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Internationalization indicators for higher education based on the TOPSIS decision-making method

MARCIA CRISTINA ALVES DOS ANJOS ALMEIDA

WESLEY MARCOS DE ALMEIDA
PONTIFÍCIA UNIVERSIDADE CATÓLICA DO PARANÁ (PUCPR)

EDSON PINHEIRO DE LIMA
UNIVERSIDADE TECNOLÓGICA FEDERAL DO PARANÁ (UTFPR)

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ABSTRACT

Purpose - Contemporary Universities are international higher education institutions that should give more serious consideration to how their internationalization strategies are managed. The evolution of the internationalization of higher education is complex and multilayered. This study explores the evolution of thinking regarding internationalization among the different groups of interested Universities.

Design/methodology/approach - This paper proposes a new approach to evaluate the Brazilian universities' internationalization indicators based on multiple criteria decision-making method. The TOPSIS method evaluated a set of criteria of three institutions: a non-profit HEI, a public HEI and a private HEI.

Findings - The internationalization indicators were divided in seven dimensions: international agreements and partnerships; diversity of professors, students, and collaborators; double degree; internationalization at home; academic mobility; research potential; and international visibility. The analysis allowed to evaluate the strategies and performance of institutions according to forty-nine internationalization indicators, highlighting the superiority of public HEI for the most indicator. This superiority of the public HEI was repeated in the assessment by dimension, except for the Research Potential dimension, in which the non-profit HEI was ahead.

Originality/value - The results indicate that TOPSIS method is a useful for evaluating and supporting decisions on topical themes in the sphere of education, as performance evaluation and quality management of internationalization indicators.

Keywords: Higher education, Internationalization performance, Multiple criteria, Decision-making

1. INTRODUCTION

In recent decades, internationalization within higher education has emerged as a distinct field for practice and research. Internationalization has become one of the most powerful forces in action in higher education all over the world (Wit and Hunter, 2015). The practical applications and conceptual understandings of internationalization have evolved significantly, and today internationalization is a key issue of concern for higher education institutions (HEI), directly addressing social and curricular matters, institutional quality and prestige, national competitiveness, and a potential for innovation. For better or worse, institutions have also come to view internationalization as a potential source of revenue (Rumbley *et al.*, 2014).

Opportunities to accelerate internationalization in higher leaning institutions include a general improvement in the quality of education, diffusion of technology and the creation of a globally competent workforce (Alsharari, 2019). De Gayardon (2019) still emphasize, the importance of identifying enduring patterns of global inequality, recognizing ethical

responsibilities, and allowing for alternative possibilities. This visibility means that research involving the development of methods to measure the internationalization of universities increasingly attracts attention. Several contributions and attempts have been made in different countries to develop tools to view internationalization efforts (Gao, 2014). These include contributions that relate multicriteria methods and internationalization in HEI (Bortoluzzi *et al.*, 2019).

The search for tools that aid the rationality of evaluations helps internationalization to advance in consistent processes and with consistent results (Nanayakkara *et al.*, 2020). In this context, the evaluation system of Brazilian universities that offer undergraduate and graduate courses is a problem influenced by several factors that aid the analysis of a larger set of attempts to solve it. Thus, the multicriteria approach to support decisions is adjusted to the problem of HEI. The present article contributes to the field by quantitatively discussing the internationalization of higher education by identifying and collecting data on internationalization indicators to evaluate them using the Technique for Order of Preference by Similarity to the Ideal Solution (TOPSIS). This technique enables the ranking of alternatives, establishing a systematic analysis that reduces the subjectivity inherent to the decision-making process regarding actions that will be determined in future decisions.

This paper proposes a new approach to evaluate the Brazilian universities' internationalization indicators based on multiple criteria decision-making method. The TOPSIS method evaluated a set of criteria of three institutions: a non-profit HEI, a public HEI and a private HEI. The internationalization indicators were divided into seven dimensions, namely: international agreements and partnerships; diversity of professors, students and collaborators; double degree; internationalization at home; academic mobility; research potential; and international visibility.

In Section 2, the topics regarding related works are presented. Section 3 addresses the research methodology and application of the method in the ordering of the criteria. The discussions and results are presented in Section 4 and, finally, the conclusions in Section 5.

2. LITERATURE REVIEW

2.1 Internationalization in Higher Education

According to Knight (2012), the term internationalization began to be widely used by the higher education sector in the 1980s to promote international studies, educational exchanges, and technical assistance. Since that time, there number of types of initiatives used by higher learning institutions, organizations and governments has soared. The internationalization strategies, programs and policies developed by these players have evolved accordingly over the years and acted as agents of the generalized drive for globalization (Demorgon, 1999). As the twenty-first century progresses, the international dimension of higher education is becoming increasingly important, and at the same time increasingly complex.

Along with this complexity, Take and Shoraku (2018) concluded in surveys conducted in Japan that it is unclear how study abroad programs offer students opportunities to acquire knowledge and skills. Second, universities that face the same challenge of cultivating global citizenship through study abroad must review their educational content to determine whether

students are achieving the goals set out in their policies. Universities must realize the importance of studying abroad in terms of providing opportunities through which students can achieve their educational goals.

Another factor related to this complexity is that demands have arisen for measurements of university internationalization. This is emphasized by Gao (2014). To this author, there is an urgent demand for means of measuring internationalization performance. This is because as internationalization matures, it requires effective measures to monitor and evaluate institutional internationalization performance. Policy makers and decision makers need information to position their institutions in the globalized education scenario and compare their internationalization performance with that of their peers. Bearing in mind the importance of internationalization to HEI and the importance of measuring it correctly, it is pertinent to present some important works related to the theme.

Gao (2014), understanding this urgent demand to gauge the internationalization of universities, proposed a new approach to develop a set of internationally applicable indicators to measure internationalization performance in universities. The new approach highlights the method used to develop indicators, the people that should be engaged in the process and the steps to be followed in the development of indicators, in addition to providing a conceptual structure for university internationalization to develop the set of indicators. The author's findings include six university internationalization dimensions: governance and organizational support; student; faculty; curriculum; research; and engagement.

Egron-Polak (2007), after researching 526 institutions in 95 countries, identified seven justifications for internationalization, which can also be understood as dimensions of internationalization. They involved the internationalization of faculty and students, greater research capacity, acquiring an international profile, academic quality, diversity of faculty and students, curriculum innovation and income diversity.

Bortoluzzi et al, (2019) aimed to discuss the criteria and weights used in the evaluation conducted by the Coordination for the Improvement of Higher Education Personnel (CAPES) in the field of Engineering III of graduate programs in Brazil. The authors evaluated the possibility of incorporating some criteria and/or methodological aspects of international evaluation systems with the aid of Multicriteria Decision Analysis to study the analysis of the impacts of the criteria and weights used by the systems. The results of the study helped to improve the CAPES evaluation system, considering the criticisms identified in the analysis, suggesting the inclusion of new indicators and criteria and the redistribution of weights. It was also observed that the performance of the study has been considered in the analysis and classification of universities in the main international university rankings.

These and other related works, as well as some internationalization methods and models in HEI, such as those of Lepori *et al.*, (2015), Seeber *et al.,* (2016), Fleacã (2017), Patel (2017), Chang and Lin (2018), Wu and Zha (2018) and Kim *et al.,* (2019), in addition to understanding the internationalization of HEI, have sought to propose improvements, such as an organizational model, engagement structure and new typology. This emphasizes the perception of Gao (2014) concerning internationalization. According to the author, the internationalization is perhaps the most popular and constantly used concept in current higher education discourses, yet it undoubtedly remains ambiguous and unclear. The disagreement in the dimensions that different researchers have used to categorize indicators, demonstrate the vagueness in both the conception of the phenomenon and the development of measurement.

3. RESEARCH METHOD

To understand the research sample, it is first necessary to comprehend that Brazilian HEI are classified by Law 9.394/96, and thus organized using academic, administrative, and educational sectors. Regarding academic categories, the Ministry of Education (MEC) classifies HEI as colleges, university centers, public institutes, or universities. In administrative terms, distinctions are made according to the legal nature of their sponsors, defining them as public or private. A public institution can be subdivided into municipal, state, or public categories. A private institution can be classified as for-profit or non-profit. The educational aspect is related to the activities of Brazilian higher education of the triad: teaching, research, and extension.

To form the sample, a private non-profit HEI was chosen, along with a public HEI and a private for-profit HEI, given that internationalization is an institutional and cross-sectional topic that can be found in different categories and organizations. Three institutions were researched due to the possibility of understanding the internationalization process in different kinds of HEI and drawing comparisons in the analysis. For ethical reasons, the identities of the HEI involved in the study will not be revealed. For purposes of analysis, they will be identified as Public HEI, Non-profit HEI and Private HEI (Table 1).

Table 1. Characterization of the Brazilian universities analyzed in the study

Institution	Characterization	Mission	Vision
Public HEI	Public technological university	To develop excellent technological education, and build and share knowledge with a focus on addressing the real challenges facing society	To be an internationally recognized university due to the importance of its work striving for sustainable regional and national development
Non-profit HEI	Catholic, private, confessional and non-profit university	To develop and diffuse knowledge and culture, in addition to promoting the integral and permanent education of citizens and professionals committed to life and the progress of society	By 2022, to be consolidated as a world class institution with excellence in teaching and knowledge production, providing services and being socially relevant
Private HEI	University center, private and for-profit	To develop and transform people through education	To be recognized as an organization of excellence for study, work and investment

The data collection process involved three different and complementary stages. The first step in the data collection process was taken in 2019 and reviewed in the first semester of 2020. It included a survey of internationalization indicators used as evaluation criteria in the QS

World University Rankings (Q&S), Times Higher Education World University Rankings (THE), Scimago, Brazilian University Ranking (RUF) and the CAPES four-yearly evaluation forms. After surveying and clustering the data by similarity, forty-nine internationalization indicators were identified achieved and clustered into evaluation dimensions, as shown in Table 2 in additional results. The evaluation indicators were adapted in accordance with the indicators that were identified based on the study of Egron-Polak (2007). The list of indicators was used as a reference for the beginning of the second stage of the research.

The second step in the data collection involved surveying the data of the internationalization indicators in secondary sources maintained by agencies linked to the Ministry of Education (open data on the CAPES platform and microdata from the Higher Education Census). The data on Undergraduate education (Census) and Graduate education (CAPES) were collected for the reference years 2017 and 2018, as they configured the most recent and common period for the two sources.

The third stage of primary data collection included the participation of the HEI under study. The data and indicators collected in the first and second stages were forwarded to representatives of the HEI in question. In this stage, the representatives evaluated and validated the collected data that were collected and complemented them with non-open data (from internal and managerial databases). At the end of the third stage, the database of the HEI under study for the years 2017 and 2018 was complete, with open and internal data. The data analysis involved using the TOPSIS multicriteria method, aided by SDI Windows TOPSIS software.

3.1 Multicriteria Decision-Making Method

The Technique for Order of Preference by Similarity to the Ideal Solution (TOPSIS) method was first proposed by Hwang and Yoon in 1981 and has been widely used to order preferences through evaluating the performance of alternatives by similarity to the ideal solution (Aires and Ferreira, 2019; Vivas *et al.*, 2020).

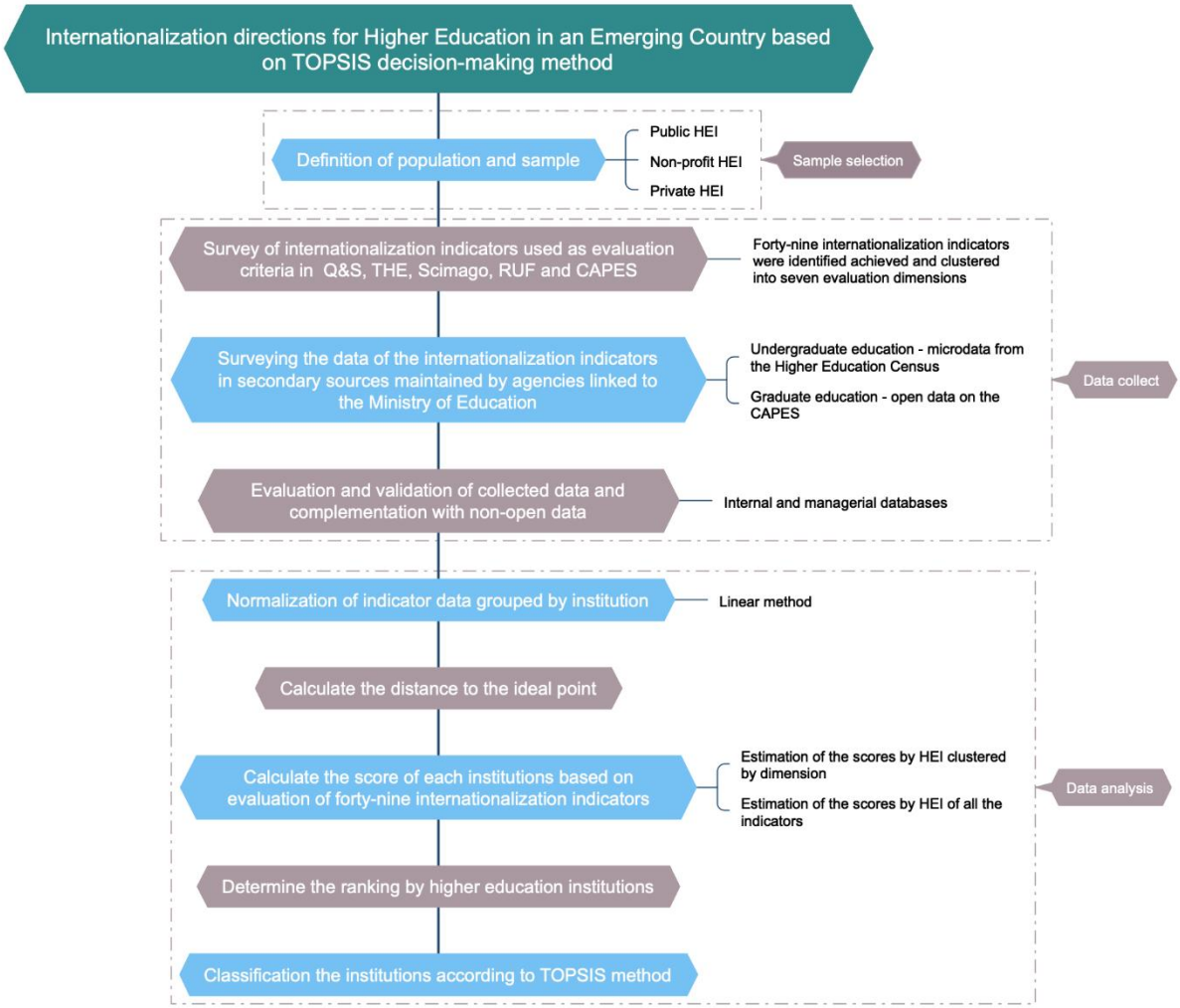
The general process of the TOPSIS method is to calculate the distance to the ideal point, both positive and negative. It is necessary to quantify the relative importance of the criteria, and no specific method is required to determine the weights. Normalization can be linear or vector. Another advantage is that it can be used for many alternatives and criteria, utilizing scalar and quantitative data. Consequently, the TOPSIS method performs the general ordering of the alternatives (Aires and Ferreira, 2019). The application of the method is described in a series of successive steps, in which an electronic spreadsheet can be used as a basic tool for its development (Nanayakkara *et al.*, 2020). The application of every step of the method was modeled using a computer application.

The TOPSIS method was chosen because it is based on the concept that the chosen alternative should be the shortest distance from the positive ideal solution and the longest possible distance from the negative ideal solution. The method is capable of adequately treating quantitative criteria, is easy to understand and has low computational complexity. It is stable during the inclusion or exclusion of alternatives and there are no limitations on the number of suppliers and criteria that can be evaluated at any one time.

Therefore, the TOPSIS method is an approach used to identify an alternative that is closest to the positive ideal solution and farthest from the negative ideal solution in a

multidimensional computing space (Qin *et al.*, 2008). Figure 1 summarizes the strategy adopted to classify institutions according to the TOPSIS method.

Figure 1. Outline of classification the institutions



4. RESULTS AND ANALYSIS

The results allowed to identify the score of each institution based on evaluation of forty-nine internationalization indicators. The TOPSIS method to calculate the scores in two different ways: estimation of the scores by HEI clustered by dimension; and estimation of the scores by HEI of all the indicators (Overall). Table 2 shows the results of dimensions ranking by higher education institutions.

The method estimates score values between 0 and 1, with 1 being the closest to the positive ideal, and this allows to compare the higher education institutions. Considering all the indicators (Overall), the institutions were classified in the following order: 1st place – Public HEI (0.625); 2nd place – Non-profit HEI (0.416); 3rd place – Private HEI (0.273).

Table 2. Results of dimensions scores by higher education institutions

Dimensions	No. Criteria	Non-profit HEI	Private HEI	Public HEI
International agreements and partnerships	5	0.383	0.382	0.661
Diversity of professors, students and collaborators	13	0.440	0.384	0.535
Double degree	2	0.106	0.000	1.000
Internationalization at home	12	0.362	0.246	0.663
Academic mobility	2	0.000	0.140	1.000
Research potential	11	0.626	0.000	0.609
International visibility	4	0.257	0.123	1.000
Overall	49	0.416	0.273	0.625

In addition to classifying the institutions according to TOPSIS method, it is more important to understand how these institutions operate in terms of managing the internationalization indicators based on the requirements of the Ministry of Education, according to their category in the clustering of the HEI. Thus, after surveying and clustering the data by similarity, forty-nine internationalization indicators were identified achieved and clustered into evaluation dimensions. The dimensions investigated: international agreements and partnerships; diversity of professors, students and collaborators; double degree; internationalization at home; academic mobility; research potential and, international visibility.

- **International agreements and partnerships:** many universities address internationalization by developing partnerships with overseas institutions (Gao, 2014; Fleaca, 2017; Lustrea; Sava; Borca, 2017; Yesufu, 2018).
- **Diversity of professors, students, and collaborators:** internationalization cannot belong to only one group, as it needs to operate inclusively. Thus, discussions all over campus on the theme need to be encouraged to address subjects such as need, purpose, strategies, doubts, implications, and benefits (Knight, 1994).
- **Double degree:** a double degree (Souza, 2020; Jowi 2009) allows students to experience an exchange and earn two university diplomas.
- **Internationalization at home:** internationalization at home (Knight, 2008), in other words, internationalization independent of international mobility, is a concept that increasingly emerges when the internationalization of higher education institutions is discussed. To Knight (2012), the evidence of this change is revealed in the bifurcation of internationalization into two interdependent pillars: “at home” and “abroad”.
- **Academic mobility:** academic mobility (Maranhão *et al.*, 2017) has passed from the student to the provider and the mobility of the program. Cross-border education has gradually shifted from a cooperation framework to the development of a partnership model and now in the direction of commercial competition (Knight, 2012).
- **Research potential:** knowledge production is also an active and applicable process that involves interconnections, plurality, relativity, collaboration, and engagement with the world. Learning has thus become more collaborative and international. Learning, in this case, has become global (Kahn and Agnew, 2017).

- **International visibility:** some factors should be included for the development of international strategy, including identity and regulation, specialization, and the increased use of brands to exploit reputable assets (Ayoubi and Massound, 2007). Thus, internationalization is increasingly characterized by competition, commercialization, self-interest and gaining status (Knight, 2015).

In this respect, the results of the analysis also showed the superiority of the Public HEI when the indicators were clustered by dimension. As shown in Table 4, the classification order of the general scores (1st place – Public HEI; 2nd place – Non-profit HEI; 3rd place – Private HEI) is repeated in the following dimensions: International agreements and partnerships; Diversity of professors, students and collaborators; Double degree; Internationalization at home; and International visibility. In the Academic mobility dimension, the Private HEI had a higher score than the Non-profit HEI. In the Research potential dimension, the Non-profit HEI scored higher than the others.

The classification of the institutions in each dimension, as well as the application of the TOPSIS method, in addition to its predictable use in the ordering of the institutions according to the internationalization criteria, provides a better understanding of actions related to internationalization:

1st) The classification of the HEI in most of the dimensions (Table 3), as in the general evaluation, shows an alignment between internationalization actions according to the prioritization of teaching, research and extension expected for each academic category and administrative organization.

2nd) The results of the scores for each HEI in each dimension (Table 3) help to understand how the management of the HEI prioritizes its monitoring of the performance indicators.

3rd) The amount of missing data may indicate a problem in the management of data that give rise to the indicators and, consequently, distort the HEI's perception of its performance in internationalization actions.

In accordance with Gao (2014), the difficulties involved in generating a set of internationalization indicators for universities that can be used across national borders should not be underestimated. An important point cited by the authors, and which corroborates the findings of this study is that not everything that is valued in internationalization can easily be quantified and measured by indicators, and qualitative information is necessary for some of the important elements that challenge quantification. The amount of missing data is a point in question. Quantitative research is recommended with the use of multicriteria methods aligned with qualitative information. Concentrated efforts on classification, as well as prioritization according to different categories and organizations, are also recommended. Another recommendation is to concentrate on classification and prioritization using the different academic categories and administrative organizations (Table 3).

Table 3. Results of higher education institutions ranking by dimensions

Dimension	Theoretical basis	Classification		
		Non-profit HEI	Private HEI	Public HEI
International agreements and partnerships	GAO (2014); FLEACA (2017); LUSTREA; SAVA; BORCA (2017); YESUFU (2018)	2nd	3rd	1st
Diversity of professors, students and collaborators	KNIGHT (1994)	2nd	3rd	1st
Double degree	SOUZA (2020); JOWI (2009)	2nd	3rd	1st
Internationalization at home	KNIGHT (2008; 2012)	2nd	3rd	1st
Academic mobility	MARANHÃO, DUTRA, MARANHÃO (2017); KNIGHT (2012)	3rd	2nd	1st
Research potential	KAHN; AGNEW (2017)	1st	3rd	2nd
International visibility	AYOUBI; MASSOUND (2007); KNIGHT (2015)	2nd	3rd	1st

5. CONCLUSIONS

We proposed a new approach to evaluate the Brazilian universities' internationalization indicators based on multiple criteria decision-making method. The results made it possible to find the scores of each of the three institutions based on the analysis of the forty-nine internationalization indicators. The results indicate that TOPSIS method is a useful for evaluating and supporting decisions on topical themes in the sphere of education, as performance evaluation and quality management of internationalization indicators.

When reflecting on the impacts of indicators for the management of internationalization actions, we can assume that their groupings (dimensions) reflect the direction of the institutions' strategies. The results in table 4 help to understand that the management efforts in the public HEI do not prioritize research potential, while the private HEI prioritizes actions related to academic mobility and the non-profit HEI prioritizes the research potential.

Another important finding is the lack of data regarding the internationalization indicators in the managerial databases of the institutions and in the databases with open data. Although the employed method is useful in scenarios with missing data, the lack of data can present distortions in the institutions' managerial vision, and there is room for future research.

Future research could focus on efforts to reduce the number of indicators by classifying and prioritizing in accordance with the different academic categories and administrative organizations, as well as reviewing the dimensions and clustering of indicators. Future research can also concentrate on prioritizing the collection of data on internationalization indicators to compare the scenario in more than one HEI.

Our future work will concentrate on the study and presentation of identified internationalization indicators and their application and data collection in other higher learning institutions.

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APPENDIX

Table below shows the results of the internationalization indicators for calculating the scores, using the TOPSIS method, grouped by dimensions that are part of the findings of this research.

Table. TOPSIS results by indicator, grouped by dimension

Dimensions	**Criteria**		**Options**		
			Non-profit HEI	Private HEI	Public HEI
International agreements and partnerships	C01	Number of formal partnership agreements with foreign universities	0,577	0,052	0,371
	C02	Number of courses with dual degree agreement/Number of dual degree courses	0,135	0	0,865
	C03	Number of internationally accredited courses and/or schools/Number of internationally accredited courses	0	0	0
	C04	Number of consolidated collaboration links with foreign institutions of high standard of excellence, involving most of the faculty	0	0,778	0,222
	C05	International research project funding	0,286	0	0,714
Diversity of professors, students and collaborators	C06	Number of foreign students participating in PIBIC	1	0	0
	C07	Number of undergraduate foreign exchange students (incoming)	0	1	0
	C08	Number of professional hires - QTA - foreigners	0	0	0
	C09	Number of foreign students enrolled in subjects in a foreign language/Number of foreign students enrolled in subjects in English	0	0	1

Dimensions	Criteria		Options		
			Non-profit HEI	Private HEI	Public HEI
	C10	Number of incoming exchange students in all modalities (regular, double degree, short-term, free move)	0,316	0,576	0,108
	C11	Number of nationalities represented in the student body	0,491	0,083	0,426
	C12	Number of foreign students in graduate programs	0,17	0,626	0,205
	C13	Role of professors from international institutions/visitors in the program (lectures, benches, courses, post-doctoral research activities)	0	0,091	0,909
	C14	Proportion of foreign exchange scholarship students in postgraduate studies (incoming and outgoing; broken down by country)	0	0,5	0,5
	C15	Number of visiting foreign professors/researchers	0,846	0	0,154
	C16	Number of nationalities represented on the faculty	0,308	0,077	0,615
	C17	Number of permanent foreign professors/Proportion of foreign professors	0,066	0,033	0,902
	C18	Number of foreign students participating in projects	0,561	0	0,439
Double degree	C19	Number of courses with dual degree agreement/Number of dual degree courses	0,135	0	0,865
	C20	Number of students dual diploma (incoming and outgoing) / Number of students dual diploma (incoming and outgoing)	0	0	1
Internationalization at home	C21	Number of courses offered in English and other languages/Number of courses offered in English	0	0,277	0,723
	C22	Number of local scholarship holders (outgoing)	0	0	0
	C23	Permanent professors holding productivity grants	0,367	0,007	0,626
	C24	Number of local students enrolled in foreign language courses	0	0,273	1
	C25	Number of local students doing internship abroad	1	0	0
	C26	Number of visiting professors at international institutions	0	0,042	0,958
	C27	Number of administrative and academic staff in international missions	0	0,5	0,5
	C28	Number/proportion of faculty with proficiency in 1 or more foreign language(s)	0	0	1
	C29	Program students developing a project or internship in HEIs abroad	0	0	0
	C30	Professors with postdoctoral training in foreign HEI programs	0	0,008	0,992

Dimensions	Criteria		Options		
			Non-profit HEI	Private HEI	Public HEI
	C31	Number of professors with medium and long-term international cooperation activities	0	0	1
	C32	Number of professors with short-term international cooperation activities	0,84	0,08	0,08
Academic mobility	C33	Exchanges and international agreements, promoting the mobility of teachers and students	0	0,123	0,877
	C34	Number of short-term (faculty-led) programs – incoming and outgoing	0	0	0
Research potential	C35	Outstanding international production	1	0,167	0,167
	C36	Number of theses and dissertations defended in other languages	0,459	0	0,541
	C37	Number of scientific/academic publications in international partnership	0	0	1
	C38	Qualified participation and presentation of papers in international scientific events of high academic level	0,391	0,011	1
	C39	Impact of scientific production of faculty on the international community measured by high H index	0	0	0
	C40	Publication in international journals	0,277	0,01	0,713
	C41	Number of doctoral co-tutorships	0,889	0	0,111
	C42	Books or book chapters from renowned international publishers	0,418	0,027	1
	C43	PQD: number of publications A1 to B1-equivalents of permanent professors / total number of professors	0	0	0
	C44	Faculty members participating in the editorial committee of a periodical published abroad	0,778	0	0,222
	C45	International cooperation project	0,531	0	0
International visibility	C46	Numbers of outstanding scientific events at an international level	0,45	0,05	0,5
	C47	Number of visiting international delegations	0	0	1
	C48	Number of participations in programs of international organizations	0	0	1
	C49	International awards	0	0,2	1