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Citation analysis of papers published by university-based Turkish physicists in journals listed in SCI

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Abstract. I have studied the citation rates and characteristics of 466 Turkish physics publications that appeared in the research journals listed in the Science Citation Index (SCI) for the period 1983-2003 (considering one year every 5 years), and I derived the following results: The papers appeared in a set of 96 journals, and approximately half of the total output is included in 13 of them; 6 or 7 of which are journals of high impact. There has been a substantial shift of Turkish papers from European journals to American journals over the last decade. This change is an example for a developing country to integrate with the world scientific society. Turkish publications are mainly about Astrosciences, Condensed Matter Physics and Mathematical Physics. On the contrary, Turkish physics education studies seldom appeared in the SCI journals.

Keywords: Science Citation Index (SCI), Citation analysis, Turkish physics publications, Physics education

1 Introduction

We are well aware that there has been a significant rise after World War II until the 1980's in the number of papers authored by Turkish physicists published in foreign journals as well as of the rates they have been cited [1]. This fact can be seen partly in international breakdowns of publication output in relative terms [2-7] and in the citation impact of European physics research [8-10]. Turkish publications output is in favour of the subfields of condensed matter physics, mathematical physics and astrophysics. More than 90% of this output is based on the research done in universities, where the research efforts in experimental and theoretical physics are now almost balanced [11]. But it is less clear how the papers split into different journals with different impact factors (IF), how quickly an "average" Turkish paper is cited, and whether its citation rate is comparable with the related characteristics [immediacy index (II) and impact factor (IF)] of the journal in which it appears (See Appendix: IF and II for the detail explanation and examples). The studies about science and technology published in nearly six thousand journals indexed by Science Citation Index (SCI) are classified by Institute for Scientific Information (ISI). With the help of these indicators the scientific situation of a country can be assessed [12,13].

The purpose of this study is to collect data objectively to answer these and other questions to provide some insight into the present trends of Turkish publication output and its recognition among the physics society.

2 Methodology

The printed edition of *Science Citation Index* (1983-2003) and the online version of *Science Citation Index Expanded* available in the Web of Science databases of the Institute for Scientific Information (ISI) were searched in order to determine the number of cited papers and the number of citations each paper attracted. The Cd-Roms were scanned through the 'abstract word search field' to compile the data. SCI and SSCI databases have been used frequently in recent years as a bibliometric tools for cross-national comparisons of citation analysis in different fields [14]. The study was limited to the years 1983, 1988, 1993, 1998, and 2003. The volumes and issues of each journal for these years were selected for examination. Moreover, the study was a follow up of work conducted by Uzun et al. [15] and was carried out with the examination of the journals based on that work.

2.1 Data analysis

The previous works' data base is the result of tracing 466 publications (articles, reviews and letters) from Turkey in 96 Science Citation Index (SCI) covered physics journals together with their citation rates and citation immediacy for the period 1983-2003 every 5 years. For each publication, citations were counted on SCI Compact Disc Edition in the year of publication and in the two subsequent years, a procedure also employed in Journal Citation Reports (JCR) annuals in calculating the journal impact factors and immediacy. The publication total given above and the associated citation counts (around 1100 citations were counted in accordance with the JCR procedure) are large enough to produce statistically valid conclusions. It is estimated that these counts are accurate at about, or better than, a 90% level over the journals and years. For ease of description the set of publications are classified with respect to:

i) the individual journals in which they are published,

ii) the journal's publishing country of origin,

iii) their subjects on the basis of the subject categories of the journals as given in the JCR, and are analysed briefly to explore the questions raised above.

The following three basic citation indicators are used in the analysis:

a) Citation Rate (CR): It is a measure of the citedness of a paper published in a journal, and is calculated in the same way as the impact factor (IF) is calculated for the journal, i.e. it is the ratio of the total number of citations, in a particular year, received by the total number of Turkish papers published in two previous years to the same total number of papers.

b) Citation Immediacy (CI): Similar to the Immediacy Index (II) of a journal (see Appendix), it is the ratio of the total number of citations, in a particular year, received by the total number of Turkish papers published in that year to the same total number of papers.

c) Relative Citation Rate (RCR): It is simply the ratio CR/IF which is calculated for each of the 96 journals.

For ease of description, these indicators are used in each of the three classifications noted above for the selected years.

3 Findings and discussion

The findings are presented in tabular forms under the related subtitles and obtained data are discussed as required.

3.1 Publication statistics

The journals that have papers published by Turkish physicists are listed according to the number of Turkish publications, in descending order, in Table 1. Those journals which published, on average, less than two papers a year are included in the group designated "others", excepting journals that published educational papers. In this work, I paid special attention to Turkish physics education papers because it is a new trend for our country.

At first glance, the journals listed and the figures in the table indicate that, i) Turkish publications in physics appear most frequently in a small set of a variety of around 300 relevant source journals, ii) this set of 13 journals accounts for half of the total outputs, iii) nearly half of these are the journals with IF ranging between 1.6 and 4.6, and they have a share of 20% in the total output.

Another point to be emphasized is that, on the face value, there is no significant increase in the yearly publication totals from 1983 to 1993; the figures (last row) fluctuate between the minimum of 54 for 1983 and the maximum of 84 for 1988. This apparent plateau in the growth of output seems to be a new phase which happens for the first time in the history of physics research in Turkey. It can be attributed mainly to the adverse conditions in Turkish Universities in the 1980's [16]. However, by examining the years 1998 to 2003, there can be seen a significant increase in the Turkish physics publications. The reason is the recent financial support given by TÜBİTAK-ULAKBİM to the researchers whose works are published in journals listed in SCI. In addition, universities started in this period to give importance to such publications to promote academic degree. The contribution of our country was 0,001 in 1988 to the world of science in all fields, and it increased to 0,01 in the year 2003 according to the ISI [12,13]. This growth was as much as ten times the world average. As shown in Table 1, it can be seen that this growth was just three times for the physics publications. It can be claimed that the growth of Turkish physics publications has not been up to the potential.

TABLE 1. Distribution of the Turkish physics publications by journals indexed SCI for two decades*

	Journal	ISSN	1983	1988	1993	1998	2003	IF-2003	Total	%
1.	Astro. Sp. Sci.	0004-640X	3	9	7	9	14	0.52	42	9.0
2.	Act. Cryst. C	0108-2701	0	6	5	8	13	0.83	32	6.9
3.	Phys. Rev. B	1098-0121	0	5	6	8	12	2.96	31	6.7
4.	Phys. Let. B	0370-2693	3	6	2	5	4	4.10	20	4.3
5.	J. Math. Phys.	0022-2488	1	2	4	5	4	1.48	16	3.4
6.	Sol. St. Comm.	0038-1098	1	5	0	3	7	1.60	16	3.4
7.	J. Phys. A	0305-4470	3	2	2	3	5	1.36	15	3.2
8.	Phys. St. S-B	0370-1972	0	3	1	4	6	0.99	14	3.0
9.	Appl. Phys. A	0947-8396	0	2	1	4	6	1.22	13	2.8
10.	Phys. Rev. D	0556-2821	3	1	1	2	4	4.60	11	2.4
11.	Astron. Astr.	0004-6361	2	1	0	3	4	3.84	10	2.1
12.	Am. J. Phys.	0002-9505	0	0	1	0	0	0.79	1	0.2
13.	Phys. Teach.	0031-921X	0	1	0	0	0	0.17	1	0.2
	Subtotal		16	43	30	54	79		222	47.6
	Others (83)		38	41	33	49	83		244	52.4
	All Journals		54	84	63	103	162		466	100

* The journals are listed in decreasing order of the total number of publications, and the names of the journals for which less than 10 publications are recorded in selected years are not included. However, Am. J. Phys. and Phys. Teach. are examined as they are related to educational studies.

In the academic year of 1981-82, the Turkish higher education system and Universities underwent a process of reorganization and deep change. Turkey's 19 universities that were academically and administratively autonomous at the time were brought, by an act, under the control of a political and central authority, called the Higher Educational Council (YÖK). In the same year YÖK was established. 8 universities were founded in relatively large cities in the country, thus increasing the number of universities to 27 [17]. In 1987 a university, in 1992 21 universities and in the following years up to 2000 4 universities were established in the same manner, hence a total number of 53 state universities was reached in 2000. This consequent and sudden expansion of higher education gave rise to considerable cut-offs in the budgets of the formerly found universities and forced older researchers to move to the newly open ones. Inevitably, this led to the dispersal of the existing research staff and hence hampered the efforts of collaboration within the old universities. The main effect of all these is the observed stationary state in the publication activity in the years following 1982.

3.2 Citation Status

3.2.1 Assessment by individual journals

Citation indicators of the Turkish publication in the journal listed Table 1 is given in Table 2.

TABLE 2. Citation indicators of an average Turkish papers in major journals* for 1988 and 2003

	1988					2003				
Journals	IF	CR	RCR	II	CI	IF	CR	RCR	II	CI
1. Phys. Let. B	3.5	0.7	0.2	0.6	0.2	4.1	9.4	2.3	1.4	1.0
2. Phys. St. S-B	0.7	1.7	2.4	0.2	0.3	1.0	1.8	1.8	0.2	0.1
3. Astro. Sp. Sci.	0.4	0.8	2.0	0.2	0.1	0.5	0.9	1.8	0.1	0.1
4. Sol. St. Comm.	2.5	5.0	2.0	0.7	0.2	1.6	2.6	1.6	0.3	0.1
5. J. Math. Phys.	0.8	1.5	1.9	0.2	1.5	1.5	2.0	1.3	0.3	0.1
6. Act. Cryst. C	0.4	0.7	1.8	0.2	0.0	0.8	1.0	1.3	0.2	0.0
7. Phys. Rev. B	3.8	4.8	1.3	0.9	0.6	3.0	3.1	1.0	0.5	0.2
8. Astron. Astr.	2.0	4.3	2.2	0.4	3.5	3.8	3.3	0.9	1.1	4.7
9. J. Phys. A	1.9	0.7	0.4	0.7	0.3	1.4	0.4	0.3	0.5	0.3
10. Phys. Rev. D	2.3	0.7	0.3	0.6	0.0	4.6	0.9	0.2	1.6	0.4
11. Appl. Phys. A	1.8	0.0	0.0	0.4	0.0	1.2	0.1	0.1	0.5	0.1
12. Am. J. Phys.	1.0	1.7	1.7	0.3	0.1	0.8	0.0	0.0	0.2	0.1
13. Phys. Teach.	0.4	0.0	0.0	0.2	0.0	0.2	0.0	0.0	-	-

* The journals given in Table 1 are rearranged here by decreasing order of the RCR values for 2003 (column 8)

Indicator values, which were calculated for all journals every five years from 1983 to 2003, are displayed for only 1988 and 2003, due simply to the difficulties that would arise from the large number of data entries for the entire period 1983-1993 and 1993-2003.

The figures showing the RCR values for 2003 (column 8) indicate that an average Turkish paper is cited at a rate much higher than that of a corresponding average paper in each of the first 4 journals, at about the same rate in the next 4, while practically uncited in the rest of the journals. What is more interesting in Table 2 is that there is a notable positive correlation between the number of Turkish publications and their citation rates in Phys. Lett. B, Phys. St. S.-B, Astro. Sp. Sci. etc. This result is expected because of increasing the number of publications and the number of mutual and self citations.

On the other hand, most of the RCR values seem to change quite sharply from 1988 to 2003. This results, to a great extent, from the relatively low publication number per year (see Table 1), that was used in calculating the RC values. These changes are negative for the following American Journals: Sol. St. Comm., Phys. Rev. B, J. Math. Phys., Am. J. Phys.; and for these European Journals: Phys. St. S-B, Act. Cryst. C, J. Phys. A; the changes are positive for: Phys. Lett. B, Appl. Phys. A; and there is no significant change for the group of the remaining journals. It is worth noting that the RCR values of the publications in the latter group journals, i.e., in Astro. Sp. Sci. and Phys. St. S-B turn out to be around 2.2 for 1988, indicating a more stable and high recognition of the works of Turkish authors in these journals.

As for the citation immediacy, the Turkish papers published in Phys. St. S-B, Act. Cryst. C, J. Math. Phys. and Appl. Phys. A seem to be cited with immediacies similar to that of the journal's practices (i.e., II) in both 1988 and 2003, while those in the rest appear to deviate appreciably from the common practices in the relevant journals.

3.2.2 Assessment by journal's country of origin

The distribution of the publication output with respect to the journal's publishing country of origin for 1988-2003, every five years, and the related citation indicators are given in Table 3.

TABLE 3. Turkish physics publications and their mean citation rates in the journals, aggregated for their country of origin

Country of Journal	No of Journals	% of publications in the selected years	Mean IF of the Journals (MIF), 2003	Mean Citation Rate of Publications (MCR), 2003
Netherlands	17	26	2.2	1.9
United Kingdom	16	12	1.3	1.0
Germany	8	11	1.2	2.1
Other European Countries	12	12	1.1	0.5
All European Countries	53	61	1.5	1.4
USA	43	39	3.1	3.3
All Countries	96	100	2.3	2.2

The figures in 3 and 4 columns show the Mean Journal Impact Factor (MIF) of the Turkish papers in the journals which are aggregated for countries/country groups, and the Mean Citation Rates (MCR) respectively. They are calculated as the weighted means over the relevant journals, to account for the differences in publication and citation practices in different journals.

The most conspicuous feature of the distribution given in this table is that nearly half of the journals are of the American origin, accounting 39% of the total publication output. This reflects, by and large, a significant shift of Turkish preference from European to American Journals in recent years. Previous studies show, however, that almost all of the works by Turkish physicists in the decades between the 1940' and the mid 1960's were published in European, notably German and French journals [18]. The reason seems to be the fact that the pattern of teaching and research in Turkish universities were heavily influenced, in many respects, by the German system in that period. Many German scientists had been accepted into Turkish universities, and many scholarships to study in Germany and France were provided for the students in past war years. All these created good opportunities for Turkish physicists to maintain contact with their European colleagues, and publish their work in European journals [15].

Comparing the MIF and MCR values given in the last two columns in Table 3, one can safely say that an average Turkish paper in foreign journals almost reached the current citation standards of the corresponding average papers published in those journals. Although the MCR values show a high variance between 3.3 for the USA journals, and 0.5 for the journals of "other" European Countries (notable Denmark, France, Italy and Switzerland), it is interesting to observe that its value corresponds precisely to the European average of 1.4. The value of MCR over the journals for all European countries is slightly lower than the corresponding average, whereas it is exactly the same (2.1) as that for the German journals.

3.2.3 The situation by subjects

SCI gives a subject classification for each journal it processes. Table 4, based on this classification, gives a subject classification of the total number of 222 papers in the set of 13 journals, together with the related citation indicators for 2003. Under the label "others" one can find the papers published in the journals like Phys. Rev. B and Phys. Lett. B, which can be classified as contributing to several subjects simultaneously.

TABLE 4. A subject classification of Turkish physics publications and their citation indicators*

Subjects	No (%) of publications for selected years	Mean IF of the Journals (MIF), 2003**	Mean Citation Rate of Publications (MCR), 2003**
Astrosciences	52 (23.4)	1.6	2.5
Atomic, Mol., Nuc. and Chem. Phys.	32 (14.4)	2.1	3.4
Condensed Matter Phys. and Appl.	43 (19.4)	1.5	1.3
Math. Phys., Gen. Phys. and its apply	42 (18.9)	1.5	1.6
Phys. Edu.	2 (0.9)	0.5	0.1
Others	51 (23.0)	1.9	1.0
All Subjects	222 (100)	2.1	1.7

* Analysis by major journals: A total of 222 publications in 13 journals are considered

** MIF and MCR are calculated as the weighted means over the relevant journals in each subject

The relative contribution of different subjects to the output of 222 publications (47.6% of total) in major journals, as given in this table show marked deviations: the Turkish papers contribution is significantly above the world average in astrosciences, condensed matter physics and mathematical physics, whereas it is below the average level in atomic and nuclear physics. Besides, there are very few Turkish publications in physics education.

The positive deviations of Turkish output of publications in astrosciences and mathematical physics, from the corresponding international outputs, are quite understandable; results in these areas are mainly theoretical and carried out in universities, do not depend critically on equipment or investment and thus they are more numerous. On the contrary, the weakness of the performance in atomic and molecular physics publications is basically due to the lack of appropriate equipment and laboratory facilities, which are important for cooperative experimental and productive work. The insufficient number of studies related to the physics education can be explained by the fact that importance started to be given to this field only in the beginning of 1990s and new academic researchers in this field begun to be trained during that period. The second reason of the scarcity of Turkish physics education publications may be caused that these studies are mostly published in journals listed in Social Science Citation Index (SSCI), Education Index (EI), Current Index to Journals in Education (CIJE), etc. instead of SCI.

Finally, several remarks can be made with regard to the Mean Citation Rates of the Turkish papers (MCR values are averaged over the publications in individual subjects) as given in the last two columns of Table 4. The MCR values are well above the corresponding MIF's for astrosciences, and atomic and molecular physics, they are nearly the same for condensed matter, and mathematical physics, whereas quite below for subjects under "others". When averaged over all subjects, the MCR value turns out to be slightly lower than the corresponding MIF for the set of the 13 journals concerned. It must be kept in mind, however, that all of the analysis related to the citation characteristics of Turkish publications (see Table 4 as a whole) reflects only macro level characteristics due to the global nature of the relevant data. For assessing the citation status of individual Turkish physicists, one needs more detailed data and analysis.

4 Conclusion

The general purpose of this paper is to collect statistical information about the papers which were internationally published by Turkish physicists or those who worked in Turkey, and the ratio of the number of citations that these papers got to the number of citations that the journals got has been emphasized. IF and II ratios and citation indicators (RCR, CI, CR) were mentioned in the study. In the statistical research, 96 journals were examined as well as 240 physicists working for our universities referring to the years 1983-2003. The obtained data show that Turkish physics publications in journals indexed by SCI grew relatively slow between 1983-1993. However, there was a remarkable increase in publications from 1993 to 2003. Compared to previous years, there was a considerable shift in publications of Turkish authored articles from journals that are published in Europe to journals that are published in the United States. Turkish physics follows the pattern of world physics in four ways:

i) Approximately one third (31.3%) of Turkish publications appeared in "high impact" journals (IF>1.0). Girgin and Arıoğlu [19] claimed that Turkish papers in all fields were published in low impact factor journals in the last two decades but this is not the case for physics publications.

ii) Citation rates for Turkish articles are about equal to the citation rates of the journal in which they are published.

iii) 39% of Turkish physics papers were published in USA journals and nearly the half of the studies published in Europe were published in Netherlands.

iv) Most of the Turkish studies are about Astrosciences, Condensed Matter Physics and Mathematical Physics. So their citation rates are high (i.e; CR_{2003} = 9.4 of Phys. Let. B, CR_{2003} = 3.3 Astron. Astr., CR_{2003} = 2.6 Sol. St. Comm.etc.). However, Turkish physics education publications are rarely published in journals indexed in SCI. This study shows that it is necessary to carry out more research on teaching physics subjects and concepts in order to reach international level and to make contributions.

Regarding the last item, it is believed that ISI should make some necessary arrangements to cover some qualified journals about physics education in SCI. There are many periodicals on physics education papers in our country. Recently, two of these periodicals, Eurasian Journal of Educational Research (EJER-ISSN: 1302-597X) and Educational Sciences: Theory and Practice (ESTP- ISSN: 1303-0485) were

included in the Australian Higher Education Research Data Collection (HERDC) and were indexed by Educational Research Abstracts (ERA) and thus considered in the evaluations for academically promotions in Turkey.

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Appendix

IFs are calculated and then published annually in the Journal of Citation Reports (JCR) by the Institute of Scientific Information (ISI), a commercial organization founded by Eugene Garfield [20]. The journal impact factor is a measure of the frequency with which the "average article" in a journal has been cited in a particular year. The impact factor will help one evaluate a journal's relative importance, especially as compared to others in the same field. The impact factor is calculated by dividing the number of current citations to articles published in the two previous years by the total number of articles published in the two previous years. *Example:*

A= 2003 total cites to articles published in 2001-2002

B= number of articles published in 2001-2002

C= A/B= 2003 impact factor

If the journal X has an impact factor of 5.1, this means that every article published in issues of the journal X in 2001 and 2002 was quoted in 2003 an average of just over 5 times.

The journal Immediacy Index is a measure of how quickly the "average article" in a journal is cited. The Immediacy Index will tell you how often articles published in a journal are cited within the same year. The Immediacy Index is calculated by dividing the number of citations to articles published in a given year by the number of articles published in that year [21]. *Example:* The journal X contained 40 articles in 2003. These articles were in the same year quoted 100 times, i.e. each article was quoted on average 2.5 times (=Immediacy Index).