

How does South African academia rate internationally?

by Anastassios Pouris

Comparative assessments of higher education institutions provide valuable information for research administrations, researchers and students. However, such information is not currently available for South Africa's 22 higher education institutions. South Africa's higher education institutions mostly make use of the Essential Science Indicators (ESI) database of the Institute for Scientific Information (ISI) to identify their disciplinary strengths and international standing in the various scientific disciplines.

Probably the most well known of the large and increasing number of national and international rankings of higher education institutions are those produced by the Times Higher Education Supplement in the UK and the USA News and World Report.

Rankings are important for a number of reasons. They provide an indication of the quality of an institution's research output. The allocation of scarce resources by national research administrations is determined on the basis of an academic institution's performance. The administrations of the individual academic institutions use their rankings to measure their performance in relation to their competitors, so that they can adjust their policies and strategies appropriately. Rankings also have the potential to create socially beneficial competition among academic institutions.

Although rankings are often criticised for their shortcomings and deficiencies, their visibility in the press is considerable, and the fact that higher education institutions continue to contribute to league tables and informal analysis indicates that after the rankings are published, many schools acknowledge their rank, adjust their actions and often see them as an important factor in recruitment (Sharp, 2000).

To assess the performance of South African higher education institutions, the citation of articles in a number of scientific disciplines by authors from individual institutions is often used as a yardstick. Citations are in many ways the currency of science and technology and a number of authors use them for evaluation purposes (Butler, 2003; Haiqi & Yuha, 1997; Johnson & Osborne, 1997; Pouris, 2003). They indicate, inter alia, the recognition, visibility and utility of research produced by particular research groups.

Citation analysis reflects scientific impact and is a useful tool in the evaluation of academic research. It is in certain ways superior to publication counting. Publication counts on their own may fail to "distinguish between the

fluency of genius and the loud noises of empty vessels" (Editorial, 1970). For example, publication counting can tell us little about the effect of a laboratory's work on others, but citation analysis can provide valuable information.

It is important to highlight the difference between the short-term and long-term impact of citation. The short-term impact indicates how groups maintain themselves at the research front, while the long-term impact indicates the extent to which they succeed in prevailing in research. On the research front, scientists publish theories about the structure of reality and these theories are confronted with each other. In the end, only a few theories will prevail and be added to fundamental knowledge in the field.

The ESI database of the ISI is particularly useful for the assessment of academic institutions. It is neutral in the sense that it is produced by an independent organisation with no links to any of the assessed institutions; it does not suffer from subjective indicator biases; and the results are repeatable. It provides information of the most cited institutions worldwide during the most recent 10 years, and identifies 22 scientific fields.

To compensate for varying citation rates across scientific fields, different thresholds are applied to each field. The thresholds are set in such a way as to select roughly the same proportion of entities from each scientific field. According to a citation frequency threshold, only the top 1% of the world's institutions cited in scientific literature is included in the ESI database.

Only six South African universities have been identified to be included in this database. These are the universities of Cape Town, Pretoria, the Free State, Witwatersrand, KwaZulu-Natal and Stellenbosch. Analysis of the scientific disciplines in which the South African institutions meet the threshold requirements for inclusion in the database shows that the country has citation footprints in only nine of the 22 broad scientific disciplines.

Table 1 shows the 22 scientific fields, the relevant thresholds for institutional inclusion and the number of institutions in the ESI database.

Table 1. *Scientific disciplines, relevant citation thresholds for institutional inclusion in ESI and number of included institutions from January 1995 to April 2005*

Scientific field	Citation threshold	Number of institutions
Agricultural Sciences	550	312
Biology and Biochemistry	3 759	587
Chemistry	2 540	757
Clinical Medicine	1 121	2 646
Computer Science	496	277
Economics and Business	1 015	152
Engineering	525	915
Environment/Ecology	1 181	405
Geosciences	1 812	356
Immunology	3 670	253
Materials Science	757	524
Mathematics	1 102	164
Microbiology	2 972	250
Molecular Biology and Genetics	6 597	323
Multidisciplinary	516	76
Neuroscience and Behaviour	3 679	375
Pharmacology and Toxicology	1 771	294
Physics	3 633	589
Plant and Animal Sciences	959	708
Psychiatry/Psychology	1 312	370
Social Sciences, General	335	588
Space Science	6 754	106

The performance of South African institutions

The number of citations and publications of the South African institutions included in the ESI database is indicated in Tables 2 and 3. Only figures for the disciplines in which the different institutions meet the relevant thresholds are provided.

Table 2. *Number of citations in the ESI database from January 1995 to April 2005*

Scientific field	Cape Town	Pretoria	Free State	Witwatersrand	KwaZulu-Natal	Stellenbosch
Biology and Biochemistry	5 763					
Chemistry				3 714		
Clinical Medicine	12 577	3 807	1 217	10 351	4 695	6 936
Engineering		1 086		711		
Environment/Ecology	4 932	2 152			1 403	
Geosciences	3 597			4 314		
Materials Science				783		
Plant and Animal Sciences	4 947	4 633	1 620	1 459	3 357	1 998
Social Science, General	1 033			1 266	360	

Table 3. Number of publications in the ESI database from January 1995 to April 2005

Scientific field	Cape Town	Pretoria	Free State	Witwatersrand	KwaZulu-Natal	Stellenbosch
Biology and Biochemistry	415					
Chemistry				529		
Clinical Medicine	1 655	529	203	1 418	889	940
Engineering		439		315		
Environment/Ecology	536	385			261	
Geosciences	488			637		
Materials Science				193		
Plant and Animal Sciences	880	1 461	411	370	654	650
Social Science, General	397			443	196	

By examining the frequency of appearance as illustrated in these figures, one gets a sense of the scientific strengths of the various institutions. The University of the Witwatersrand meets the thresholds in seven fields; the University of Cape Town meets these thresholds in six; the universities of Pretoria and KwaZulu-Natal meet the thresholds in four; while the universities of Stellenbosch and the Free State only meet the thresholds in two scientific fields.

By examining the figures for each individual institution, one gets a sense of the disciplinary emphasis of the country's higher education institutions. Only the University of Cape Town meets the thresholds for Biology and Biochemistry, while only the University of the Witwatersrand meets the thresholds for Chemistry and Materials Science. In the field of Engineering, it is only the universities of Pretoria and the Witwatersrand that meet the criteria for inclusion. Similarly, only the universities of Cape Town and the Witwatersrand have the necessary impact

in the Geosciences, while Environment/Ecology is emphasised by the universities of Cape Town, Pretoria and KwaZulu-Natal; and Social Sciences by the universities of Cape Town, the Witwatersrand and KwaZulu-Natal. Clinical Medicine and Plant and Animal Sciences receive emphasis at all six institutions.

It is important to stress the significance of the scientific fields that do not appear in these figures. The fact that South African institutions meet the threshold requirements in only nine of the 22 fields in the database means that, currently, government-identified priority fields like Molecular Biology and Genetics, Space Science and Mathematics (DST, 2002) are not emphasised adequately by any of the country's academic institutions.

Table 4 gives another variation of the concept of citations – the institutional share in national citations, or the international visibility or impact of a particular institution in the national context in terms of the respective disciplines.

Table 4. Institutional share in national citations

Scientific field	Cape Town	Pretoria	Free State	Witwatersrand	KwaZulu-Natal	Stellenbosch
Biology and Biochemistry	40.48%					
Chemistry				25.35%		
Clinical Medicine	24.17%	7.31%	2.34%	19.89%	9.02%	13.33%
Engineering		21.40%		14.01%		
Environment/ Ecology	36.75%	16.03%			10.45%	
Geosciences	24.44%			29.32%		
Materials Science				28.16%		
Plant and Animal Sciences	17.99%	16.85%	5.89%	5.30%	12.21%	7.27%
Social Science, General	23.54%			28.85%	8.20%	

Table 5 shows the worldwide ranking of South African higher education institutions in the various disciplines according to the total number of citations received by the publications of the particular institutions from January 1995 to April 2005.

Table 5. International ranking of South African institutions in the ESI

Scientific discipline	Cape Town	Pretoria	Free State	Witwatersrand	KwaZulu-Natal	Stellenbosch
Biology and Biochemistry	444					
Chemistry				604		
Clinical Medicine	497	1 136	2 511	560	984	764
Engineering		573		778		
Environment/Ecology	103	265			366	
Geosciences	207			166		
Materials Science				521		
Plant and Animal Sciences	188	200	489	533	271	427
Social Science, General	279			244	565	

The highest internationally ranked institutional disciplines in the country are Environment/Ecology by the University of Cape Town (103rd), Geosciences by the University of the Witwatersrand (166th), and Plant and Animal Sciences by the universities of Cape Town (188th) and Pretoria (200th). In Engineering, the University of Pretoria is ranked 573th and the University of the Witwatersrand 778th in the world out of 915 institutions to make the grade.

While the world ranking of each field is given in Table 5, for comparative assessments of the institutions in the national context, cognisance should be taken of the number of

institutions and the relative ranking of the other South African institutions in the database. For example, the University of Pretoria is ranked as the top university in Engineering in the country, second in Environment/Ecology and Plant and Animal Sciences, and fifth in Clinical Medicine.


Table 6 shows the quartiles in which the ranking of the South African institutions fall among all the institutions that are included in the ESI database. Institutions ranked in the fourth quartile in a particular discipline are in danger of being excluded from the ranking list in the future as other institutions (not in the database) may increase their impact over and above them.

Table 6. Quartile of international ranking of South African institutions

Scientific discipline	Cape Town	Pretoria	Free State	Witwatersrand	KwaZulu-Natal	Stellenbosch
Biology and Biochemistry	4					
Chemistry				4		
Clinical Medicine	1	2	4	1	2	2
Engineering		3		4		
Environment/Ecology	2	3			4	
Geosciences	3			2		
Materials Science				4		
Plant and Animal Sciences	2	2	3	4	2	3
Social Science, General	2			2	4	

It will be interesting to monitor the future performance of the University of the Witwatersrand. With four of its rankings in the fourth quartile, it may not be able to maintain its current impact in seven disciplines.

The investigation into the performance of South African academic institutions identifies, for the first time, the citation footprints of these organisations, their international standing, and the disciplines in which they excel. It also links the findings to national policy efforts. The findings are valuable for both higher education and science and technology policy development. The finding that the country's universities are profiled in only nine of the 22 disciplines in the database reveal the country's specialisation and the need for support in areas identified as being a priority by the government, but which do not feature in the universities' strong disciplines. Government therefore needs to identify institutions with "seed" expertise in the particular fields and support them to develop international profiles.

The apparent prevalence of Clinical Medicine and Animal and Plant Sciences by all six institutions is the result of the country's traditional preoccupation with health and agriculture. It is questionable, however, whether a scientifically small country like South Africa can afford to distribute its limited expertise to a number of different universities, as is currently the situation. 

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