



COMPARATIVE ANALYSIS OF UNIVERSITIES IN TOP1 OF GLOBAL RANKING OF ACADEMIC SUBJECTS 2020

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Abstract: *Global Ranking of Academic Subjects (GRAS) is an annual classification of worldwide universities, grouped by subject, according to five indicators: Q1, CNCI, IC, Top and Award, evaluating, in particular, the quality of research activities. This paper aims to perform a comparative study, through a descriptive analysis, of universities in Top1 of GRAS 2020, to relate and compare their indicators. This report first presents information about ranking indicators and, then, shows the results of them: Q1, CNCI, IC, Top and Award. The best performing institution is Harvard University (HARVARD), achieved the best Total Score values in two subjects: Biological Sciences (BS) of Life Sciences field and Statistic of Social Sciences field. However, Massachusetts Institute of Technology (MIT) achieves placing with the highest Total Score values in two subjects: Physics of Natural Sciences field and Materials Science & Engineering of Engineering field. Also, Michigan University (UMICH) obtains the highest Total Score value in Dentistry & Oral Sciences subject of Medical Sciences field.*

Keywords: *Global Universities, GRAS, Global Ranking of Academic Subjects, indicators, GRAS 2020*

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1. Introduction

Global Ranking of Academic Subjects (GRAS) and Academic Ranking of World Universities (ARWU) are published to know the positioning of the best higher education institutions (IESs) in the world [1] [2]. Indicators are used to measure the quality of universities according to academic activities, production



and dissemination of research, innovation, internationalization, competitiveness, to name just a few [3] [4] [5] [6].

In the case of GRAS [2], also edited every year since 2009, is presented by field: Natural Sciences, Engineering, Life Sciences, Medical Sciences, and Social Sciences, through a World Rank value (WR) positioning the university and, also, a Total Score value (TS) as university performance to relate five indicators: Q, CNCI, IC, Top and Award [7] [8].

Top1 of universities classified in each subject is considered in this paper. Universities from the US take top positions in 31 subjects; universities from China dominate 11 subjects. The greatest performing IES is Harvard University (HARVARD), taking 14 crowns, 5 of which are from Social Sciences subject, 4 from Medical Sciences, 3 from Engineering, and 2 from Life Sciences. Massachusetts Institute of Technology (MIT) tops 6 subjects, 5 of which are engineering field [7] [8]. Other universities included are: University of California Berkeley (UC Berkeley), University of Pennsylvania (UPENN), New York University (NYU), University of Chicago (UCHICAGO), Yale University (YALE), Michigan University (UMICH) and University of Colorado at Boulder (CU Boulder) from the US. Oxford University (OX) from the United Kingdom and Nanyang Technological University (NTU) from SG. Paris-Saclay University (PSU) tops the list of the subject of Mathematics at its first appearance in GRAS 2020. Also, universities of CN highlights: Tsinghua university (Tsinghua), Harbin Institute of Technology (HIT), Tongji University (TONGJI), Jiangnan University (JU), Beihang University (BUAA), Shanghai Jiao Tong University (SJTU), Beijing Jiaotong University (NJTU), Wuhan University (WHU), Central South University (CSU), The Hong Kong Polytechnic University (POLYU), University of Science and Technology Beijing (USTB). From NL are classified Wageningen University & Research (WUR) and University of Amsterdam (UVA). From DK, Aarhus University (AU) and from BE, Ghent University (UGENT), to name just a few.

This paper aims to perform a comparative study, through a descriptive analysis, of universities in Top1 of Global Ranking of Academic Subjects (GRAS) 2020 [9], to relate and compare their indicators. This report first presents information about ranking indicators and, then, shows the results of them: Q1, CNCI, IC, Top and Award.

Nomenclature

GRAS	Global Ranking of Academic Subjects
ARWU	Academic Ranking of World Universities
IES	Higher education institution
TS	Total Score
WR	World Rank
Q1	Q1 Journal Impact Factor Quartile
CNCI	Category Normalized Citation Impact
IC	International Collaboration

2. GRAS 2020 edition

Since 2009, ShanghaiRanking Consultancy started to publish the ARWU on a global scale and, also, by academic subjects, called Global Ranking of Academic Subjects (GRAS) [1] [2]. 2020 edition was published on 29th of this year and has a classification higher than four thousand (4.000) IESs in five fields: Natural Sciences, Engineering, Life Sciences, Medical Sciences, and Social Sciences, which are divided in fifty-four (54) subjects [7].

While six objective indicators of ARWU are about the number of students and staff winning Nobel Prizes and Fields Medals, number of highly cited researchers selected by Clarivate Analytics, number of articles published in journals of Nature and Science, number of articles indexed in Science Citation Index - Expanded Social Sciences Citation Index and per capita performance of a university [10] [11], GRAS ranking indicators are five: Q1, CNCI, IC, Top and Award, which have different weightings, according to subjects (Table 1) [8]. Two similarities in both rankings are: 1) the maximum indicator value is one hundred (100), corresponding to the obtained by the best university. The indicator is



calculated as a percentage proportionate to this maximum value (100) to others universities [8] [10] [11] [12] and, 2) each university is associated to a World Rank value (WR) which informs about their position and calculates Total Score (TS) as academic performance, product of a relationship with indicators [8] [13] [14] [15].

GRAS ranking focuses its objective to research activities, and most especially, for cutting-edge research [15], because universities are selected from a minimum amount of scientific papers during the period 2014-2018, which is variable depending on subject . Bibliometric data are collected from Web of Science and InCites. Web of Science categories are mapped to 54 academic subjects [8] [9].

Table 1. Indicators, definition and weight according to field and subject of GRAS 2020 [8].

Indicador	Definition	Natural Sciences			Engineering				Life Sciences			Medical Sciences				Social Sciences		
		Mat, Phys, Chem, EarthS, AtmS	Geo, Eco	Ocea	ME, EEE, AC, CSE, CE, Che, MSE	TE, IST, FST, B, TST	BE, NN, ESE, AE, MOE, RS, MME, MeE	WR	BS, HBS	AS	VS	CM, DOS	PH	N, PPS	MT	Ec, S	L, S, Ed, Co, Ps, BA, F, M, PA	PS, HTM, LIS
Q1	The number of papers (articles) published in Q1 Journal Impact Factor Quartile in an Academic Subject, during the period of 2014-2018. Papers in different Web of Science categories are grouped into relevant Academic Subjects.	100	100	200	100	200	100	100	100	200	100	100	100	100	200	150	150	150
CNCI	Category Normalized Citation Impact (CNCI) from InCites to measure average impact of papers authored by an institution in an Academic Subject, during the period of 2014-2018.	100	100	100	100	100	100	100	100	100	100	100	100	100	100	50	50	50
IC	International Collaboration (IC) is the number of publications that have been found with at least two different countries in addresses of the authors divided by the total number of publications in an Academic Subject for an institution, during the period 2014-2018.	20	20	20	20	20	20	20	20	20	20	20	20	20	10	10	10	
Top	The number of papers published in top journals and conferences in an Academic Subject, during the period 2014-2018. Top Journals are identified through ShanghaiRanking's Academic Excellence Survey.	100	100	NA	100	NA	100	100	100	NA	100	100	100	100	NA	100	100	100
Award	The total number of the staff of an institution winning a significant award in an Academic Subject since 1981. The significant awards in each subject are identified through ShanghaiRanking's Academic Excellence Survey.	100	NA	NA	20	NA	NA	20	100	NA	NA	100	NA	20	NA	100	NA	20

3. Characterization and comparison of universities in Top1 of Global Ranking of Academic Subjects (GRAS) 2020 edition

Below is presented the comparative study of universities in Top1 1 of GRAS 2020 [9], classified in five fields: Natural Sciences, Engineering, Life Sciences, Medical Sciences, and Social Sciences, in respect to rank indicators.

3.1. Field: Natural Sciences (NS)

Fig. 1 shows TS value of universities positioned in eight subjects considered in Natural Sciences field[8] [9]: Mathematics (Math), Physics (Phys), Chemistry (Chem), Earth Sciences (ES), Geography (Geo), Ecology (Eco), Oceanography (Ocea) and Atmospheric Science (AtmS). Four universities are positioned above average value of TS (344.76), the first three from US and the last one from FR: MIT (Phys), CU Boulder (ES), UC Berkeley (Chem) and PSU (Math) with values of 390.1; 387.2; 380.6 and 362.9, respectively. Fig. 2 presents values of Q1, CNCI, IC, Top and Award of these universities. In respect to MIT (Phys), which has the highest TS value (390.1), in the same order, the values are: 90.1; 85.9; 80.8; 97.9 and 100. Universities with highest scores of Q1, CNCI, IC, Top and Award, to Natural Sciences field, are:

- Q1: OX (Geo), UW (Ocea) and CU Boulder (AtmS) with 100.
- CNCI: UC Berkeley (Chem) with 99.8.
- IC: OX (Eco) con 91.8.
- Top: OX (Geo), OX (Eco) and CU Boulder (AtmS) with 100.
- Award: PSU (Math), MIT (Phys) and CU Boulder (ES) with 100.

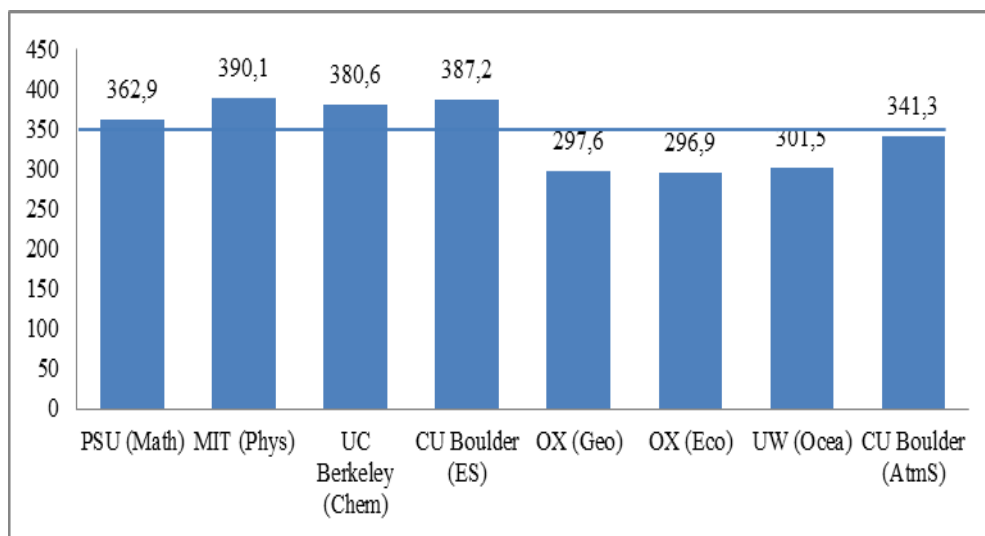


Fig. 1. Total Score of universities in Top1 of GRAS 2020 Natural Sciences field [9].

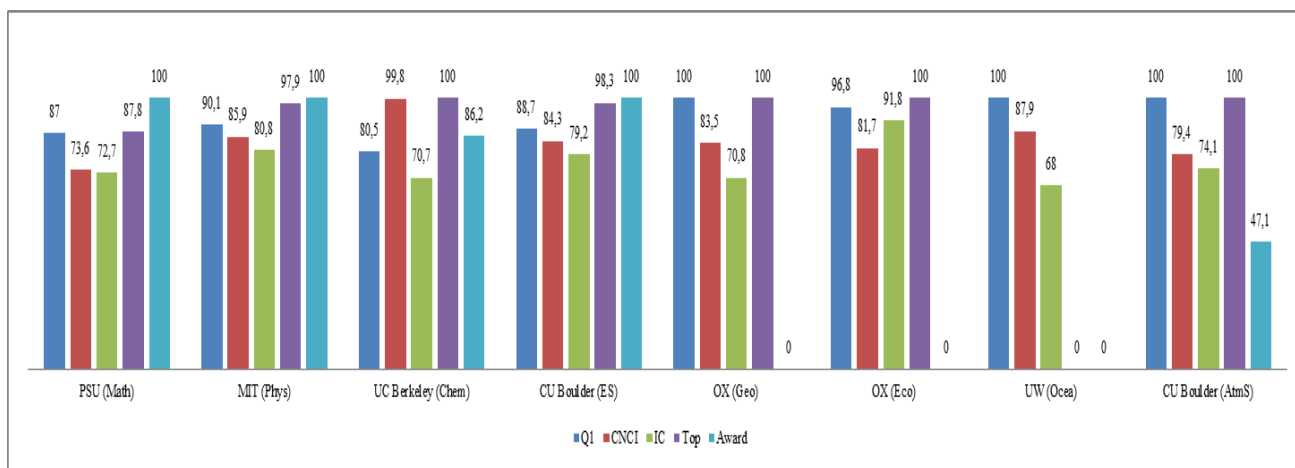


Fig. 2. Q1, CNCI, IC, Top and Award of universities in Top1 of GRAS 2020 Natural Sciences field [9].

3.2. Subject: Life Sciences

Fig. 3 presents TS value of universities positioned in four subjects considered in Life Sciences field [8] [9]: Biological Sciences (BS), Human Biological Sciences (HBS), Agricultural Sciences (AS) and Veterinary Sciences (VS).

TS values are above the average (326.35) correspond to a university from US: HARVARD (BS) and HARVARD (HBS).

Fig. 4 presents the values of Q1, CNCI, IC, Top and Award of universities in this field. In respect to HARVARD (BS), with the highest TS of 360.9; in same order, reaches the values of: 100; 100; 76.2; 100 and 45.6. Universities with highest results of Q1, CNCI, IC, Top and Award, to Life Sciences field, are:

- Q1: HARVARD (BS), HARVARD (HBS) and WUR (AS) with 100.
- CNCI: HARVARD (BS) with 100.
- IC: WUR (AS) with 86.
- Top: HARVARD (BS), HARVARD (HBS), UGENT (VS) with 100.
- Award: HARVARD (BS) with 45.6.

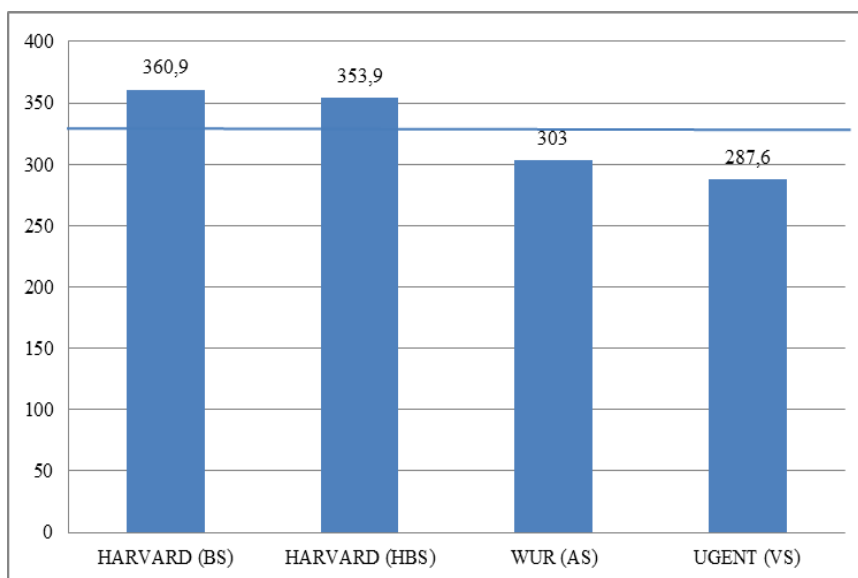


Fig. 3. Total Score of universities in Top1 of GRAS 2020 Life Sciences field [9].

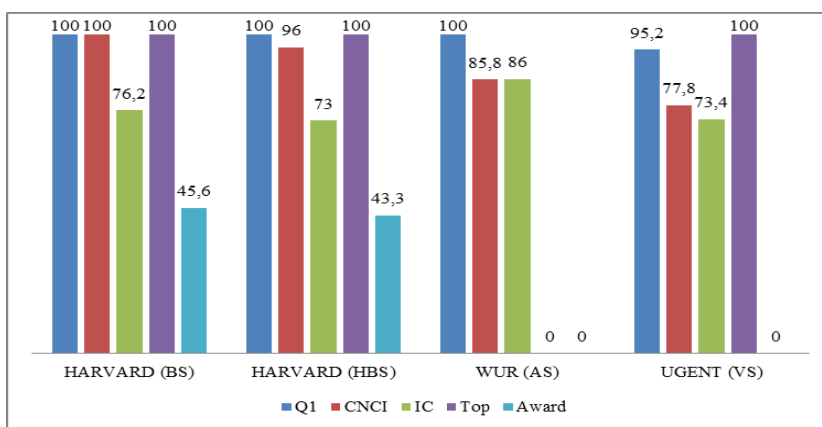


Fig. 4. Q1, CNCI, IC, Top and Award of universities in Top1 of GRAS 2020 Life Sciences field [9].

3.3. Field: Medical Sciences

Fig. 5 shows TS value of universities positioned in six subjects considered in medical sciences [8] [9]: Clinical Medicine (CM), Public Health (PH), Dentistry & Oral Sciences (DOS), Nursing (N), Medical Technology (MT), and Pharmacy & Pharmaceutical Sciences (PPS).

TS values are above the average (311.18) correspond to two universities from US: UMICH (DOS) and HARVARD (CM).

Fig. 6 presents values of Q1, CNCI, IC, Top and Award of universities in this field. In respect to UMICH (DOS), with the highest TS of 367.4; in the same order, the values are: 66.9; 86.5; 83.5; 97.3 and 100. Universities with the highest Q1, CNCI, IC, Top and Award results, to Medical Sciences field, are:

- Q1: HARVARD (CM), HARVARD (PH), HARVARD (MT) and HARVARD (PPH) with 100.
- CNCI: UMICH (DOS) with 86.5.
- IC: UMICH (DOS) with 83.5.
- Top: HARVARD (CM), HARVARD (PH) and UPENN (N) with 100.
- Award: UMICH (DOS) and UPENN (N) with 100.

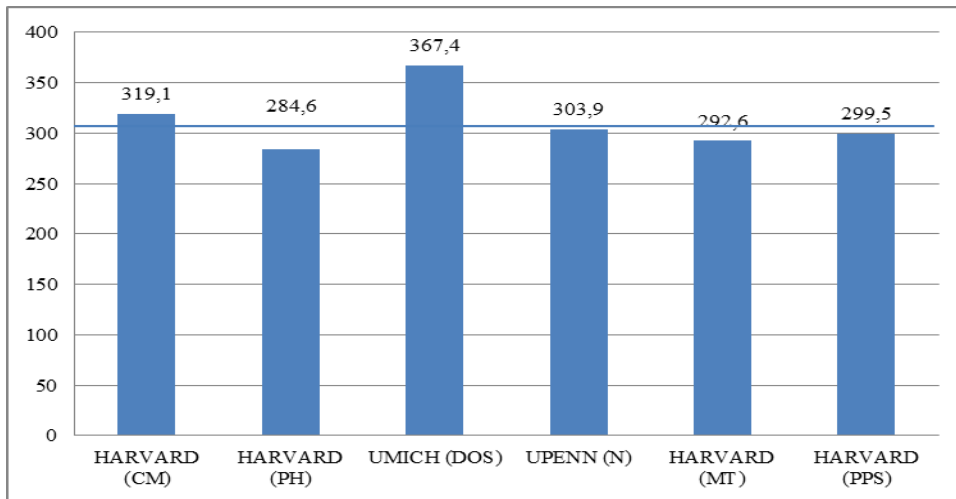


Fig. 5. Total Score of universities in Top1 of GRAS 2020 Medical Sciences field [9].

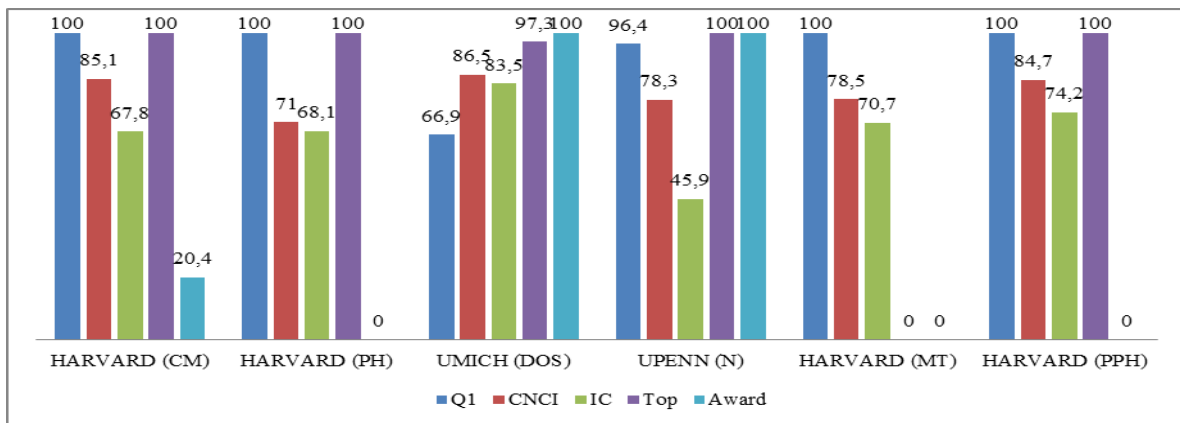


Fig. 6. Q1, CNCI, IC, Top and Award of universities in Top1 of GRAS 2020 Medical Sciences field [9].

3.4. Subject: Social Sciences

Fig. 7 presents TS value of universities positioned in fourteen (14) subjects considered in Social Sciences field [8] [9]: Economics (Ec), Statistic (S), Law (Law), Political Sciences (PS), Sociology (S), Education (Educ), Communication (Co), Psychology (Psycho), Business Administration (BA), Finance (F), Management (M), Public Administration (PA), Hospitality & Tourism Management (HTM) and Library & Information Science (LIS).

TS values are above the average (301.81) correspond to three universities: UCHICAGO (Ec), HARVARD (S), HARVARD (PS) from US; and POLYU (HTM) from CN.

Fig. 8 presents the values of Q1, CNCI, IC, Top and Award of universities in this field. In respect to HARVARD (S), with the highest TS of 399.8; in same order, reaches the values of: 100; 87.2; 62.2; 100 and 100. Universities with highest results of Q1, CNCI, IC, Top and Award, to Social Sciences field, are:

- Q1: HARVARD (S), UVA (Co), HARVARD (Psycho), NYU (F), AU (PA), POLYU (HTM), HARVARD (LIS) with 100.
- CNCI: UCHICAGO (Ec), YALE (Law) and AU (PA) with 100.
- IC: NUS (M) with 90.4.
- Top: HARVARD (S), YALE (Law), HARVARD (PS), UC Berkeley (S), HARVARD (Psycho), UPENN (BA), POLYU (HTM) and HARVARD (LIS) with 100.



- Award: UCHICAGO (Ec), HARVARD (S), HARVARD (PS) and POLYU (HTM) with 100.

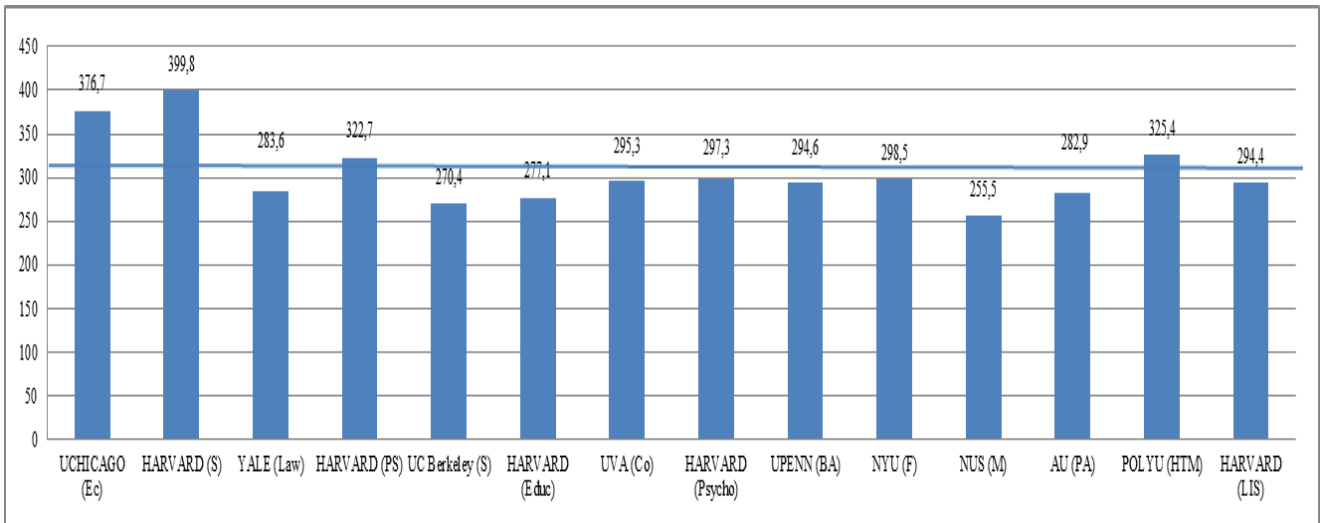


Fig. 7. Total Score of universities in Top1 of GRAS 2020 Social Sciences field [9].

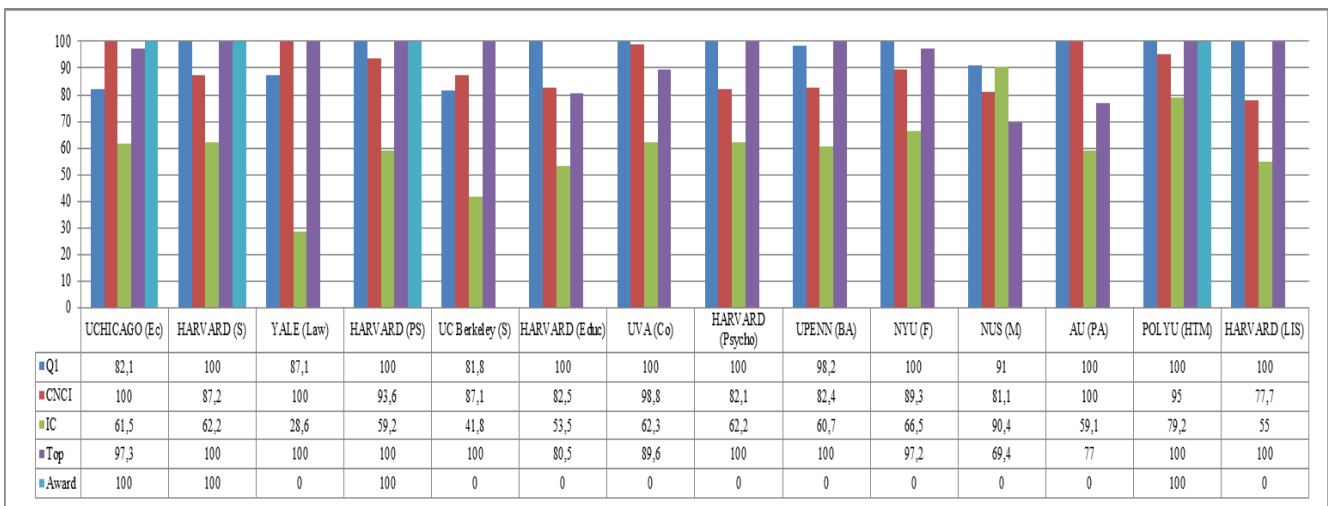


Fig. 8. Q1, CNCI, IC, Top and Award of universities in Top1 of GRAS 2020 Social Sciences field [9].

In summary form, table 2 shows the best universities in the world by field and indicator to compare them side by side by TS value:

- In Q1 indicator, seventeen universities obtained the score of 100: OX (Geo), UW (Ocea), CU Boulder (AtmS), Tsinghua (TE), HIT (IST), HARVARD (BE), TONGJI (CE), JU (FST), HARVARD (B), BUAA (AE), SJTU (MOE), NJTU (TST), WHU (RS), CSU (MME), HARVARD (BS), HARVARD (HBS), WUR (AS), HARVARD (CM), HARVARD (PH), HARVARD (MT), HARVARD (PPH), HARVARD (S), UVA (Co), HARVARD (Psycho), NYU (F), AU (PA), POLYU (HTM) and HARVARD (LIS).
- In CNCI indicator, four universities obtained the score of 100: HARVARD (BS), UCHICAGO (Ec), YALE (Law) and AU (PA).
- In IC indicator, a university obtained the best score of 91.8: OX (Eco).
- In Top, twenty universities obtained the score of 100: OX (Geo), OX (Eco), CU Boulder (AtmS), SJTU (MOE), WHU (RS), USTB (MEt), HARVARD (BS), HARVARD (HBS), UGENT (VS), HARVARD (CM), HARVARD (PH), UPENN (N), HARVARD (S), YALE (Law), HARVARD (PS), UC Berkeley (S), HARVARD (Psycho), UPENN (BA), POLYU (HTM) and HARVARD (LIS).

- In Award indicator, twelve universities obtained the score of 100: PSU (Math), MIT (Phys), CU Boulder (ES), MIT (CSE), MIT (ChE), HARVARD (EnSE), UMICH (DOS), UPENN (N), UCHICAGO (Ec), HARVARD (S), HARVARD (PS) and POLYU (HTM)

Table 2. Universities located in Top1 of GRAS 2020 by field and indicator with the best scores [9].

Field	Q1	CNCI	IC	Top	Award
Natural Sciences	OX (Geo), UW (Ocea), CU Boulder (AtmS)	UC Berkeley (Chem)	OX (Eco)	OX (Geo), OX (Eco), CU Boulder (AtmS)	PSU (Math), MIT (Phys), CU Boulder (ES)
	100	99,8	91,8	100	100
Engineering	Tsinghua (TE), HIT (IST), HARVARD (BE), TONGJI (CE), JU (FST), HARVARD (B), BUAA (AE), SJTU (MOE), NJTU (TST), WHU (RS), CSU (MME)	HARVARD (B)	ETH (WS)	SITU (MOE), WHU (RS), USTB (MEt)	MIT (CSE), MIT (ChE), HARVARD (EnSE)
	100	84,4	88,7	100	100
Life Sciences	HARVARD (BS), HARVARD (HBS), WUR (AS)	HARVARD (BS)	WUR (AS)	HARVARD (BS), HARVARD (HBS), UGENT (VS)	HARVARD (BS)
	100	100	86	100	45,6
Medical Sciences	HARVARD (CM), HARVARD (PH), HARVARD (MT), HARVARD (PPH)	UMICH (DOS)	UMICH (DOS)	HARVARD (CM), HARVARD (PH), UPENN (N)	UMICH (DOS), UPENN (N)
	100	86,5	83,5	100	100
Social Sciences	HARVARD (S), UVA (Co), HARVARD (Psycho), NYU (F), AU (PA), POLYU (HTM), HARVARD (LIS)	UCHICAGO (Ec), YALE (Law), AU (PA)	NUS (M)	HARVARD (S), YALE (Law), HARVARD (PS), UC Berkeley (S), HARVARD (Psycho), UPENN (BA), POLYU (HTM), HARVARD (LIS)	UCHICAGO (Ec), HARVARD (S), HARVARD (PS), POLYU (HTM)
	100	100	90,4	100	100

4. Conclusions

GRAS and ARWU are classifications of global universities, performed by ShanghaiRanking Consultancy, to visualize the positioning of these University Education Institutions, and compare their total score according to indicators. In the case of GRAS are five: Q1, CNCI, IC, Top and Award, which have different weightings according to 54 academic subjects divided into five fields: Natural Sciences, Engineering, Life Sciences, Medical Sciences and Social Sciences. In this paper, a comparative study was performed, through a descriptive analysis, of universities in Top1 of GRAS 2020, to relate and compare their indicators.

The best performing institution is Harvard University (HARVARD), which achieves the greatest values of Total Score in two subjects: Biological Sciences (BS) with TS (360.9) in Life Sciences field and Statistic (S) with TS (399.8) in Social Sciences field. However, Massachusetts Institute of Technology (MIT) also achieves to position with the best scores in two subjects: Physics of Natural Sciences field with TS (390.1) and Materials Science & Engineering with TS (366.4) in Engineering field. And Michigan University (UMICH), in Dentistry & Oral Sciences subject, with TS (367.4) is the best in Medical Sciences field.

In Q1 indicator, 9 universities achieve the best score (100). In CNCI indicator, four universities achieve that score. In IC indicator, one university achieves the highest value of 91.8. In Top indicator, 20 universities reach 100. Finally, Award indicator, 12 are positioned as the best universities also with the value of 100.



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