116	68	20	5	**344**
Multidisciplinary sciences	1	16	149	104	54	9	1	**334**
Engineering		2	119	102	44	25	17	**309**
Agricultural sciences		4	79	101	82	20	14	**300**
Mathematical & earth sciences		1	71	92	41	27	25	**257**
Biological sciences			38	67	39	27	16	**187**
Linguistics, languages & literary studies		1	45	51	34	11	5	**147**
All	**6**	**54**	**858**	**922**	**556**	**204**	**118**	**2.718**

b) by state and evaluation intervals



Source: Prepared by the author. Data from Capes.
Note: See Table 1S.

a) by major areas of knowledge and evaluation scores

The EGPs amount to less than 12% of all graduate programs evaluated in the country, and they are concentrated in six knowledge areas Health sciences, Mathematical & earth sciences, Biological sciences, Humanities, Engineering, and Agricultural sciences. In geospatial terms, states in the Southeast (São Paulo, Rio de Janeiro, and Minas Gerais) and South (Rio Grande do Sul) regions concentrate approximately 60% of all programs, and 90% of the EGPs.[6]

Data collection

A specific questionnaire was elaborated to collect data with Brazilian EGPs. It contains 14 questions divided into four sections: (a) program identification; (b) internationalization meaning(s) and justifications; (c) internationalization strategies, initiatives and partners; and (d) facilitating and inhibiting factors affecting the implementation of internationalization strategies. Questions are mostly structured, but each one contains optional text fields where respondents might add extra information and comments (see supplementary information for details).

The questionnaire was generated in electronic format and distributed via the web to Graduate Directors of all graduate programs whose score in the 2010 triennial evaluation was 6 or 7 (322 total). The questionnaire was open for responses from June 10 to 28, 2013. A database using survey data and information available in the evaluation reports for each EGP was created using database management software (MS Access 2013). Further processing and visualization were performed using several methods (co-occurrence matrices; temporal, topical, network, and geospatial algorithms) and software packages (MS Excel 2013, SAP Lumira, Tableau Public, and Sci2 Tool).

After validation, the response rate was 20.5% (66 out of 322). Figure 2 shows the distribution of informant EGPs by major areas of knowledge, state, and higher education institution.

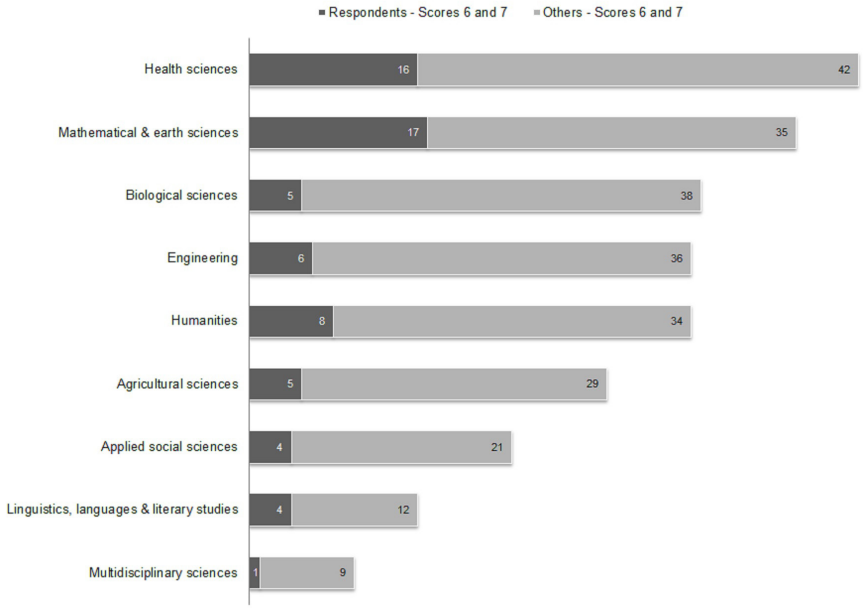
It is worth noting that EGPs in Health sciences and Mathematical and earth sciences predominate amongst the informants, which may influence the results discussed later. Also relevant is to point the absence of EGPs in Agronomy in the sample. This field contains 14 EGPs, but none of them participated in the survey.

International-level graduate programs amongst the informants (as in all graduate programs) are extremely concentrated in public universities in the Southeast region of the country, particularly in the State of São Paulo (Figures 1b and 2b). Such concentration has historical roots and only recently began to change with the expansion of higher education towards the countryside.

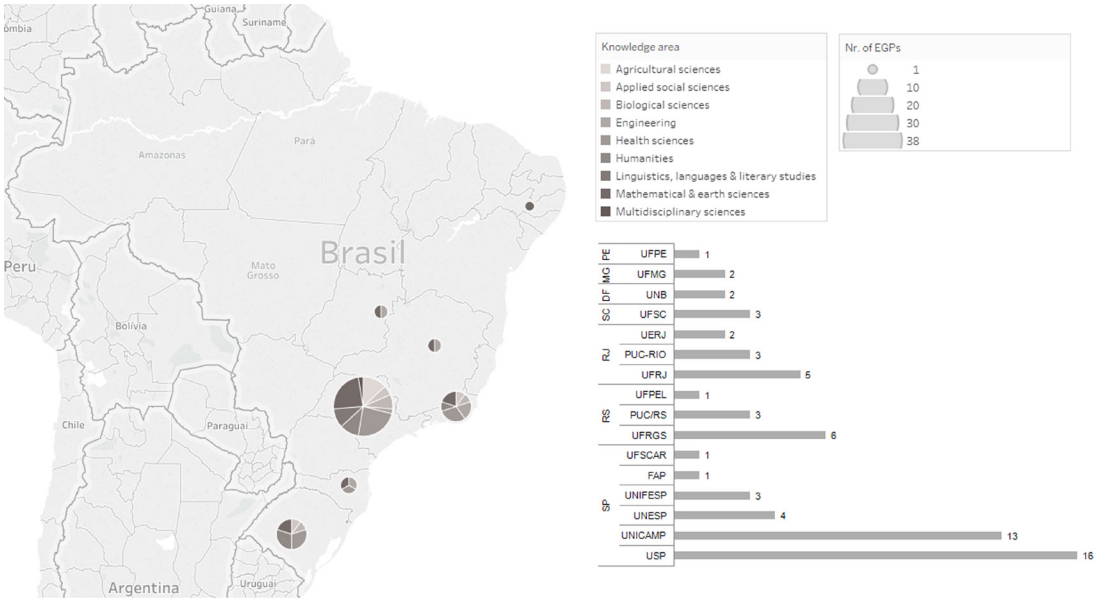
As for the profile of the respondents, 29 graduate directors have been involved in the evaluation process for more than 6 years; 17 between 3 and 6 years; 13 between

6- The final results of the 2013 triennial evaluation revealed a similar profile, although some reduction in the geospatial concentration figures is noticeable. In 2013, 12.4% of all graduate programs scored 6 or 7. Those in the states of São Paulo, Rio de Janeiro, Minas Gerais, and Rio Grande do Sul correspond to 83.1% of all EGPs.

Figure 2 - Distribution of graduate programs of excellence (respondents and others) – Brazil, 2013.
a) All EGPs by major areas of knowledge and evaluation intervals



b) Surveyed EGPs by state, major area of knowledge, and higher education institution



Source: Survey data, June 2013.
Notes: 1. States in the Southeast region are: São Paulo (SP), Minas Gerais (MG), Rio de Janeiro (RJ), and Espírito Santo (ES); 2. Except for PUC (system of Pontifical Catholic Universities), all other HEIs are public universities; 3. See Table 2S

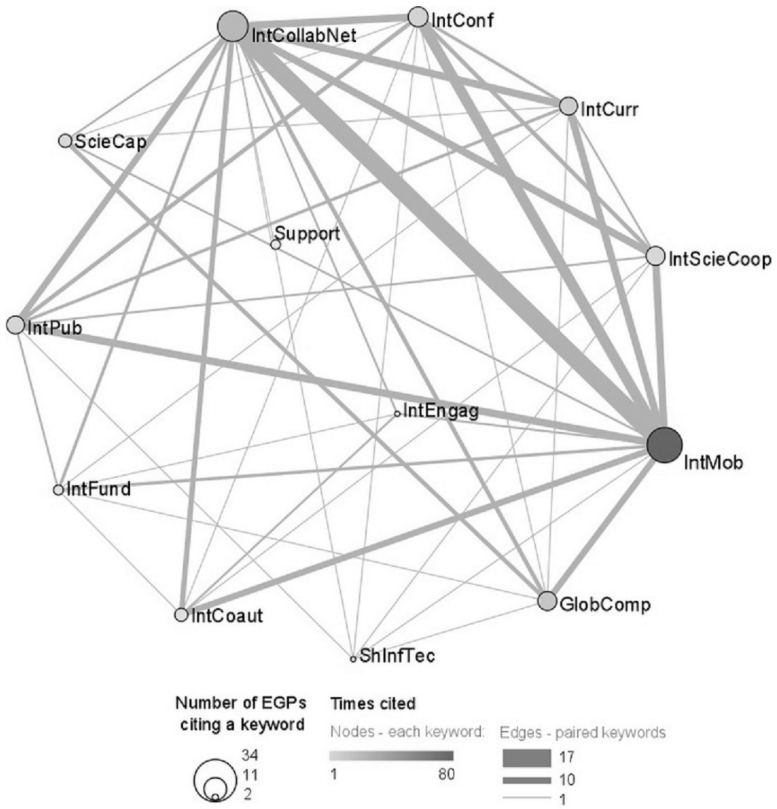
1 and 3 years; and seven for less than 1 year. Most of them, therefore, correspond to the appropriate profile to provide information about the international engagement of Brazilian EGPs. Next, the aspects of such engagement are detailed and discussed.

Results and discussion

Rationale: What does internationalization mean and why is it important?

To answer the survey question on how they conceive internationalization, Brazilian EGPs freely listed pertinent keywords, which were then synthesized into 14 categories. A co-occurrence matrix was created to detect the most frequent categories and links between pairs of categories (Figure 3).

Figure 3 - Internationalization meaning(s): Co-occurrence network of categorized keywords



ScieCap: Scientific capital
IntCoaut: International co-authorship
ShInfTec: Sharing of infrastructure and cutting-edge technology
IntScieCoop: International scientific cooperation (formal institutional agreements)
GlobComp: Global competence
IntFund: International funding to education/research
IntConf: International scientific conferences/meetings
IntEngag: International engagement - science policy and governance (participation in boards of international scientific journals, societies and institutions)
IntCurr: Curriculum internationalization
IntMob: International mobility
IntPub: International publications
IntCollabNet: International collaboration and networks in research
Support: Institutional/administrative/organizational support

Source: Survey data, June 2013. Note: Isolated nodes are not shown.

The categorized keyword co-occurrence network shows that multiple elements comprise the EGPs' notion of internationalization, ranging from *mechanisms or strategies* (international mobility, international scientific cooperation, international networks and collaboration, curriculum internationalization, international engagement in science policy/governance[7]), *academic output* (international publications[8], international co-authorships, attendance to international scientific meetings and conferences), *enabling factors* (institutional, organizational and administrative support) and *access to resources* (sharing of cutting-edge research facilities and technology, international funding) to *desirable outcomes* (global competence development and scientific capital[9] accumulation).

By using keywords such as international mobility of students, researchers and faculty, international circulation of students and scholars, academic exchanges, visiting scholars, visiting PhDs and post-doctorates, EGPs expressed their notion of internationalization as international mobility, followed by international research collaboration.

International mobility is cited more frequently by programs in Mathematical and earth sciences (60.0%), Biological sciences, and Multidisciplinary sciences (50.0% each). Traditionally, student mobility, especially outward mobility, is the primary form of internationalization of Brazilian science. The implementation of CsF reinforced this pattern,[10] and due to its large scale and political implications it has become a media phenomenon. Consequently, the respondents' perception about the meaning of internationalization may reflect the emphasis that international academic mobility is receiving in the country at present.

International networks and research collaboration – expressed through keywords such as international collaboration between research groups, joint research, multi-centric international projects, networking and intellectual/academic interaction – are relatively more important for Health sciences and the Humanities.

The third most cited category – the first for programs in Linguistics, languages, literary studies and arts (9.8% of citations) – is development of global competence. This category covers keywords such as interculturalism, international integration and expanded worldview that individuals exposed to international education or experience acquire through the awareness of and coexistence with diverse cultures, different contexts/perspectives and contact with new paradigms.

Regarding justifications to internationalization, Brazilian EGPs point to: greater research impact, greater productivity of researchers and greater international engagement of students, besides advancing the international connectivity of faculty members (Figure 4). They also perceive positive impacts on broadening the scope of teaching/research and expanding the knowledge base (e.g. forms of introducing the international dimension in the curriculum and research activities), as well as on improving their overall quality and reputation. This perception, similar in all regions and areas of knowledge, corroborates the assumption of a clear and positive association between internationalization and quality/performance enhancement by policy-makers and science leaders in Brazil.

7- For example, participating in boards of international scientific organizations and journals.

8- Expressed through keywords such as: articles in international journals (indexed in WoS, Scopus, and/or SciELO), books of Brazilian scholars translated to other languages and with international dissemination.

9- Category which encompasses keywords like: recognition by international peers evidenced by citations to publications authored by faculty members and students, repercussion of scientific knowledge about Brazilian problems abroad, impact and effectiveness.

10- In: VELHO; RAMOS (2013), the reader finds a discussion on the impacts of the CsF program on the internationalization of Brazilian science. Specifically, the authors compare performance indicators of the CsF and regular international academic mobility programs.

Figure 4 - Association between internationalization meanings and justifications

Source: Survey data, June 2013.

Note: Each square in the figure corresponds to the number of EGPs who mentioned both the meaning and the justification to internationalize.

Being connected to the leading higher education systems and institutions abroad is a driving force for Brazilian EGPs to internationalize. However, they also recognize that those benefits are not always the real aims of their efforts. A program in Linguistics, languages and literary studies, for example, states:

> Our program understands that internationalization is a necessary process for knowledge integration, which has always been present in our actions. However, we disagree with the current model to implement it, which is not always driven by academic needs.

Implicit motivations influencing the pace and direction of internationalization of teaching and research are a concern not only in Brazil; in fact, it is recognized worldwide that "strategies adopted by HEIs pursue objectives that often deviate from stated goals, notably improving academic quality of teaching and research by introducing international dimensions" (EGRON-POLAK, 2012, p. 13).

Mechanisms: How is internationalization implemented? Have the mechanisms changed recently?

Some studies show that "academic disciplines are internationalized according to their own dynamics, and the disciplines are loosely coupled to the specific higher education institution" (FRØLICH, 2008, p. 108). That is partially true in the case of Brazilian EGPs: Although most of them (around 94%) indicate similar strategy options to internationalize, nuances that differentiate them are noticeable (Figure 5).

The most popular strategies are: international mobility of faculty, scholars and students, and international research collaboration. Those strategies are implemented mainly through international cooperation agreements, of which three categories are usual: (i) Those initiated and promoted by foreign or national organizations or agencies; (ii) Those managed by higher education and research institutions; and (iii) Those ad hoc initiatives organized at an individual or department level, which form the vast majority (COMISSÃO..., 2013). The latter category relies heavily on individual trajectories of faculty members, and their personal networks formed around transnational communities usually built during their experience as PhD. students at foreign institutions.

For decades, outward mobility for degree has been prioritized in the advanced training policy in Brazil. Since the mid-90s, however, the country has been turning its focus into national institutions. Research internships or post-doctoral positions abroad have become the privileged way to engage Brazilian PhD. students and young doctorate holders internationally (RAMOS; VELHO, 2011; see also Figure 1S in the supplementary information). Such trend was detected in the survey. No respondent mentioned outward mobility for degree as a strategy they currently implement or advocate.

On the other hand, the emergence of a new understanding has recently been noticeable, one concerned with the balance between inward and outward mobility. A central argument is that outward mobility reduces the resource base (human capital) necessary to support projects and, therefore, the efficiency of research performed in national institutions. The recognition of the labor-intensive, teamwork nature of the scientific enterprise has led governmental agencies and universities to introduce several initiatives to promote movement in the opposite direction, attracting senior scholars and

Figure 5 - Internationalization strategies implemented by Brazilian EGPs by major areas of knowledge

Source: Survey data, June 2013.

postdoctoral fellows to teach and research in Brazilian institutions. Some EGPs reported having procedures to recruit and teach international students as well.

Publications in international journals and books are examples of an output actively sought in scientific exchanges. Brazilian EGPs implement incentives (for instance, providing grants) for scholars and students to develop good research compatible with that of the best centers internationally, to publish their results in international journals, especially in top-tier journals, and to encourage co-authoring publications with foreign peers.

Formal communication with foreign peers, participation in scientific associations/societies/networks and in science policy/governance positions, besides informal communication with foreign peers/communities are strategies indicated by 64% of EGPs in the survey. EGPs encourage faculty members and students to participate in international conferences and professional meetings, and provide funding for scholars and students to present their work in key international conferences and meetings. In addition, they have actively promoted the organization of international conferences, symposiums, seminars and meetings at the universities in Brazil, mainly in the traditional format (gathering people in the same place), but also mediated by technology (video conferences). Investments in improving content and developing institutional website versions in English, and in some cases also in other languages, integrate their internationalization strategies.

Participation in editorial boards of international journals and boards and committees in international scientific/professional organizations are usually implemented on the individual initiative of faculty members and scholars. Some respondents referred to financial incentives to stimulate interactions between professors and students with their peers abroad, such as organized visits to laboratories of excellence.

Internationalization at home – an approach that includes changes in the curriculum, the teaching and learning process, and co-curricular activities – is lacking. Initiatives do exist but are both very recent and restricted to a smaller subset of EGPs (around 39%). Regarding curriculum internationalization, a set of the surveyed EGPs has pointed out to efforts to bring frontier research topics into the curriculum, the use of English as a medium of instruction (EMI),[11] the adoption of flexible curriculum design to facilitate recognition of credits. Some of them also offer double-degree programs.

An even smaller subset has pointed out to international funding and teaching in international graduate programs as internationalization strategies, and none of the EGPs mentioned any export strategies, such as offering courses or entire programs abroad.

Most EGPs reported having experienced intensification of the internationalization strategies they have implemented in the past 10 years or so. In the words of a Program in Food science: "Actually, there has been no change in [internationalization] strategies; rather, they have been intensified in the past few years due to several factors [...]".

Among those factors, they mentioned a push by governmental agencies supporting graduate education and research, initiatives by HEIs, the changing dynamics of scientific

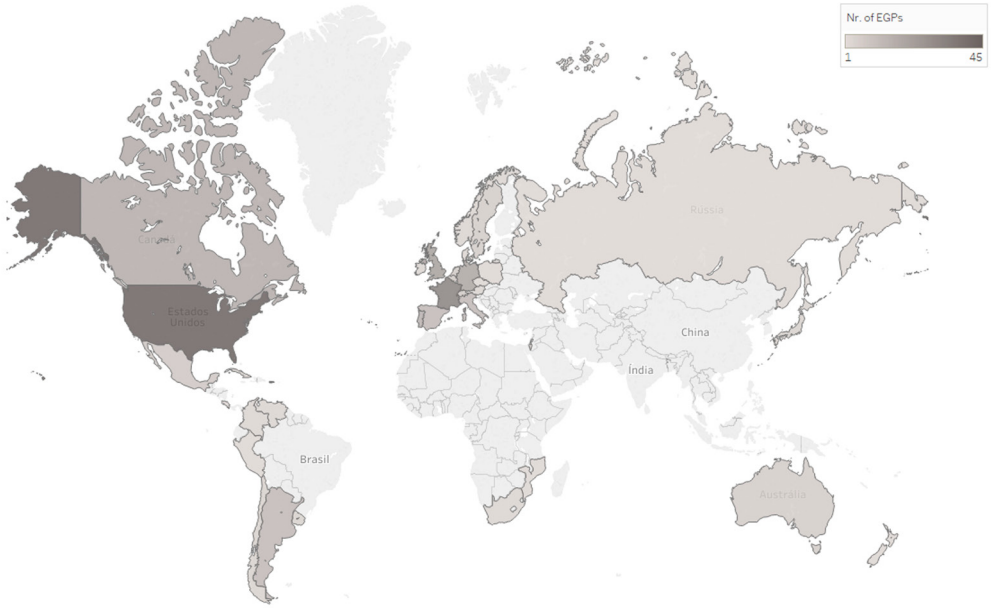
11- The use of EMI "refers to the teaching of a subject using the medium of the English language, but where there are no explicit language learning aims and where English is not the national language" (MADHAVAN; MCDONALD, 2014, p. 1).

knowledge, and the individual initiative of faculty members active in international research networks.

Beyond intensification of internationalization efforts, some programs have experienced transformative changes, like this Program in History: "From a provincial and almost insulated Program 10 years ago, we have developed into an international-level Program in our field through a significant renovation of our faculty members, who are now much more oriented towards international exchanges and networks." The respondent emphasized that "many of them pursued their PhD. degrees in foreign institutions or have experienced research internships abroad." To a Program in Philosophy, a tradition of scientific exchange with partners abroad has developed into deeper collaboration: "We have progressed from a period of mobility and joint organization of scientific meetings to more organic and permanent cooperation endeavors."

Considering the geospatial pattern of international collaboration, the major foreign partners of Brazilian EGPs are the United States, European countries (France, the United Kingdom, and Germany) and Canada (Figure 6). To a smaller extent, they collaborate with counterparts in Portugal, Spain, Italy and Argentina. Some programs indicate partnerships with Mexico, Belgium, Switzerland, the Netherlands and Australia. Collaborative research programs and projects with new partners in Europe, Asia, Africa and Oceania show that Brazilian EGPs are increasingly diversifying their international collaboration.

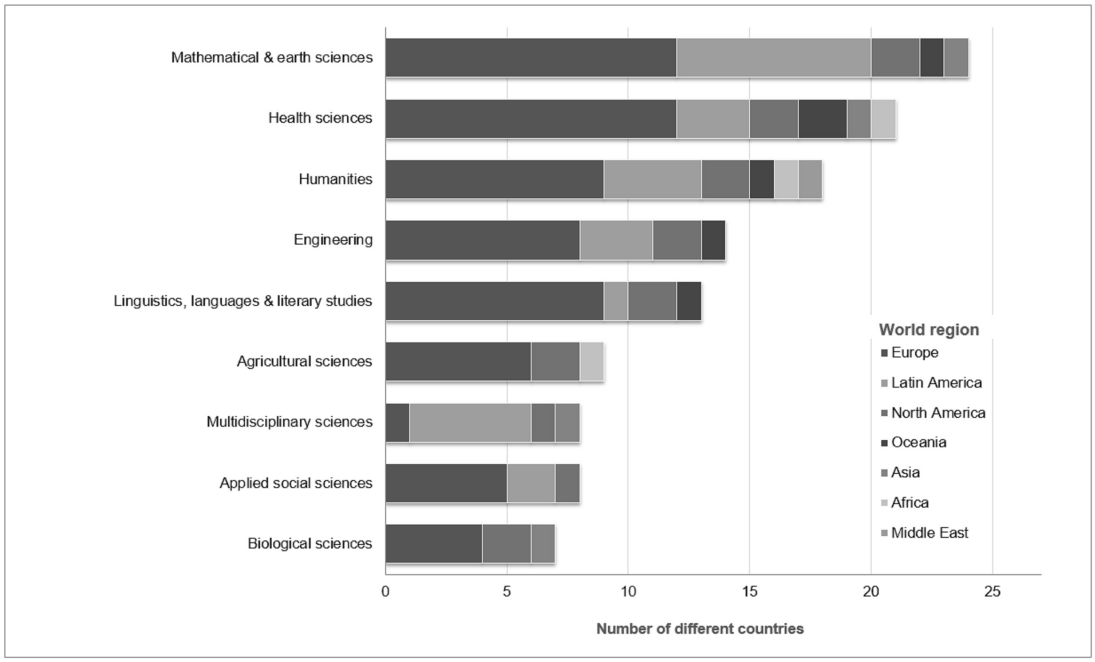
Figure 6 - Map of Brazil's international collaboration: Number of EGPs which have mentioned partners abroad, by country.



Source: Survey data, June 2013.

Mathematical and earth sciences and Health sciences are the most internationally engaged areas of knowledge in terms of the number and diversity of international partners (from 24 and 21 different countries, respectively; see Figure 7); Humanities, Engineering, and Linguistics, languages, literary studies and arts form an intermediary group, with partners from 18 to 12 countries; and Agricultural, Applied social, Multidisciplinary, and Biological sciences show a relatively lower level of international engagement, with partnerships in 7 to 9 countries each.

Figure 7 - International partners of Brazilian EGPs by major areas of knowledge and world regions.



Source: Survey data, June 2013.

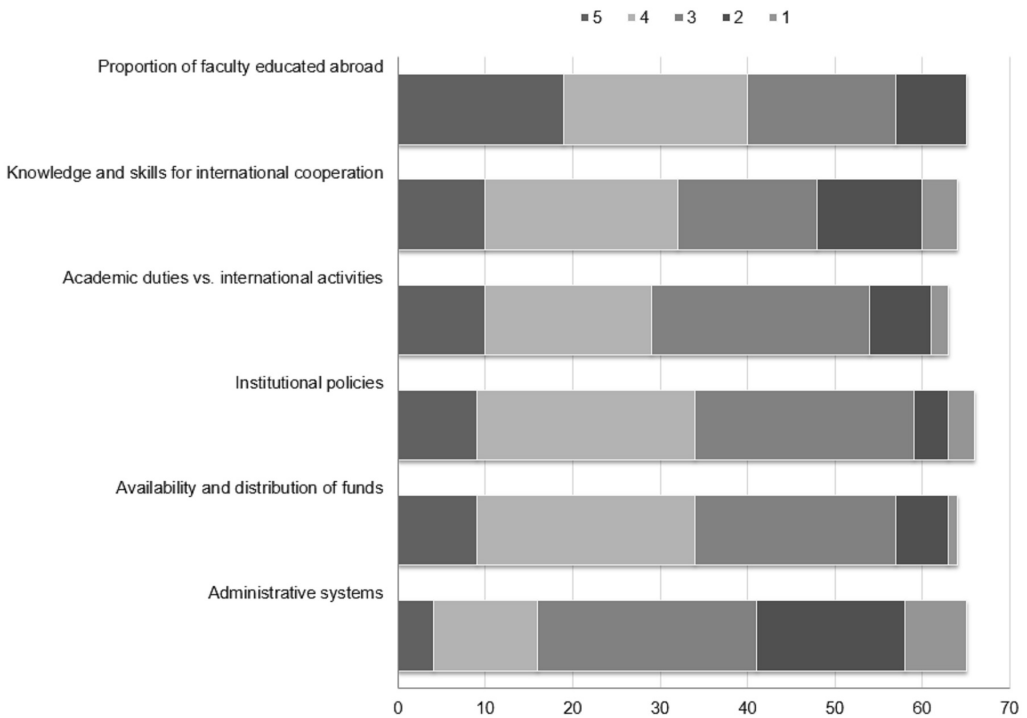
Interestingly, this profile of international collaboration is similar to that of citation impact of Brazilian scientific articles. According to Gaze; Breen (2014), Brazilian articles in Mathematics, Physical sciences and astronomy, Earth and related environmental sciences published between 2008 and 2012 had greater relative citation impact; Engineering and technology, Clinical medicine and Basic medical research had an intermediary citation impact, as well as Computer and information sciences and Chemical sciences; Agricultural and Biological sciences, in turn, showed the lowest citation impact amongst the disciplines considered in the study.

Now from the perspective of the partner countries, three groups can be distinguished based on the diversity of knowledge domains involved in scientific exchange with Brazilian EGPs: With 7 to 8 out of 9 major areas of knowledge, a first group of countries comprises

the United States, France, the United Kingdom, Canada, Portugal, Spain and Argentina; a second group, consisting of Germany, Italy, Belgium, Mexico, Sweden and Australia, collaborate in 4 to 6 major areas of knowledge; And a third group comprising 20 countries from all continents collaborate in 1 to 3 knowledge domains.

In making these partnerships operational, Brazilian EGPs are affected by the institutional capacity of the HEI where they are based. The survey detected inequalities between institutions in the provision of proper conditions for internationalization (Figure 8).

Figure 8 - Facilitating and inhibiting factors affecting the internationalization of Brazilian EGPs.



Source: Survey data, June 2013.

Note: Some factors concerned with administrative systems and institutional policies affecting EGPs internationalization were listed in the survey questionnaire and the respondents were asked to rate them using a scale ranging from 1 (unsatisfactory) to 5 (fully satisfactory). Those factors rated 1 to 3 were interpreted as inhibiting factors and those rated 4 and 5 as facilitating factors. Respondents were allowed to include and rate additional factors they believe are relevant to their internationalization efforts.

There is evidence (RUMBLEY et al., 2012, p. 14) that the presence of faculty members with international experience have a direct and positive effect on student participation in study abroad. In addition, the presence of foreign faculty enhances efforts to infuse curricula and campus life with an international dimension, and domestic faculties with international experience are more likely to "buy in" to initiatives designed to advance campus internationalization.

This also applies to most of Brazilian EGPs who point out to the proportion of faculty members who have pursued their PhD abroad as a facilitating factor for internationalization. Indeed, a Program in Physics emphasizes that "[international networks derive from] natural collaborations between individuals, not connections between programs". Other EGPs add that "the choice of universities with which we have formal agreement depends on the contacts that our faculty keep with researchers from other countries", and this is facilitated by "former students [now faculty members in our program]".

On the other hand, a lack of administrative and organizational supports either at the level of the whole institution or at the department/institute/school level, is a major factor inhibiting further internationalization of Brazilian EGPs (Figure 8). Insufficient support, bureaucratic processes and lack of or unbalanced distribution of funds were mentioned as the main barriers. In addition, the absence of a national strategy that might set a common direction for the HEIs and the lack of appropriate institutional policies hamper the development of international contacts and scientific exchanges into meaningful and sustained institutional cooperation networks.

Concluding remarks

A series of systemic transformations in the modus operandi of doing research and organizing science have impacted higher education globally in the past 20 or 30 years. The international dimension has become an integral part of education activities and scientific research. In this article we have examined the rationale and mechanisms used by the top graduate programs in Brazil to realize their internationalization vision.

Overall, survey data show the prevalence of an activity-oriented conception of internationalization: international mobility toward foreign countries is seen as the main mechanism to boost cross-border education activities, network building and research collaboration. Improved international profile and impact are expected benefits. This vision is realized by means of a model still heavily based on an "outward-oriented approach", in which research is clearly at the center of the internationalization process. Indeed, Brazil has been increasingly sending fewer students to pursue their doctoral degree abroad. Doctoral training in national institutions complemented by research internships abroad (as visiting PhD students or post-doctoral researchers) has become the preferred mechanism of advanced training.

Albeit incipient, initiatives to attract foreign scholars and efforts towards "internationalization at home" are gaining momentum. In general, the presence of faculty members trained abroad, with international experience and interest who can mobilize their transnational networks to establish scientific exchanges and research collaborations is considered a key condition for internationalization. However, the absence of a national strategy, the lack of efficient and effective administrative systems, institutional policies and professional management in most Brazilian HEIs hamper the development of those connections into more meaningful and sustained cooperation.

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