A Study on Scientific Product of the University of Tehran in Web of Science Database during 1989-2009

Tahran Üniversitesinin Bilimsel Üretimi: Web of Science Veri Tabanına Dayanan Bir Araştırma (1989-2009)

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Abstract: *The University of Tehran (UT) is the oldest and one of the largest academic centers in Iran. It plays an important role in education and research in the country. Due to the importance of Tehran University we decided to study its academic scientific output in the Web of Science during 1989-2009 using a scientometric approach. The purpose of this study was to identify the rank of UT among Iranian universities. The key authors and influential journals, types of documents, the rate of yearly output and the annual growth rate were also identified. We also specified the countries with whose scholars UT academic members collaborated during the studied period. In addition, we drew and analyzed two historiographical maps of UT, based on Local Citation Score (LCS) and Global Citation Score (GCS).*

Keywords: *University of Tehran (UT), scientific output, Web of Science, historiographical map, mapping of science*

Öz: *Tahran Üniversitesi İran'daki en eski ve en büyük akademik merkezlerden birisidir. Ülkenin eğitim ve araştırma faaliyetlerinde önemli bir rol oynamaktadır. Tahran Üniversitesinin öneminden dolayı bu araştırma 1989-2009 yılları arasında Web of Science kapsamında yer alan bilimsel yayın çıktılarını bilimetrik bir yöntem ile araştırmayı amaçlamaktadır. Çalışmanın amacı, Tahran Üniversitesinin Iran üniversiteleri sıralamasındaki yerini belirlemektir. Anahtar yazarlar ve dergiler, yayın yapılan doküman türleri, yıllık üretim ve üretimdeki yıllık artış oranı da incelenmektedir. Ayrıca, Tahran Üniversitesinde çalışan akademisyenler ile ortaklaşa yayın yapan ülkeler çalışma dönemi itibariyle belirlenmiştir. Bunlara ek olarak, Tahran Üniversitesinin Yerel Atıf Skoru ve Küresel Atıf Skoruna dayanan iki tarihyazımsal haritası çizilmiş ve analiz edilmiştir.*

Anahtar sözcükler: *Tahran Üniversitesi, bilimsel çıktı, Web of Science, tarihyazımsal harita, bilimin haritalanması*

Introduction

Nowadays scientific output, among others, is taken as one of the important criteria in the evaluating and ranking of different countries. Toffler (1990) in his famous work titled *Powershift: knowledge, wealth, and violence at the edge of the 21st century* assumed that knowledge is power. In a similar vein, more than a thousand years ago, the Persian poet Ferdowsi maintained that "knowledgeable people are powerful". As is the case at the present time, countries are evaluated not only by their national products, military power, geographical area, etc, but by such factors as the production and consumption of scientific information.

Along with the aforementioned issues, the production of scientific information has an increasing impetus in the era in which we live. Given this increasing speed as well as the huge volume of the produced knowledge and the plurality of scientific branches, one cannot examine all the scientific literature, even in a specific field, since managing huge amounts of information is a demanding task. Put another way, we can say that the dream of a comprehensive library or information center has not yet come true.

All of these discussions support the exploitation of citation index and databases as necessary measures for scholars and researchers in the field. In fact, these databases, using quantitative methods and bibliometric and scientometric approaches, can be exploited as proper tools for judging scientific products at local, national and international levels.

In ranking universities, the number of documents recorded in databases is considered. However, focus on scientific products as the only measure is not reasonable, although we cannot deny their importance as good criteria for evaluating the scientific work of a person or an organization.

Problem Statement

The University of Tehran (UT), as the oldest and one of the largest universities in Iran, has an important role in higher education and research in the country. With a glance at the ranking of universities, we see that UT has the highest rank among Iranian universities (University of Tehran, 2008). Therefore studying the UT's scientific productivity as a method for evaluating its performance is reasonable. This research was intended to investigate the key authors from UT who have published in influential documents and journals included in the Web of Science 1989-2009. The main subject categories of the clusters in both UT historiographical maps during the studied period were also analyzed.

Goals and Questions

The present study evaluated the scientific productivity of UT, as indexed in WOS during 1989-2009. Besides, Iranian key authors, influential documents, yearly output and growth rate of UT scientific output were investigated in the study. To do so, we drew two historiographical maps of science based on Global Citation Score (GCS shows the total number of citations to a paper in the Web of Science) and Local Citation Score (LCS shows the count of citations to a paper within the collection) for UT. To reach the above goals, the following questions were raised:

1. What is the rank of UT according to scientific output compared to other Iranian universities during 1989-2009, in the WOS?
2. Who are the most productive authors in UT based on scientific output?
3. What are the type of documents written by UT academic members?
4. What are the languages of UT publications in WOS during 1989-2009?
5. What are the most important journals in which the studied documents were published?
6. What is the annual average rate of document production of UT academic members?
7. What is the annual growth rate of UT documents in WOS during 1989-2009?
8. What are the countries whose academics have the most frequent co-authorship with UT academic members?
9. How many clusters are included in the historiographical maps of UT?
10. What are the subject categories of the historiographical maps of UT?

Methodology

Applying the scientometric method, this study gathered data for UT scientific output by searching WOS on 24 January 2009. The result was 6099 records which had been published by at least one author affiliated to UT. For data analysis, HistCite™ and MS Excel were utilized. Data were extracted using analysis tools of WOS in some 500 sets. All records in 500 sets were entered in HistCite™. MS Excel was applied for drawing tables and figures.

Literature Review

Metrics methods have already been used by many researchers, while bibliometrics preceded other methods like scientometrics, webometrics and informetrics and go back some decades.

Osareh and Wilson (2002) in their research of the collaboration on Iranian scientific publication, investigated three 5-year periods: 1985-1989, 1990-1994 and 1995-1999. They found that Iranian scientific publication in the second period was twice as much as in the first period, while in the third period it was about three times (2.8) more than in the second period.

Jacobs and Pichappan (2006) investigated the scientific products of some universities in South Africa in ISI (Thomson Reuters) during 1994-2003. The results of their research showed that clinical science is the most productive field in scientific information produced by South African universities.

Lucio-Arias and Leydesdorff (2008) pointed out the advantages of HistCite™ in drawing historiographical maps.

Osareh and McCain (2008), in their article titled "The Structure of Iranian Chemistry Research, 1990-2006: An Author Co-citation Analysis", studied Iranian chemistry research. Their results revealed that the yearly growth rate of chemistry publication among Iranian authors was 26%. By using the method of co-citation analysis, they also introduced important factors in scientific products of Iranian chemistry.

In Iran, HistCite™ was introduced and used for the first time by Asnafi, Hamidi and Osareh (2008). They investigated scientific publications in the fields of Bibliometrics, Scientometrics, Informetrics and Webometrics in WOS during 1990-2005. They found that among 53 countries which collaborated in writing documents in the mentioned areas, the US ranked first followed by the UK, Germany and the Netherlands.

Data Analysis

The 6099 records gathered from WOS, were all published by authors affiliated to UT including faculty members and postgraduate students. All records were analyzed using the HistCite™ software. We can explain the results of data analysis as below:

According to WOS records, UT ranked first among Iranian universities. Table 1 shows the status of the top 10 universities of Iran according to WOS records. As can be seen, UT, with a total of 6099 records, has produced the most scientific documents followed by the Tehran University of Medical Science, Sharif University, Shiraz University and Tarbiat Modarres University.

Table 1. Top 10 Iranian Universities according to WOS records

#	**Institute**	**Records**
1	University of Tehran	6099
2	Tehran Univ of Med Sci	3800
3	Sharif Univ	3591
4	Shiraz Univ	3332
5	Tarbiat Modarres Univ	3115
6	Islamic Azad Univ	2398
7	Amir Kabir Univ	2334
8	Shahid Beheshti Univ of Med Sci	1900
9	Isfahan Univ of Technology	1829
10	Shiraz Univ of Med Sci	1501

Data analysis showed that among authors affiliated to UT, Ganjali with 300 records was the most productive author and ranked first. Mousavi Movahedi, Saboury, Norouzi and Zarrindast ranked 2-5 respectively.

Table 2 shows UT academic members ranked by the number of their publications. As can be seen in this table, authors with at least 40 publications are listed. In table 2, we can see that of the 6099 documents written by UT authors, 1982 documents (32.4%) were published by only 24 authors (0.25%). The 6099 documents had a total of 9400 authors, an average 1.5 authors for each document.

Table 2. Top 24 authors affiliated to UT with at least 40 documents in WOS during 1989-2009

Rank	Author	Records	Rank	Author	Records
1	Ganjali MR	300	13	Mahmudi R	50
2	Mousavi-Movahedi AA	251	14	Soltanian-Zadeh H	50
3	Saboury AA	231	15	Alimohammadi M	47
4	Norouzi P	174	16	Mohajerzadeh S	47
5	Zarrindast MR	98	17	Sarbolouki MN	47
6	Shamsipur M	84	18	Hakimelahi GH	46
7	Lucas C	69	19	Nemat-Gorgani M	45
8	Yazdanparast R	68	20	Ghandi M	44
9	Salavati-Niasari M	67	21	Darafsheh MR	43
10	Faiz J	60	22	Siavoshi F	41
11	Adib M	58	23	Yassemi S	41
12	Larijani B	51	24	Dehpour AR	40

Considering type of the documents, 82.7% (5047 of 6099) were articles, followed by meeting abstracts and proceedings papers and nearly all documents [6079 of 6099= 99.6%] were written in English.

These UT publications were published in 1926 journals. The number of journals that had published at least 5 UT documents was 333. The total number of documents published in these 333 journals was 3403. Thus of 6099 documents, 55.7% were published in 17.2% of all journals. According to Table 3, *FEBS Journal* published the most UT documents followed by *Biophysical Journal* and the *Journal of Applied Polymer Science*. Table 3 shows 10 top journals in which UT publications were published.

Table 3. Important journals in which UT documents have been published (first 10)

#	Journal	Articles
1	FEBS Journal	88
2	Biophysical Journal	54
3	Journal of Applied Polymer Science	49
4	Iranian Journal of Chemistry Chemical Engineering - International English Edition	45
5	Journal of Materials Processing Technology	42
6	International Journal of Psychology	36
7	Materials Science and Engineering A-Structural Materials Properties Microstructure and Processing	36
8	International Journal of Environmental Research	35
9	Applied Mathematics and Computation	34
10	Iranian Journal of Public Health	34

Another important issue was the production of scientific documents per year. 1991 was the only year in which the number of scientific documents decreased. In all other years they increased compared to the previous year. For more information about yearly output, see Table 4.

We also calculated yearly growth rate for publications of UT in WOS from 1989-2008. The number of UT publications grew at approximately 37.8% per year.

Table 4. UT publications in WOS by year

Year	Articles	Year	Articles
1989	3	1999	119
1990	11	2000	166
1991	6	2001	224
1992	32	2002	228
1993	41	2003	358
1994	46	2004	479
1995	48	2005	592
1996	80	2006	857
1997	89	2007	1278
1998	94	2008	1333

The authors of UT publications collaborated with colleagues from 81 countries. Among them, were 411 from the USA, followed by Canada, UK, Germany and France. Table 5 shows the collaboration between authors of UT and other countries.

Table 5. Collaboration between authors of UT and other countries (first 10)

#	Country	# of Co-Works
1	USA	411
2	Canada	250
3	UK	184
4	Germany	151
5	France	94
6	Japan	85
7	Australia	68
8	Italy	53
9	Taiwan	51
10	Sweden	43

There are some tools which can be used in drawing the structure of science in each field. For example, we can use SPSS, PathFinder and more recently HistCite™. Among them, HistCite™ has more capability in drawing the map of science and the structure of a field, like its ability to provide detailed information about authors, journals, cited references, keywords, yearly output and other data. Added to these applications, HistCite™ can draw historiographs based on Local Citation Score (LCS) and Global Citation Score (GCS) to show the important works and history of science in a field or in an organization, so we decided to use HistCite™ for this study.

Our study showed that the 6099 UT documents received 6621 local citations and 19,562 global citations. We extracted 60 top documents to draw two separate graphs based on LCS and GCS. These 60 documents received a minimum of 19 and a maximum of 60 local citations.

Records 243 (Saboury AA, 1996, J CHEM THERMODYN, V28, P1077) and 247 (Saboury AA, 1996, BULL CHEM SOC JPN, V69, P3031) were the first documents which received local citations in 1996. Record 654 (Shamsipur M, 2000, ANAL CHEM, V72, P2391) received the most local citations in comparison with the other 60 top documents, followed by 1076 (Ganjali MR, 2004, SENSOR ACTUATOR B-CHEM, V98, P92), 451 (Ganjali MR, 1998, ANAL CHEM, V70, P5259), 330 (Fakhari AR, 1997, ANAL CHEM, V69, P3693) and 1336 (Ganjali MR, 2003, TALANTA, V59, P613). These are important documents and the focal point of the main cluster.

Figure 1. Historiograph of UT based on LCS with 60 top documents

As we can see in Figure 1, each circle is an indicator for a document: the larger the circle the more citations.

All of the mentioned articles which are the core of the main cluster were published by faculty members of the Department of Chemistry. We can see a type of collaboration among colleagues in this area. This graph also showed some self-citations and mutual citations. Of course, because of the similarity of their area, this type of citation behavior is natural. We saw two clusters besides the main cluster in the graph of LCS.

The cluster located at the left of the main cluster belonged to authors affiliated with the Institute of Biochemistry and Biophysics of UT. We can also observe a type of collaboration among some colleagues with the same research interest and methods, who are working in nearby offices.

There is another cluster located to the right of the main cluster. This cluster belonged to two colleagues in the Chemistry Department, but was separated from the main cluster and made an isolated cluster.

This graph shows that according to LCS, authors in the fields of Chemistry and Biochemistry & Biophysics are the cornerstone of science structure in UT. According to this graph Ganjali with 29 articles (of the 60 top articles) played a very important role.

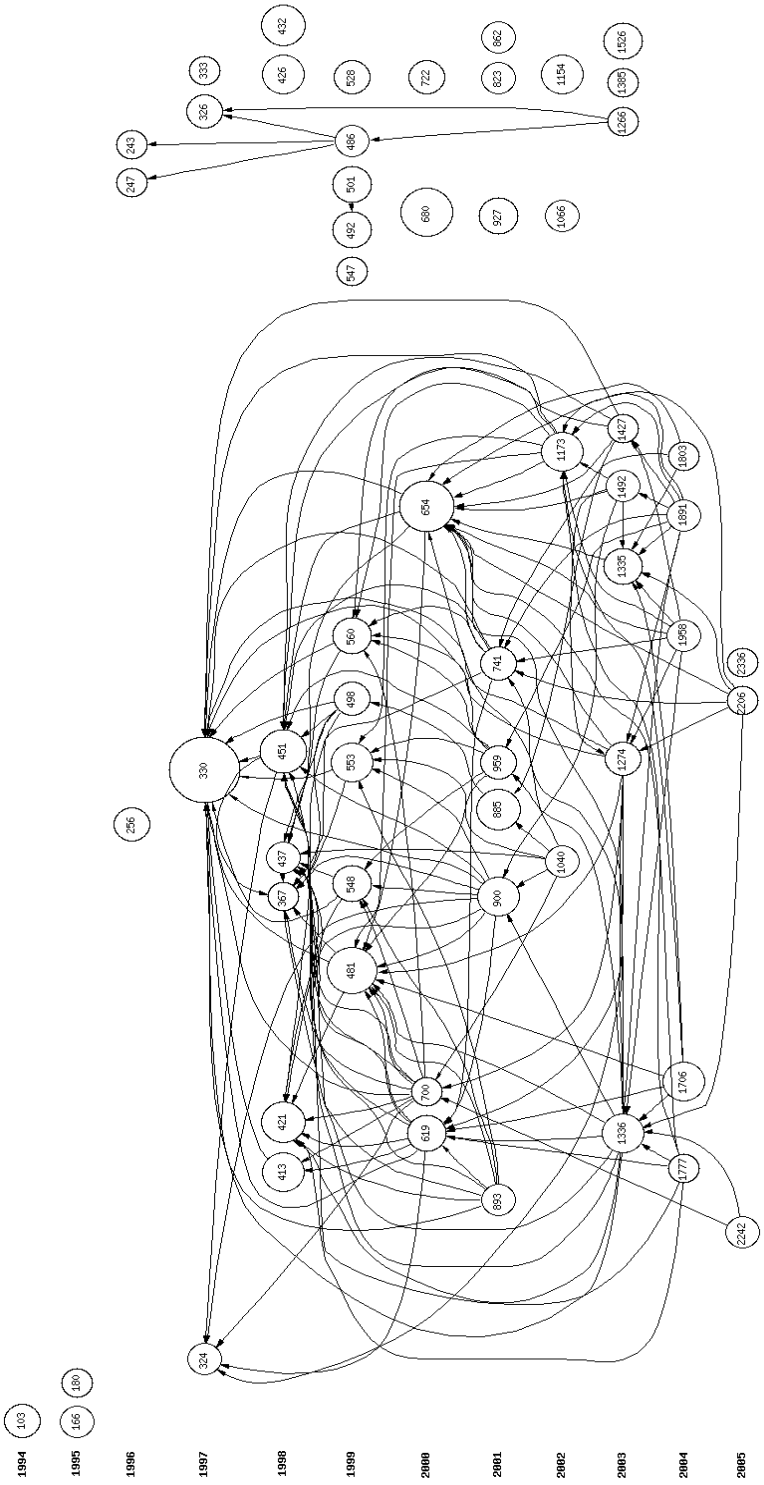

Figure 2. Historiograph of UT based on GCS with 60 top documents

We drew another graph with the 60 top documents based on GCS. Totally these 60 top documents received a minimum of 33 and a maximum of 166 global citations. We can see in the graph that among the 60 top documents, record 103 (Khosravi AR, 1994, MYCOSES, V37, P43) was the first document which received global citations in 1994, followed by records 166 (Vetter W, 1995, CHEMOSPHERE, V30, P1685) and 180 (Testillano PS, 1995, EXP CELL RES, V221, P41) which received global citations in 1995. See Figure 2.

According to this graph, record 330 (Fakhari AR, 1997, ANAL CHEM, V69, P3693) with 166 global citation occupied the first rank, followed by records 654 (Shamsipur M, 2000, ANAL CHEM, V72, P2391), 680 (Zimmer S, 2000, J BIOL CHEM, V275, P25672), 481 (Javanbakht M, 1999, ELECTROANAL, V11, P81) and 451 (Ganjali MR, 1998, ANAL CHEM, V70, P5259) with, respectively, 106, 92, 86 and 74 global citations. The GCS graph included three clusters. Chemistry, biochemistry and biophysics were the main part of the GCS graph.

This showed that from the viewpoint of global citation, authors from the Chemistry Department and the Institute of Biochemistry and Biophysics of UT played the most important role in the producing of science at UT. Thus, with respect to participation of scientific fields, there is no significant difference between the LCS and GCS graphs.

We also saw the same citation behavior in the GCS graph as in the LCS graph as a result of collaboration among colleagues, self and mutual citation and similarity of scientific areas. According to GCS, Ganjali was the most productive author. He, with 21 articles in the GCS graph (of the 60 top documents) played an important role. Here we can see the similarity between the two graphs.

Conclusion

The results of this study showed that UT authors published 6099 scientific documents during 1989-2008. According to the number of publications extracted from WOS, UT published more documents than other Iranian universities and ranked first among them followed by Tehran University of Medical Science, Sharif University, Shiraz University and Tarbiat Modarres University.

Ganjali, from the Department of Chemistry, was the most productive author (with 300 articles) followed by Mousavi Movahedi, Saboury, Norouzi and Zarrindast.

Our findings showed that 82.7% (5047 of 6099) of documents were in article format. Approximately all documents (99.6%) were written in English.

UT documents were published in 1926 journals, with 3403 articles (55.7%) published in 17.2% (333 journals) of all journals. *FEBS Journal* published the most documents of UT, followed by *Biophysical Journal* and *Journal of Applied Polymer Science*.

1991 was the only year in which the number of publications decreased in comparison with the previous year and we saw an increase in the number of publications in other years. The growth rate of UT publications per year was, approximately, 37.8%.

International collaboration among scholars is a traditional norm. Totally UT authors collaborated with scholars of 81 countries. Among them, the authors of USA with 411 co-works were in first place, followed by authors of Canada, UK, Germany and France. Probably the collaboration of UT authors with foreign peers has been affected by the English language.

As mentioned before, due to its capabilities, we used HistCite™ to draw scientific maps and depict the structure of science in UT. We made two historiographs with 60 top documents based on LCS and GCS.

We found that in the main clusters of both graphs, authors affiliated to the Chemistry Department and the Institute of Biochemistry and Biophysics were the cornerstone of science structure in UT.

Ganjali, who had published the most articles (300 articles), was present in both graphs more than others. We also found the same citation behavior in both graphs, as a result of collaboration among colleagues, self and mutual citation as well as the similarity of scientific areas.

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