ORIGINAL PAPER

RANKING CHEMISTRY JOURNALS USING THE HIRSCH INDEX AND ARTICLE INFLUENCE SCORE

SILVIU JIPA[1], LAURA MONICA GORGHIU[1], CRINELA DUMITRESCU[1], CALIN OROS[1]

Manuscript received: 07.10.2012; Accepted paper: 14.11.2012;

Published online: 01.12.2012.

Abstract. *This study presents the Hirsch-index, impact factor and article influence score for the ranking of Chemistry journals. The study concludes that the Hirsch-index exhibits a good correlation with the influence score. A correlation of 60 Chemistry journals is analyzed.*

Keywords: *research, Scientometrics, Hirsch index, influence score, impact factor*

1. INTRODUCTION

Scientific academic research constitutes one of the essential foundations for a country's sustainable advancement by means of study programmes oriented toward new directions and priorities as well as by promoting excellence at national and international level. The outcome of a research depends, among other things, on the quality o the documented information regarding the knowledge on the scientific experience in the field under investigation as well as on the scientific quality of the results obtained and published. The number of the citations provides a clear indication regarding the impact and appreciation by the scientific community of the papers published in an academic journal.

Henry Oldenberg (1618 – 1677) is considered to be the father of the scientific journals. Of German origin, Oldenburg settles in London after 1652. In his position as Secretary to the Royal Society since 1663, he creates in 1665, as editor and publisher, the first scientific journal in the civilized world [1]. The evolution of the number of scientific journals throughout the years records a tremendous rise: in 1665, the first journal, in 1800, one hundred journals, in 1900, one thousand journals, in 2000, twenty thousand journals (Fig. 1).

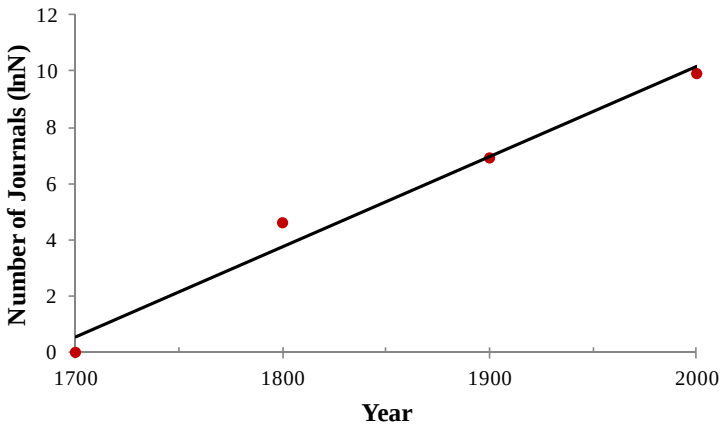

Fig. 1. The rise of the number of scientific journals in the last three centuries (in accordance with the data in [1]).

[1] Valahia University of Targoviste, Faculty of Science and Arts, 130024 Targoviste, Romania.
E-mail: jipasilviu@yahoo.com; laura_monica@yahoo.com; c_dumi13@yahoo.com; oros@valahia.ro.

The Thomson Reuters ISI database provides comprehensive indexed coverage of 16000 titles that represent the scientific journals acknowledged by very strict selective criteria. The academic journals, which are indexed by ISI Thomson – Institute of Scientific Information / headquarters in Philadelphia (USA), from all science fields are to be found at the address given in the references [2].

The ranking of scientific journals has been the subject of many papers [3-8]. To achieve a proper ranking they have used several scientometric parameters such as the impact factor [3, 4], the eigenfactor [5], the Hirsch index [6-8] and so on. The current paper is trying to rank an appreciable number of chemistry journals by employing the influence score, impact factor and Hirsch index as scientometric parameters.

The influence score is a measure that reflects, for a certain journal, the mean impact of an article in that journal within five years from its publication by considering the number of citations received by the articles in that journal, weighed against the influence of the journals that quote the papers [9]. The influence score is calculated by Thomson Reuters and then appears in the Journal Citation Reports. The mean article in the Journal of Citation Reports has an influence score of 1.00. A score greater than 1.00 indicates that each article in the journal has above-average influence and vice versa [9]. This parameter can be obtained directly by accessing [11].

The impact factor represents an index showing how often the articles of a journal are cited in other publications, thus indicating the importance of the journal within its particular field.

The impact factor of a scientific journal is a measure reflecting the average number of citations received by the articles in that journal, published within a year, in a time period of two years after the year taken into consideration. For example, the impact factor for the year 2010 in the case of a journal X is: the number of citations received in 2010 for the articles published in 2008 and 2009, divided by the total number of citable articles that were published in 2008 and 2009 [10]. The impact factor is also calculated by Thomson Reuters and published in the Journal Citation Reports.

The Hirsch index is a scientometric measure that characterizes the number of ISI published papers in a journal as well as the number of citations for the journal's articles in other ISI publications [12]. The Hirsch index can be determined either manually by using free access online databases (e.g. Google Scholar) or by means of certain databases which require prior registration (e.g. Scopus, Web of Knowledge).

The use of Hirsch index for ranking scientific journals was the subject of a study by Schubert and Glänzel [13] which indicated the possibility of its application as a supplementary indicator to the impact factor.

2. EXPERIMENTAL

We have analyzed a number of 70 journals, of which 60 are from the field of chemistry and 10 belong to the group Nature.

The journal impact factors and influence scores for the journals were obtained from references [14]. The Hirsch indices were extracted from SCImago Journal and Country Rank [15].

3. RESULTS AND DISCUSSIONS

Tables 1-5 present the data collected with reference to the impact factors, influence scores and Hirsch indices for the journals under consideration.

The analysis of the data shown in the tables reveals the existence of some differences in the values of the three parameters in close relation with the particular scientific field. Thus, the Hirsch index has a decreasing direction shown bellow, corresponding of the fields of:

Biochemistry (350) > Physical Chemistry (223) > Analytical Chemistry (199) > Polymer Chemistry (188) > Organic Chemistry (138) > Inorganic Chemistry (133)

The Hirsch index of the best-rated journals in the field decreases →

Table 1. Impact factors, influence scores and Hirsch indices for the journals in the group entitled *"Multidisciplinary Chemistry"*.

Journal title	Hirsch index	Relative impact factor (journal)	Relative influence score (journal)
Chemical Reviews	356	9.20794	37.54250
Accounts of Chemical Research	204	4.66146	19.74343
Chemical Society Reviews	160	5.14366	19.80835
Coordination Chemistry Reviews	155	4.55191	8.16686
Annual Review of Physical Chemistry	96	5.75231	10.74175
Catalysis Reviews – Science and Engineering	58	2.55764	5.49638
Advances in Catalysis	35	1.17622	5.01689
Advances in Organometallic Chemistry	41	2.90105	4.66275
Progress in Inorganic Chemistry	38	1.66707	4.20917
Progress in Solid State Chemistry	25	1.24088	3.77673

Table 2. Impact factors, influence scores and Hirsch indices for the journals in the group entitled *"Polymer Chemistry"*.

Journal title	Hirsch index	Relative impact factor (journal)	Relative influence score (journal)
Macromolecules	188	1.93396	4.08257
Polymer	133	1.52237	3.19878
Polymer Degradation and Stability	65	0.91777	2.03670
Polymer Engineering and Science	64	0.69838	1.41667
Polymer International	54	0.91052	1.79817
Macromolecular Materials and Engineering	43	0.74222	1.69419
Polymer Testing	42	2.06312	1.66972
Polymer Bulletin	39	0.43204	1.00000
Journal of Macromol. Sci. Pure and Appl. Chemistry	30	0.33745	0.55352
Journal of Inorg. and Organometallic Polym. and Met.	23	0.72049	1.18960
Journal of Polymer Engineering	13	0.20707	0.37920
E-Polymers	6	0.27439	0.57798

Table 3. Impact factors, influence scores and Hirsch indices for the journals in the group entitled *"Analytical Chemistry".*

Journal title	Hirsch index	Relative impact factor (journal)	Relative influence score (journal)
Analytical Chemistry	199	1.97650	3.03561
Journal of Chromatography A	130	1.55459	1.65412
Analitica Chimica Acta	98	1.42418	1.73957
Journal of Chromatography A: Analytical	87	1.05269	1.47915
Analyst	81	1.24033	1.89420
Talanta	83	1.24716	1.51577
Analytical and Bioanalytical Chemistry	75	1.31918	1.80671
Microchimica Acta	58	1.00379	0.84435
Journal of Analytical and Applied Pyrolysis	54	1.22405	1.22792
Analytical Scicences	44	0.57847	0.80570
Analytical Letters	38	0.49924	0.53713
Phytochemical Analysis	36	0.70894	1.02217
Intern. Journal of Environ. Analytical Chemistry	27	0.68780	0.66124
Current Analytical Chemistry	12	0.81236	0.98067

Table 4. Impact factors, influence scores and Hirsch indices for the journals in the group entitled *"Chemistry of Miscellaneous Fields".*

Journal title	Hirsch index	Relative impact factor (journal)	Relative influence score (journal)
Chemical Reviews	356	9.20794	37.54250
Chemical Society Reviews	160	5.14366	19.80835
Green Chemistry	81	1.49449	4.44822
New Journal of Chemistry	71	0.76978	2.34621
Organic and Biomolecular Chemistry	68	1.31954	1.74797
European Journal of Organic Chemistry	83	1.08593	1.51395
European Journal of Inorganic Chemistry	70	1.19262	1.64042
European Journal of Medicinal Chemistry	62	1.24628	1.60731
Helvetica Chimica Acta	60	0.36748	1.19320
Canadian Journal of Chemistry	46	0.36440	1.16847
Central European Journal of Chemistry	15	0.27273	0.75734
Revue Roumaine de Chimie	14	0.06735	0.12983
Revista de Chimie	12	0.30890	0.09274

Table 5. Impact factors, influence scores and Hirsch indices for the group "*Nature*" jornals.

Journal title	Hirsch index	Relative impact factor (journal)	Relative influence score (journal)
Nature	698	16.90196	33.71015
Science	678	14.58186	30.94421
Cell	485	7.38199	22.36000
Nature Medicine	343	7.81117	19.16185
Nature Biotechnology	237	9.83494	17.83384
Nature Review Cancer	209	6.55963	19.05598
Nature Reviews Immunology	194	7.44860	18.21360
Nature Reviews Genetics	173	6.14037	13.41284
Cell Metabolism	89	4.46704	11.02888
Laser and Photonics Reviews	22	3.10577	9.18421

This difference is also observed in the case of the Hirsch indices of journals in the field of Physical Chemistry (223) and Chemical Physics (195) (Table 6). Physical Chemistry is the branch of chemistry that is concerned with the application of physics to chemical systems whereas chemical physics is the branch of physics that studies chemical processes from the point of view of physics. In the Russian Federation, in Moscow, the two related fields are represented by independent research units: Karpov Institute of Physical Chemistry and N. N. Semenov Institute of Chemical Physics of the USSR Academy of Science respectively. Also, there are differences depending on the scientific potential of the journal in the respective time period as well as on the number of citation recorded.

Table 6. Impact factors, influence scores and Hirsch indices for the journals in *Physical Chemistry* and *Chemical Physics*.

Journal title	Hirsch index	Relative impact factor (journal)	Relative influence score (journal)
Journal of Physical Chemistry (B)	223	1.14328	2.25101
Journal of Physical Chemistry (A)	137	1.12758	1.42237
Journal of Chemical Physics	195	1.20303	1.48321
Chemical Physics Letters	143	0.89109	1.27755
Chemical Physics	73	0.88565	1.17940
Chinese Journal of Chemical Physics	9	0.19020	0.13139

The dependences between influence scores and Hirsch index values for the journals presented in the tables 1-6 have been studied and are presented in Figs. 2-7.

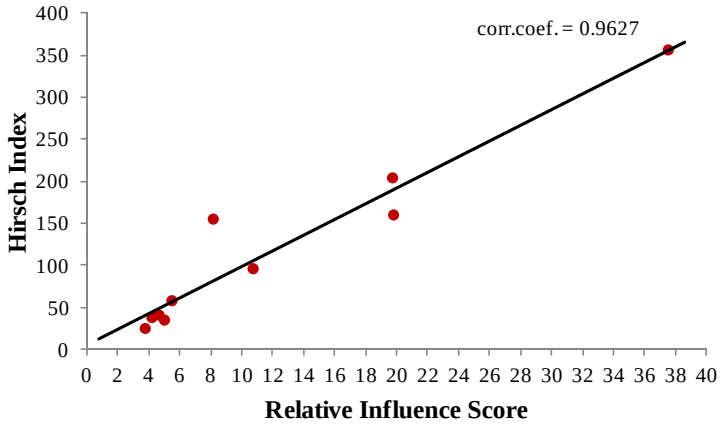

Fig. 2. Influence score versus Hirsch-index values for journals in Multidisciplinary Chemistry.

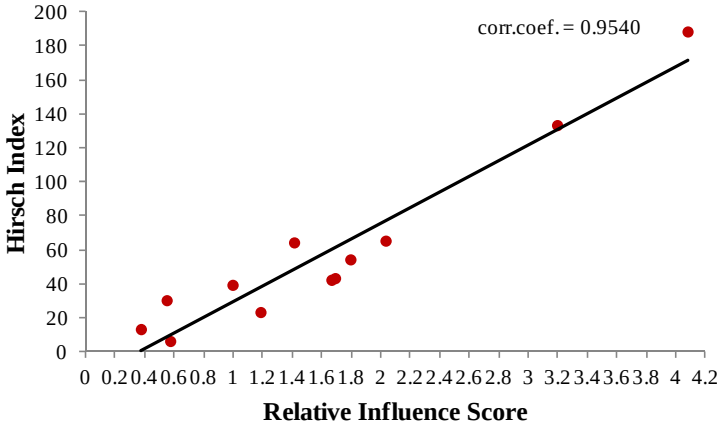

Fig. 3. Influence score versus Hirsch-index values for journals in Chemistry of macromolecular compounds.

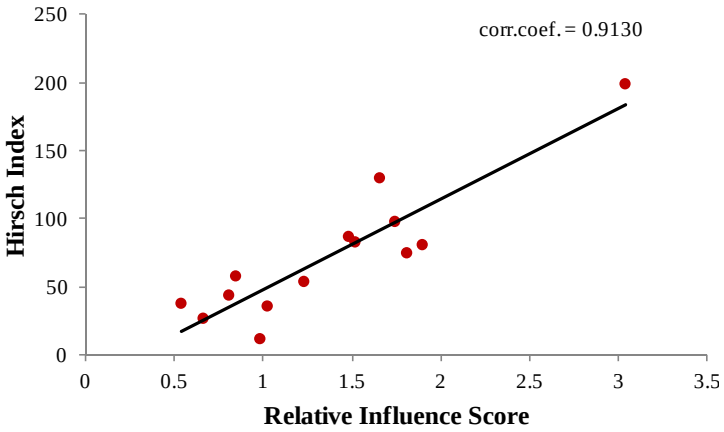

Fig. 4. Influence score versus Hirsch-index values for journals in Analytical Chemistry.

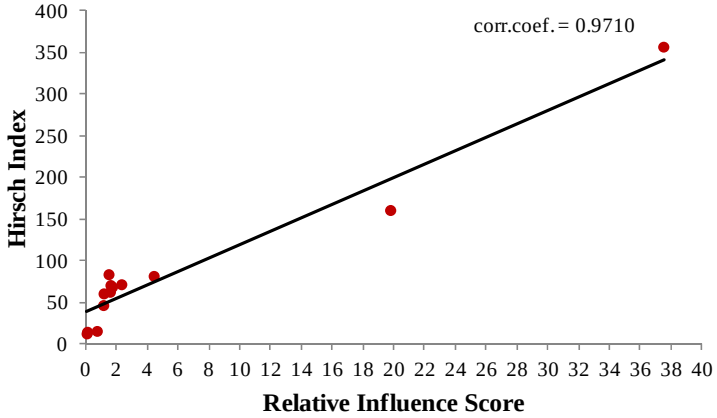

Fig. 5. Influence score versus Hirsch-index values for journals in Chemistry of miscellaneous fields.

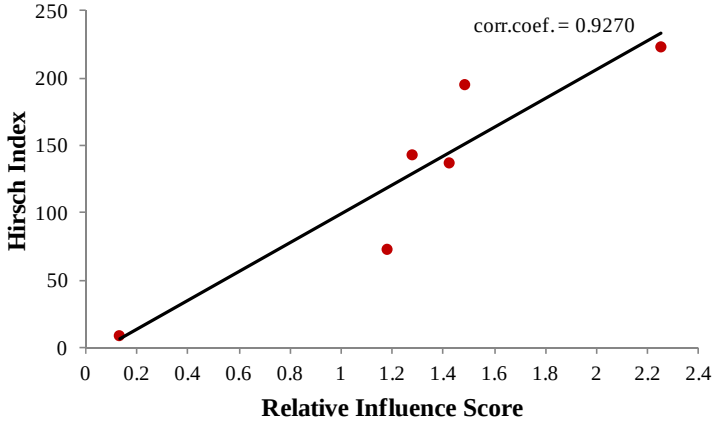

Fig. 6. Influence score versus Hirsch-index values for journals in Physical Chemistry and in Chemical Physics.

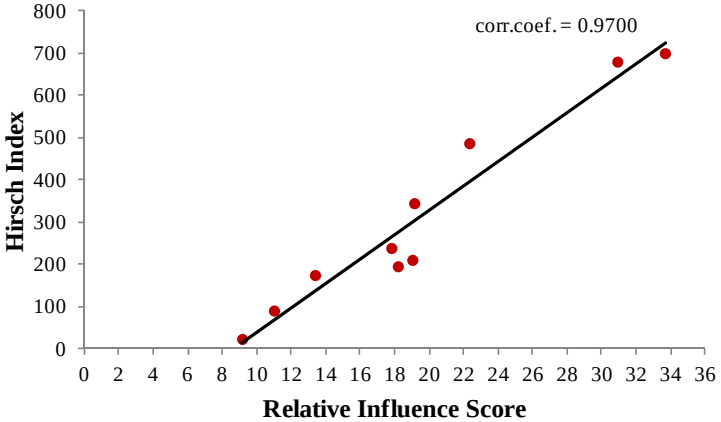

Fig. 7. Influence score versus Hirsch-index values for Nature group journals.

The Hirsch is in close correlation with both the impact factor and the influence score, although the later has yet a somehow greater correlation coefficient (Table 7). The correlation coefficient has been determinate using linear regression analysis method.

Table 7. Hirsch index correlation with the influence score and impact factor respectively.

Journal type	Number of journals	Hirsch-index correlation:	
		Influence score	Impact factor
Multidisciplinary Chemistry	10	0.963	0.919
Chemistry of macromolecular compounds	13	0.954	0.957
Analytical Chemistry	14	0.913	0.893
Chemistry of miscellaneous fields	13	0.971	0.976
Physical Chemistry / Chemical Physics	6	0.927	0.882
Nature group journals	10	0.970	0.908
Organic Chemistry	4	0.974	0.989

The indicators we have analyzed measure aspects similar to the scientific output. All the three of them are based, in one way or another, on the number of citations received by the articles in a journal. The Hirsch-index superiority over the impact factor comes from its simple manual or automatic determination.

The differences among the correlation coefficients shown in table 7 can derive only from the limits of the databases from where the citations are taken. There are three databases: Web of Science, Scopus and Google Scholar. None of the three databases is comprehensive, which means that the more databases are consulted, the more comprehensive the result will be. However, we can consider that, for the field of Chemistry, the Hirsch-index derived from the ISI Web of Knowledge provides an acceptable alternative for rating a journal. On the other hand, the Hirsch-index gives a direct indication of any journal's rank (Table 8, see also Figure 8). And yet "the h-index it is not suited to substitute impact factor which have long ago become standard in bibliometric research" [3].

Table 8. Impact factors, influence scores and Hirsch indices for the journals of Organic Chemistry in different countries.

Journal title	Hirsch index	Impact factor	Influence score	Country
Journal of Organic Chemistry	138	1.47983	1.88839	USA
European Journal of Organic Chemistry	83	1.08593	1.51395	UK
Chinese Journal of Organic Chemistry	19	0.21150	0.14401	China
Russian Journal of Organic Chemistry	15	0.18415	0.19262	Russian Federation

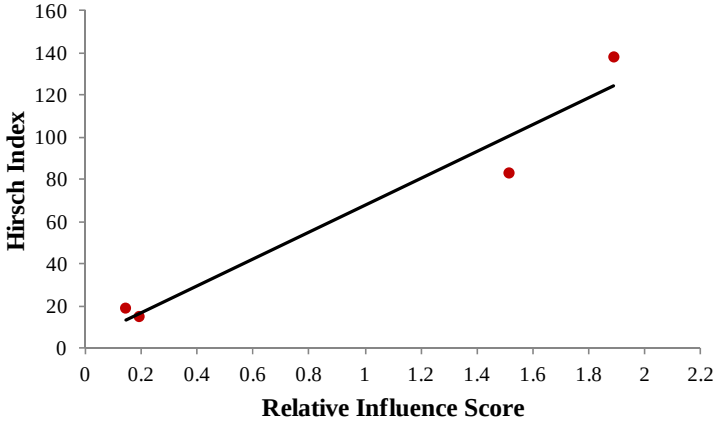

Fig. 8. Influence score versus Hirsch-index values for Organic Chemistry journals from different countries.

We should specify that the impact factor was first proposed by Eugene Garfield and Irving Sher in the year 1963, in their paper "New factors in the evaluation of scientific literature through citation indexing" [16].

CONCLUSIONS

From what has been presented in this study, it is obvious that the Hirsch-index, the influence score and the impact factor represent valuable indicators by means of which citation data are used for assessing and tracking through time the influence of a scientific journal in relation to other similar journals. Certainly, these metrics provide different information but overall, they make up a battery of very selective criteria according to which scientific journals are rated. What is more important than that is the fact that these three indicators can be used in combination to evaluate a journal's measure of importance. Although the Hirsch-index is most frequently considered the most robust indicator, there are strong points and weak points about each one of them.

Therefore, we can conclude this study by stating that the Hirsch-index and the influence score can be used alongside with the impact factor to rank the chemistry-field journals in full agreement with the journal's scientific quality.

REFERENCES

[1] http://www.ecs-univ.ro/UserFiles/File/Training_Editorial_versiunea%20finala%20Paun%20Viorel.pdf
[2] http://scientific.Thomson.com/mjl/
[3] Weidong, H., Qi, Y., Yanli, W., *Journal of Animal and Veterinary Advances*, **9**(11), 1552, 2010,
[4] Bornmann, L., Marx, W., Gasparya, A. Y., Kitas, G. D., *Rheumatol. Int.*, DOI 10.1007/s 0029-011-2276-1
[5] Chun-Yang, Y., *Current Science*, **100**(5), 648, 2011.
[6] Braun, T., Glänzel, W., Schubert, A., *Scientometrics*, **69**(1), 169, 2006.
[7] Vanclay, J. K., http://arxiv.org/ftp/arxiv/papers/0712/0712.1916.pdf
[8] a. Braun, T., Glänzel, W., Schubert, A., *The Scientist*, **19**(22), 8, 2005; b. Takeda, H., Cuellar, M. J., *Proceedings of the Southern Association for Information Systems Conference*, Richmond, V. A., USA, March 13th – 15th, 1, 2008; c. Bornmann, L., Marx, W., Schier, H., *European Journal of Organic Chemistry*, **2009**(10), 1471, 2009.
[9] OxfordLibGuides, http://ox.libguides.com/content.php?pid=207971&sid=1733765
[10] http://www.rcis.ro/ro/factor-de-impact.html
[11] http://www.eigenfactor.org
[12] Hirsch, J. E., *Proc. Natl. Acad. Sci USA*, **102**, 2005, p. 16569-16572
[13] Schubert, A., Glänzel, W., *J. Informatrics*, **1**, 2007, p. 179-184
[14] http://us.mc1607.mail.yahoo.com/mc/welcome?.gx=1&.tm=1343543985&.rand=4bo7r
[15] SCImago SJR journal and country rank, http://www.scimagojr.com
[16] Gartfield, E, Sher, I. H., *American Documentation*, **14**(3), 195, 1963.