AN ASSESSMENT OF INTERNATIONALIZATION IMPACT ON ENGINEERING EDUCATION QUALITY SCORES: A BRAZILIAN CASE STUDY

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ABSTRACT

Internationalization is a trend topic in terms of research, including in engineering education. It is a consensus in the academic literature that competitive advantages are related to the development of skills considering internationalization. The objective is to provide an assessment of the internationalization impact on different education quality scores, taking as proxies well established rakings. Multivariate methods are used to estimate the importance of each variable in education quality score. The coefficients of a regression model are employed to ponder the relative importance of internalization on quality assessments. Going further, the impact of largest program of internationalization, "Ciências sem Fronteiras", after almost three years of its creation, is evaluated. Furthermore, comparative analysis is conducted to trace how Brazil behaves compared to other countries. Finally, the analysis focus strictly on the engineering domain, taking into account the specificities associated, such as the technical expertise which may be developed with internalization process and the real impact on economics aspects. The findings highlight clearly the importance of internalization indexes as majors explicative variables to quality assessment scores.

Keywords: Internationalization; engineering education; education quality scores

1   INTRODUCTION

Globalization is a term that has long and ever increasing importance. A search conducted at ISI Web of Science database is a proof that between 1985 to 2012, the number of scientific production per year with the term globalization started at 2 till more than 3000. That points out the evolution of publications with this term during the last years. As stated at the Millennium Report from United Nations, in 2000, Globalization should be faced as the greatest challenge that everybody is concerned, as it is present everywhere, and it is needed to ensure that globalization becomes a positive force for the entire world's people, building inclusive globalization.

It is also stated [1] that trends seem to suggest that globally integrated strategies are also the wave of the future for industries. In the case of Brazil, in the year of 2001, the country emerged from economic stagnation to a state of decision to link its economy to the global economy, following a new philosophy hallmark of global thinking of a flattening world, whereas there is no more considerable distance and differences across countries almost disappear [2].

In this direction, the internationalization of education follows the same pattern of growth associated with the great need for a paradigm shift in higher education institutions (HEIs). Authors claim that internationalizing the curriculum of a HEI involves providing students with global perspectives of their discipline and giving them a broader knowledge base for their future careers. This internationalization can also help to provide them with a set of values and skills to operate in diverse cultural environments; skills often labelled as "intercultural competencies" or "cross-cultural capabilities". Graduates today will need the resilience and competencies to communicate and compete in a rapidly changing, complex global workforce and world [3]. HEIs around the world are experimenting with different strategies to foster internationalization and networking, achieve critical research mass, and strengthen innovation and labour market integration [4].

In consonance with the internationalization trend, the Brazilian government created "Cuenca seem Frontiers" (CSU) - Science Without Borders - which is a program that seeks to promote the consolidation, expansion and internationalization of science and technology, innovation and

competitiveness through an exchange and international mobility. The project involves the use of up to 101 thousand scholarships over four years to promote exchanges, so that undergraduate and postgraduate can perform internships abroad in order to keep in touch with competitive educational systems in relation to technology and innovation. Moreover, seeks to attract researchers from abroad who want to settle in Brazil or establish partnerships with Brazilian researchers in priority areas defined by the program, and create opportunity for researchers from companies for specialized training abroad.

Nevertheless, many questions may be pointed out about this matter, such as: What are the impacts of these programs in the quality assessment of education? What are the differences noticed when compared Brazil with developed countries and other emergent countries? Is Brazil getting positive results from this policy? The main objective is to provide an assessment of the internationalization impact on different education quality scores, taking as proxies well established rakings and general figures issues from surveys. Multivariate methods are used to estimate the importance of each variable in education quality score. The coefficients of a regression model are employed to ponder the relative importance of internalization on quality assessments. Going further, the impact of CsF, after almost three years of its creation, is evaluated.

This article is structured in five sections. Section 1 presents the context and purpose of the research. In section 2, the theoretical background of the research is presented. Section 3 presents the details of the method employed, and section 4 presents and discusses the main findings of the research. Section 5 provides the key findings of the research, followed by the interpretation of the main results. And finally the contribution to the field, as well as the limitations of this research.

2 THEORETICAL BACKGROUND

Educators in Brazil hope that the program Ciência sem Fronteiras, (Science without Borders) will be a landmark in the policy of improving the academic quality in the country. The experience to be gained in countries with educational excellence is important but, for the purpose of internationalisation of Brazilian education, it is also necessary to attract teachers and students to our shores and not just send those abroad [5].

Internationalization has a great importance for the quality of teaching and research university. By forming partnerships with institutions abroad opens doors to new ideas and possibilities, and even for new search tools. The quality of work is greater, and the impact of the vehicle for the dissemination [6]. The acquisition of competences is, also, vital for internationalization. The opportunities open to exchanges and such is vital for strengthening national companies [7] and the recruitment of talent, such as students, staff, researchers and academics, from global markets is imperative as is the development of high level critical skills. Students have to be trained to participate in the international context and be assured that it is provided to them the best opportunities available to lead from the front and to leave a global footprint in their trail [8].

There is a necessity to explore the new means of knowledge sharing and appropriation across geographic and intellectual borders. It is needed to provide platforms for the development of multinational, multidisciplinary, multi-sectoral intellectual projects that generate the high level and scarce skills required to address development in our country and on the continent, while it is fostered intellectual communities and promote sustainable social and economic development in a globally competitive environment [8].

3 EXPERIMENTAL METHOD

Quality of education can be measured in several ways. In this research, is taken as reference a ranking produced annually, qualifying universities observing a certain set of variables. Bowman and Bastedo [9] highlight the continuous increase of ranking using to compare college and university within a country and around the world. According to [10], its conception is due to the massive expansion of higher education around the around and, by consequence, the interest of society to differentiate institutions from one another in a growing and complex world. Elsbach and Kramer [11], Espeland and Sauder [12], Sauder and Espeland [13] pointed out that these ranking seem to have a particularly influence on decision making process in professional schools and postgraduate programs. Bastedo and Boeman [14] indicate, through empirical evidences, that resource providers who are vulnerable to aspects linked to status hierarchy of higher education are significantly influenced by rankings.

Among the different factors that are taken in account, it is possible to list: research excellence and its influence, measured, for example, by the number of scientific publications and number of citations that they received, under graduated and graduated success in terms of career, number of exchange students. These ranking incorporate a widely range of data sources, issue from different surveys. In fact, the methodology adopted is not uniform, what is fostering criticisms regarding the lack of consensus [9].

For the purposes of this paper, data from one higher education ranking will be used as proxis to quality performance measure: Timer Higher Education World University Ranking. Along with Academic Ranking of World Universities, these two ranking are taken as the three most influential international university ranking [15, 16, 17]

Published by the British magazine Times Higher Education (known as THE), the Times Higher Education World University Ranking (henceforth THE), is an annual world university ranking, which employs in its analysis data from Thomson Reuters, in special, citation database information. The first rankings were released in 2009, jointly with QS World Ranking, partnership that ended in 2011.

In a first moment, Pearson Correlation test will be employed to test the statistical hypothesis of correlation between the overall score (understood as a quality measure) and internationalization score. This test will be anticipated by a Kolmogorov-Smirnov test to test the adherence to Normal distributions assumptions. In case of rejection, Spearman correlation will be employed. This first analysis will be completed by a multiple linear regression, where the variables that compose THE ranking will be used to predicted the overall score, if the assumptions of linearity of the phenomenon measured, constant variance of the error terms, independence of errors terms and normality of the error term distribution may be noticed (HAIR). This analysis will enable to verify the coherence in the terms of influence each variable in the overall score. A conclusion expected from it is the statement of internationalization in terms of quality. It is important to mention that the analysis will be restricted to the ranking regarding Engineering & Technology faculties.

In a second moment, the official figures of "Ciência sem Fronteira" will be crossed with other quality assessment. Data from scholarships that have been granted to students participate in exchange programs were collecting from official documents. The focus will be the engineering students, since the priority of this program is this area, as already explicated above.

The impact of this program, in the Brazilian reality will be verified comparing these data with the official evaluation promoted by the governmental agency CAPES, that each 3 years evaluated, based on different factors, each the most important is the academic production, of all graduate programs in Brazil. Using the same methods proposed above, correlation analysis, and the empirical data will give some important information, enabling also compare the finding from world behaviour with national ones.

4 RESULTS AND ANALYSIS

The analysis here proposed starts with the world rankings, with the aim of detecting, in this first moment, the relationship that may be established between quality scores and internationalization degree. Before conducting the analysis, the assumptions of normality are tested using Kolmogorov-Smornov test. It performs a test of a null hypothesis that data follow a normal distribution. The results gotten are illustrated by the Figures 1 and 2. From a graphical perspective, it is possible to notice that the first variable, overall score, does not follow a normal distribution. Regarding the internationalization variable, it follows a normal distribution in its turn. These findings are confirmed by the p-value from the hypothesis test that is less than 1% for overall score, the α-level chosen in all this study, and higher than 10% for the second variable. Having in mind these results, the correlations will be based on a nonparametric correlation, Spearman's Correlation.

Performing the correlation analysis, the following matrix of correlations is obtained (Table 1). If an α-level of 1% is adopted, it is not possible to reject the null hypothesis of non correlation. The conclusion will be different if 5% α-level is suggested. What is very clear from the data analyzed is the fact that the other variables, such as Teaching and Research seem to be far more important, in terms of influence, in the overall score. For the purposes of this study, the data from the top 100 universities were used. This finding enables us to conclude that internationalization is not a key point as determinant of quality scores. Other variables are at stake, more clearly correlated. Once again, the results are directly visible comparing the different Scatterplot illustrated on Figures 3, 4 and 5.
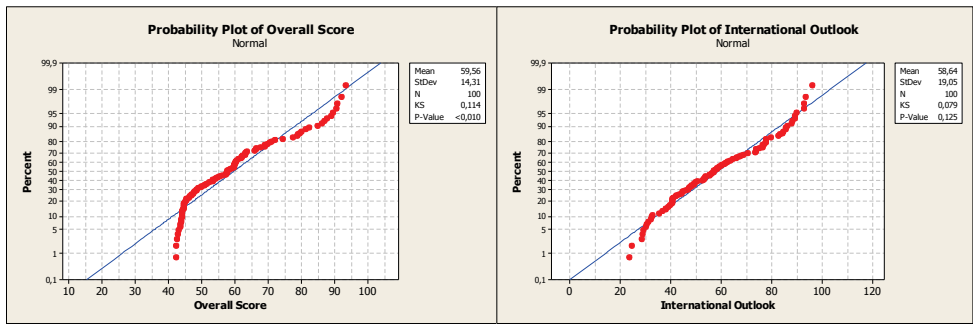
Figure 1 and 2. Normality assumption tests using Kolmogorov-Smirnov. Source: Authors from Minitab Software

Table 1. Correlation Matrix using Spearman's Correlations. Source: Authors from SPSS software

			Overall Score	Teaching	International Outlook	Research	Citations
Spearman's rho	Overall Score	Correlation Coefficient	1,000	,894**	,232*	,917**	,456**
		Sig. (2-tailed)	.	,000	,020	,000	,000
		N	100	100	100	100	100
	Teaching	Correlation Coefficient	,894**	1,000	,091	,945**	,130
		Sig. (2-tailed)	,000	.	,369	,000	,199
		N	100	100	100	100	100
	International Outlook	Correlation Coefficient	,232*	,091	1,000	,104	,194
		Sig. (2-tailed)	,020	,369	.	,305	,053
		N	100	100	100	100	100
	Research	Correlation Coefficient	,917**	,945**	,104	1,000	,165
		Sig. (2-tailed)	,000	,000	,305	.	,101
		N	100	100	100	100	100
	Citations	Correlation Coefficient	,456**	,130	,194	,165	1,000
		Sig. (2-tailed)	,000	,199	,053	,101	.
		N	100	100	100	100	100

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

While overall score presents a mean 59.558 with a standard deviation of 14.31, international outlook, the variable that are concerned with all aspects linked to international points, has a mean of 58.644 and standard deviation of 19.05. The values do not signal a statistical different among these figures. In fact, using Wilcoxon signed ranks test this empirical evidence is confirmed.
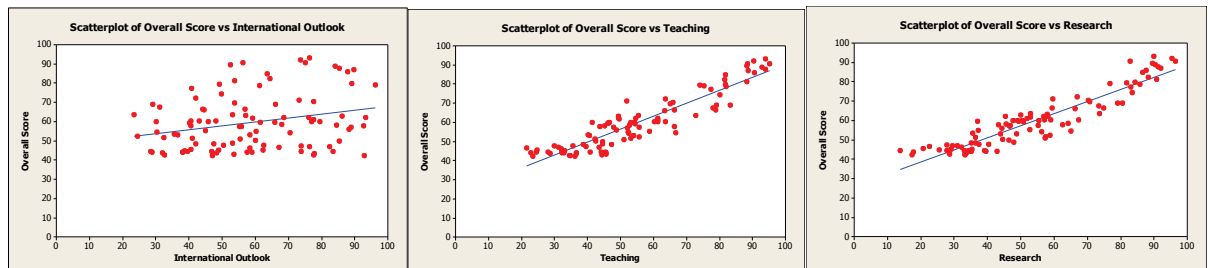
Figures 3, 4 and 5: Scatterplot between Overall Score and Internationalization, Teaching and Research respectively. Source: Authors from Minitab Software

Stricting the multiple regression model, it is equally possible to generate a regression using the data collected. Despite the fact that two variable, teaching and research, present a significant correlation, that implies problems of multicolinearity, the other assumptions can be reasinealbe statisfected. Ignoring the aspect pointed, performing the multiple linear regression, we achieve in the equation used by THE to compute the overall score.

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Overall Score = 0,078 + 0,305 Teaching + 0,0742 International Outlook
              + 0,0501 Industry Income + 0,295 Research + 0,275 Citations
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With R-squared - adjusted of 100,0%, the calculation promoted by THE favours Teaching and Research. Different from first findings, the set of analysis performed until this moment points out that internationalization factor is not the most significant in terms of participation of overall computing, not even the differentiating element that explain the better results from the Top Universities. It is interest to mention that if the spectrum analyzed were reduced to only the Top 20 universities in the 2013 ranking from THE, the findings are more net: the hypothesis of non correlation between overall

score and international outlook results in a p-value of 12%, making it impossible to reject this hypothesis at reasonable levels of significance.

Once it was not possible to establish a clear correlation between quality measures and internationalization, taking as basis the THE world universities ranking, a second approach is performed regarding the Brazilian scenario, using the program "Ciências sem Fronteira" as objet. The number of students that received scholarships since its implementation is taken as proxis of degree of internationalization. From the other side, the quality performance will be approximate by the official evaluation of graduated program. The results from 2008-2010 and 2011-2013 are considered.

As the first group of analysis, the assumptions of normality are verified. Even so, the hypothesis of normality is rejected. The sample counts with 113 Brazilian institutions, from different regions, ports and areas. The total number of students as well as the students from engineering and technological fields was collected. On average, 327.35 students received the scholarship by institution, being 139.99 from engineering and related areas, as indicated on Table 2.

Table 2. Descriptive Statistics. Source: Authors from SPSS software.

	N	Minimum	Maximum	Mean	Std. Deviation
Students by Institution	113	1	3332	327,35	509,831
Engineering Students by Institutions	113	0	1179	139,99	218,503
CAPES results 2013	113	3,0000	5,5000	3,827478	,5759891
CAPES results 2010	113	2,5000	5,4200	3,666106	,6029428
Score difference	113	-1,000	2,500	,16137	,386409
Valid N (listwise)	113				

Moved by the same logic already employed above, it is possible to conduct a correlation analysis. The results are shown on Table 3. It is possible to conclude that there exists a significant correlation between the number of students granted (considering the total number or just students form engineering related fields) and the results gotten in 2010-2013 graduated evaluation. It indicates that the courses that are better evaluated have been receiving more attention when the scholarships are distributed. Nevertheless, regarding the effect of this expressive internationalization program in terms of improvements may not be noticed yet. There is no significant correlation between the difference computed between the current and former evaluation. Moreover, the results signalized that further investigation may be valuable, once a negative correlation is obtained, an indication of a total unexpected result.

Table 3. Correlation Matrix using Spearman's Correlations for Brazilian Case. Source: Authors from SPSS software

			Students by Institution	Engineering Students by Institution	CAPES Results 2013	Score Difference CAPES 2010 and 2013
Spearman's rho	Students by Institution	Correlation Coefficient	1,000	,925**	,480**	-,177
		Sig. (2-tailed)	.	,000	,000	,061
		N	113	113	113	113
	Engineering Students by Institution	Correlation Coefficient	,925**	1,000	,421**	-,103
		Sig. (2-tailed)	,000	.	,000	,275
		N	113	113	113	113
	CAPES Results 2013	Correlation Coefficient	,480**	,421**	1,000	,192*
		Sig. (2-tailed)	,000	,000	.	,041
		N	113	113	113	113
	Score Difference CAPES 2010 and 2013	Correlation Coefficient	-,177	-,103	,192*	1,000
		Sig. (2-tailed)	,061	,275	,041	.
		N	113	113	113	113

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

5   CONCLUSION

The data analyzed shoed that other variables, such as Teaching and Research seem to be far more important, in terms of influence, in the overall score of HEIs. Other variables are at stake that is more clearly correlated. Different from first findings, the set of analysis performed in this paper points out that internationalization factor is not the most significant in terms of participation of overall computing, not even the differentiating element that explain the better results from the Top 100 Universities studied.

Since it was not possible to establish a clear correlation between quality measures and internationalization, a second approach is performed regarding the Brazilian scenario, using the program CsF as object. The findings highlight clearly the importance of internalization indexes as majors explicative variables to quality assessment scores. Observing Brazil results, many positives points may be mentioned, nevertheless many others points move away from best practices employed

by developed countries, even emergent ones. It indicates that the courses that are better evaluated have been receiving more attention when the scholarships are distributed. Nevertheless, regarding the effect of this expressive internationalization program in terms of improvements may not be noticed yet.

The quality measures have reference to the CAPES evaluation, however this review is restricted to graduate courses only. Despite the graduate programs are fully connected to academic research, one of the central goals of CsF, be restricted only to postgraduate courses can be considered as a limitation to this research. Moreover, the results signalized that further investigation may be valuable, once a negative correlation is obtained, an indication of a total unexpected result.

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