

The Information Society: Implications for National Planning

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Dr. Eugene Garfield, founder and chairman of the Institute for Scientific Information (ISI) gave the keynote address. He presented data from the 1973 Science Citation Index (SCI) to document the productivity and impact of Third World research on the international scientific community. Data were reported on the number of 1973 articles published by first authors on bylines who listed an institutional address in a developing country, and the number of citations they received from 1973 to 1978. In addition, Dr. Garfield discussed ISI's method of automatic classification of literature, co-citation clustering. He presented cluster maps of research which were most cited by Third World scientists in 1981 to identify current areas of scientific activity in the developing world.

About 353,000 articles were indexed in the 1973 SCI, and 15,900 of these listed first authors affiliated with institutions located in 93 developing countries. The 15,900 articles from the Third World received about 36,200 citations from 1973 to 1978. That is, the impact of the average Third World article over this six-year period was 2.3. By comparison, the average impact of all 353,000 articles indexed in the 1973 SCI was 5.5 during the same time period.

Of the 15,900 Third World articles in the 1973 SCI, 713 (four percent) listed first authors based in Egypt. In terms of the number of authored articles, Egypt ranked 31st among all nations represented in the 1973 SCI. Egypt ranked fourth among Third World countries, behind India (7,888 articles), Argentina (1,526), and Brazil (812). Articles from Egypt received 1,306 citations from 1973 to 1978, and the average impact for Egyptian articles was 1.8. In terms of impact, Egypt ranked 46th among Third World countries.

Third World articles were published in ten different languages, but more than 85 percent of these articles were published in English. English-language articles from the developing countries also had the highest impact (2.6). Third World articles published in German had the next highest impact (2.0), followed by French (1.4) and Italian (1.0). English was shown to be the dominant language of world scientific communication for all countries in the 1973 SCI--more than 80

percent of all articles were published in English, and they had the highest impact (6.3).

Egyptian articles in the 1973 SCI were published in four languages--English, French, German. and Russian (Table i). But 97 percent of the 713 Egyptian articles were published in English, and they had the highest impact (1.8).

Table i. Languages in which Egyptian articles were published, ranked by the number of articles.

Language	1973 Articles	1973-78 Citations	Impact
English	694	1,280	1.8
German	12	19	1.6
French	5	5	1.0
Russian	2	2	1.0
Totals	713	1,306	1.8

Source of data on articles: 1973 SCI®

Source of data on citations: 1973-78 SCI®

Twenty-two nations published at least 50 articles from Third World authors in 1973. Journals from the US alone published 3,755 Third World articles, or 24 percent. Also, US-published Third World articles came from 75 developing countries, more than any other publishing nation. India was the next largest publisher of Third World articles. But of the 3,351 Third World articles published in Indian journals, 98 percent were authored in India. Other Third World publishing countries followed the same pattern: 75 percent of the Third World articles published in Argentina were authored in Argentina; for Venezuela, this figure is 97 percent; Chile, 98 percent; Mexico, 95 percent; and Brazil, 99 percent. Third World articles had the greatest impact when they were published in the Netherlands (3.9), US (3.6) and UK (3.3).

Articles from Egypt were published in 21 nations (Table 2). The UK, US, and Federal Republic of Germany (FRG) together published 59 percent of the Egyptian articles in the 1973 SCI. Egyptian articles had the greatest impact when published in Sweden and Switzerland, but only 25 Egyptian articles were published in these countries combined. No significant conclusions can be drawn from such a small sample.

Nineteen journals from developed countries published at least 50 Third World articles in 1973. Six of these journals

were published in the UK, five in the US, and three in the Netherlands. Switzerland and Italy account for two journals each. One journal was published in the German Democratic Republic (GDR). Twenty-one Third World journals published 50 or more articles from the developing nations. Thirteen of these were Indian journals. Argentina, Chile, and Mexico each accounted for two journals. Costa Rica and Venezuela accounted for one journal each. However, no Third World journal appeared

Table 2. Countries that published Egyptian articles, ranked by the number of articles.

Country	1973 Articles	1973-78 Citations	Impact
UK	171	392	2.3
USA	145	329	2.3
FRG	105	122	1.2
GDR	99	190	1.9
Netherlands	46	40	.9
India	37	63	1.7
Hungary	21	28	1.3
Switzerland	18	60	3.3
Japan	13	14	i.I
France	10	12	1.2
Italy	8	1	.I
Austria	7	7	1.0
Sweden	7	21	3.0
Australia	5	10	2.0
Canada	5	6	1.2
Czechoslovakia	5	5	1.0
Poland	4	1	.3
Romania	3	3	1.0
USSR	2	2	1.0
Denmark	1	0	
Spain	1	0	---
Totals	713	1,306	1.8

Source of data on articles: 1973 SCI®

Source of data on citations: 1973-78 SCI®

among the top 25 journals when ranked by the impact of the developing nations' articles they published. Sixteen of the journals with the highest impact for Third World articles were published in the US, seven in the UK, and one each in Denmark and Switzerland.

Twelve journals published at least ten articles from Egypt in 1973 (Table 3). Four of these journals were published in the UK, three in the FRG, and two in the GDR. India, the

Netherlands, and the US accounted for one journal each. Thirty percent of the 713 Egyptian articles in the 1973 SCI were published in these 12 journals.

Nineteen journals were identified that had an impact of at least 5.0 for the Egyptian articles they published. The US and the UK each accounted for six of these journals. Switzerland and the FRG each published two. Austria, the GDR, and Sweden

Table 3. Journals that published at least 10 Egyptian articles, and their nation of publication, ranked by the number of articles.

Journal	1973 Articles	1973-78 Citations	Impact
Pharmazie	41	86	2.1
Indian J. Chem. (India)	23	50	2.2
J. Prak. Chem. (GDR)	23	62	2.7
Planta Med. (FRG)	21	13	.6
J. Trop. Med. (UK)	18	27	1.5
Microchem. J. (US)	17	17	1.0
Zbl. Veterinarmed. A (FRG)	15	18	1.2
Atomkernenergie (FRG)	13	26	2.0
J. Appl. Chem. Biotech. (UK)	13	24	1.8
Br. J. Ophthalmol. (UK)	10	9	.9
Qual. Plant. (Netherlands)	10	2	.2

Source of data on articles: 1973 SCI®

Source of data on citations: 1973-78 SCI®

accounted for one journal each.

Twenty-three Third World articles cited at least 50 times between 1973 and 1978 were identified. First authors based in India, Argentina, and Thailand each contributed five of the most-cited Third World articles. Four articles listed first authors based in Brazil. Chile, Iran, Jamaica, and Uganda accounted for one article each. Five of the 23 most-cited Third World articles were co-authored with scientists from developed countries.

Thirteen of the 23 high impact articles from developing

nations were published in US journals. Seven were published in the UK, and the Netherlands accounted for two. One was published in the FRG. Of the 1,800 citations these 23 articles received from 1973-78, 86 percent were from authors in developed countries. Ten percent were from the first author's developing nation. Only four percent were from authors in other Third World nations.

The 1981 SCI file was used to identify current areas of research activity in Third World science. Articles from Third World countries in the 1981 SCI were extracted, and the publications they cited that year were identified. 1981 articles from developed countries that referred to the same group of papers cited by Third World researchers were also extracted. These data were analyzed by computer to identify clusters of papers that were cited together, or co-cited. More than 2,000 clusters resulted from this co-citation analysis.

India was considered separately from the rest of the Third World before clusters of research most-cited by developing countries were mapped. India dominated the Third World in terms of the number of articles it authored and published. Thus, it would also overshadow the analysis of current areas of research activity in the Third World if it were included with all other developing nations.

Seventeen clusters of research were cited by at least 15 Third World papers in the 1981 SCI. Fourteen of these dealt with topics in clinical medicine and biomedicine. Eight were on immunology and infectious diseases caused by parasites and viruses. Three clusters focused on endocrinology research into the neurological regulation of pituitary and adrenal glands. Three biochemical clusters concentrated on protein analysis and the metabolism of trace elements, such as zinc and copper.

Three non-clinical or non-biomedical clusters were identified. Two were in physics and discussed unified field theories and transition metal complexes. The remaining cluster cited by developing world researchers focused on ecology research.

Third World articles were also considered as a proportion of all citing articles to identify clusters with a high level of participation by developing world researchers. Third World articles amounted to at least 15 percent of all 1981 citing articles in six of the 17 clusters discussed previously. A 15 percent concentration indicates a very significant level of participation because Third World articles, excluding India, accounted for two percent of all 1981 SCI articles.

Five of these clusters were in immunology and infectious disease. The topics they discussed were: "Immune response to theileria parva," "Immune response suppression by trypanosoma," "Isolation of trypanosoma glycoprotein antigens," "Serodiagnosls and subtyping of arbovirus diseases," and "Nutrition and the

immune response." The sixth cluster was in physics and discussed "Neutrino masses, neutral currents, and other factors involved in unified field theories."

The analysis showed that current Third World research activity is centered on biomedical and clinical topics, especially immunology and infectious diseases. Physics and ecology were other areas of interest to developing world researchers. Of course, Third World scientists do work in other areas not represented by the clusters identified by co-citation analysis--mathematics, chemistry, astrophysics, etc. But they were most active in the fields discussed here.

These data demonstrate how the productivity, impact, and area of specialization of a nation's scientific enterprise can be assessed, both in quantitative and cognitive terms. Science policy makers must identify strengths and weaknesses in their nation's research effort in order to allocate funds to maintain or develop excellence in various fields and disciplines. Government administrators must set priorities to ensure that the scientific community addresses the nation's most pressing problems. Researchers must decide where to publish, and in what language, to more widely communicate their findings. The data reported here can help to achieve these goals.