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Research Article

Measuring Scholarly Impact in Bosnia and Herzegovina: The Picture Beyond the Numbers

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ABSTRACT
Measuring scientific impact has long become a fact of academic life. Better scholarly output is related to higher chances of being promoted and winning a research grant. There are numerous ways to measure scholarly impact, such as through the number of publications and citation analysis. The most widely used databases for assessing these metrics are Google Scholar (GS), Scopus, and Web of Science (WoS). The goal of the present paper is to provide an in-depth analysis of GS profiles and to compare GS metrics with different metric indices from Scopus and WoS. An additional goal is to do a qualitative analysis of profiles that were identified as outliers through the visual inspection of various metric indices ratios. The sample for this study consisted of 100 researchers from the University of Sarajevo with highest number of citations according to their GS profiles. The results of this study indicated a high correlation between different metric indices. Outlier analysis revealed several errors in GS profiles, some of which are attributable to GS algorithms. An in-depth analysis of outliers provided important data for identifying limitations of all metrics currently used in researcher's evaluation. We conclude the article with several suggestions on how to improve the evaluation of individual scholar's research output.
Keywords: Scientific impact, Publications, Citation analysis, Google Scholar, Scopus, Web of Science.

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INTRODUCTION

Evaluation of scholar productivity and researcher's scientific impact has become a common practice in academic life. Quantifying scientific impact is one of the essential pillars of academic work required for career advancement.[1] Without important scientific output, researchers' prospects for tenure, promotion, and winning grants are significantly reduced.[2] There are many ways in which an individual's academic performance can be evaluated. However, evaluating scientific impact and quality is a very difficult problem which still has no satisfying conclusion.[3] New developments in information technology provide useful metrics for measuring scientific impact.[4] The number of citations and its derivative indices are a basic bibliometric index for evaluating researchers and research groups.[5] Out of these, the most common way to evaluate researchers is through their *h*-index, which is the number of publications with as many citations.[6] Although not without critics,[7] *h*-index outperforms other bibliometrics in the assessment of research performance.[8] *h*-index has gained its popularity due to factors such as easiness of computation and balance between quantity and quality.[9] However, it makes a difference which *h*-index will be used for the scholar evaluation as the *h*-index depends on the source by which publications and citations will be counted.[10] There are several databases from which *h*-index can be retrieved for an individual scholar and they include Google Scholar (GS), Scopus, and Web of Science (WoS). GS, unlike the Scopus and WoS, is freely available and researchers can make their own GS profiles easily. Other benefits of GS are: it is easy to use, requires no registration, and has a comprehensive coverage of scientific disciplines.[11]

Researchers throughout the world are encouraged to create their Google Scholar (GS) profiles to increase their own scientific visibility and the visibility of the institutions they are affiliated with.[12] Researchers worldwide are increasingly being aware of the GS, as a platform for increasing their visibility.[13] Publications indexed in GS are a way for researchers to reach a wider audience and impact a university's ranking in Webometric Ranking of World Universities.[14] Thus, it is crucial for academic institutions to motivate their staff to create GS profiles. GS has also been praised for its inclusivity as it can capture more citations than its counterparts Scopus and WoS.[15] In addition to this, GS is quite useful for

capturing citations in fields that are not well represented in WoS.[16]

Universities in Bosnia and Herzegovina are not represented in major academic ranking systems. The only academic ranking system that covers universities from BIH is the Webometrics, and the best positioned university from Bosnia and Herzegovina is the University of Sarajevo (1506th position according to July 2021 Webometrics report). It is evident that Bosnia and Herzegovina is a country on a scientific periphery[17] with a small scientific production. Thus, it is of utmost importance to perform a more detailed evaluation of scientific output of researchers from Bosnia and Herzegovina and create incentives to increase their scientific production. Given that GS is freely and widely available to the public, we chose it as a platform to perform our analysis. The goal of the present paper was to evaluate the GS profiles of the 100 most prolific researchers from the University of Sarajevo and to compare GS metrics with the Scopus and WOS metrics of these researchers. In addition to this, we performed a qualitative analysis of the identified outliers in the data. More specifically, in this study we set out to answer the following questions:

1. What is the ratio of GS citations to Scopus and WOS citations?
2. What is the correlation of various metric indices?

Although there are numerous studies conducted internationally on this topic, there are no such studies conducted in Bosnia and Herzegovina. Thus, these results might be informative for the various stakeholders in evaluating scientific performance and might provide more objective picture on the scientific evaluation process. In addition to these two research questions, we set the goal of performing a qualitative analysis of the unbalanced GS profiles to help us better understand the GS metrics. An unbalanced profile is defined as an outlier in GS citations to Scopus citations ratio, and GS citations to WOS citations. We arbitrarily defined the outliers through the visual inspection of the histograms. As the data were not following normal distribution, we could not define an outlier mathematically as a measure that is three or more standard deviations away from the mean.

METHODOLOGY

The sample for this study comprised the top 100 researchers who had their public GS profiles affiliated with the University of Sarajevo, Bosnia and Herzegovina. For each of these researchers we took the following data:

- From GS, we retrieved the following data: number of citations and *h*-index
- From Scopus, we retrieved the following data: number of papers published in Scopus, number of citations, and *h*-index
- From WoS, we retrieved the following data: number of papers published in WoS, number of citations, and *h*-index

We calculated the ratio of GS citations to those of Scopus and WoS. Through the visual inspection of the data, we identified the unbalanced profiles. These unbalanced profiles represented outliers according to their distribution of the calculated ratios. We did the same for the GS *h*-index. Finally, we calculated a correlation of all indices (with and without the outliers). We performed a qualitative analysis of each unbalanced profile and described the obtained data. All these data were retrieved on March 24, 2021.

RESULTS

We first present the distribution data of citations for the first 100 researchers according to their GS profiles. These data are presented in Table 1.

The researcher who was on 100th position had 389 citations and the researcher who was on the first position had 12298 citations on March 24, 2021.

The first research goal was to calculate the ratio of GS total citations to Scopus total citations. There was a total of eight extreme outliers (seven scores of zero (meaning no Scopus citations) and one score of 730 (only one Scopus citation)). These scores were identified as outliers and excluded from the subsequent analysis. In Figure 1. is the histogram of the distribution of GS citation to Scopus citation ratio without these eight points.

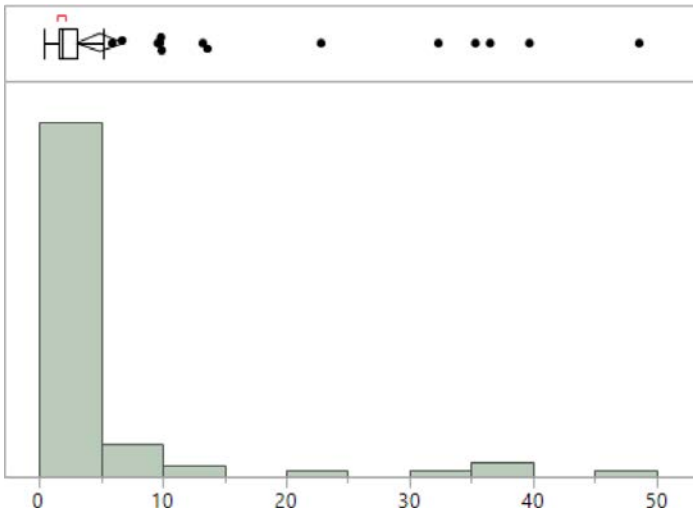

Figure 1: Histogram of distribution of GS citation to Scopus citation ratio.

Table 1: Descriptive data for Google Scholar citations.

Variable	N	Mean	Median	Minimum	Maximum	Lower Quartile	Upper Quartile	SD
GS citations	100	1184.5	596.5	389.0	12298.0	486.0	1030.5	1930.4

The five-number summary is 1. Minimal value= 0.4; 2. 1st quartile=1.55; 3. Median= 1.92; 4. 3rd quartile= 3.13; and 5. maximum value= 48.58. From Figure 1. it is evident that values above 15 can be regarded as outliers as well and they were also included in the qualitative analysis of the outliers. There were six values identified as outliers and according to the ratio of GS citations to Scopus citations there were total of 14 outliers.

We next performed the same procedure for the ratio between GS citations and WoS citations. This time, there were 10 outliers (seven with scores of zero and three with scores higher than 100). The histogram without these outliers (*n*=90) is shown in Figure 2.

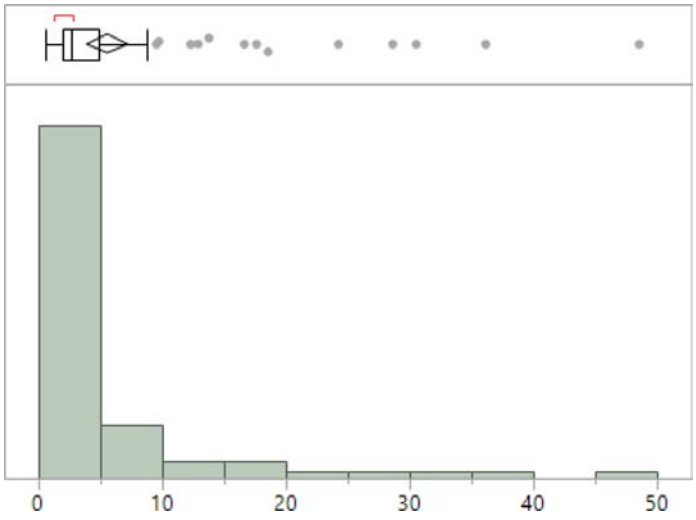

Figure 2: Histogram of distribution of GS citation to WoS citation ratio.

The five-number summary is 1. Minimal value= 0.46; 2. 1st quartile=1.86; 3. Median= 2.7; 4. 3rd quartile= 4.84; and 5. maximum value= 48.58. From the Figure 2. we determined that values above 15 can be regarded as outliers. From these two analyses, we identified total of 20 independent outliers.

We next calculated correlations between different metrics, with and without identified outliers. In Table 2. we present correlations without the outliers, and in Table 3. are correlations with outliers.

It is evident that although correlations are slightly higher in the first Table (without outliers), the outliers do not significantly affect the size of correlations.

Qualitative analysis of the outliers

As mentioned earlier, we identified a total of 20 unbalanced GS profiles (outliers) in the first 100 top researchers from the University of Sarajevo according to their GS profiles. Next, we performed a qualitative analysis to examine the nature of these outliers. We divided the outliers into the following categories:

Table 2: Correlation of metric indices without outliers.

	Google Scholar	GS_*h*_ index	Scopus	Scopus_*h*_ index	WoS	WoS_*h*
Google Scholar	1	-	-	-	-	-
GS_*h*_index	.86	1	-	-	-	-
Scopus	.88	.73	1	-	-	-
Scopus_*h*_ index	.85	.96	.78	1	-	-
WoS	.87	.68	.94	.74	1	-
WoS_*h*	.84	.94	.78	.96	.77	1

Note. All p's < .0; *n*=80.

Table 3: Correlation of metric indices with outliers.

	Google Scholar	GS_*h*_ index	Scopus	Scopus_*h*_ index	WoS	WoS_*h*
Google Scholar	1	-	-	-	-	-
GS_*h*_index	.83	1	-	-	-	-
Scopus	.87	.71	1	-	-	-
Scopus_*h*_ index	.80	.90	.77	1	-	-
WoS	.86	.66	.94	.73	1	-
WoS_h	.79	.87	.77	.96	.76	1

Note. All p's < .01; *n*=100.

1. Incorrect GS profiles

Three outliers were identified as incorrect profiles. The GS profiles of two researchers contained the articles that they did not author or co-authored. These articles were widely cited but did not belong to these researchers. The GS profile of the third researcher in this category contained a book which was not written or edited by the researcher. However, that book contained the chapter that the researcher authored. That chapter was included in the author's GS profile and had a certain number of citations. However, that number was much less than the number of citations that the book had.

2. Academic field

The second category of researchers that were identified as having unbalanced profiles were five researchers from the fields of political sciences, sociology, law, grammar of Bosnian

language and language stylistic. Their GS citation count was correct but the publications they wrote were not indexed by Scopus and WoS. The citations of their work, mainly books, were cited by various sources including other books and journals that were indexed by Scopus and WoS. However, given that their publication is not indexed in Scopus and/or WoS consequent citations to their work are not counted by these databases. The advantages of GS are evident for these authors as they would be invisible by Scopus and WoS, although their work is significant and valued by their peers.

3. Error in GS algorithm

Three profiles were identified as outliers due to a GS algorithm error. These three authors are authors of a paper published in 2018. However, the citations for this paper are not correct as GS identified citations of this paper ranging from 2009. All incorrect citations are coming from Iranian journals and website (sbu.ac.ir). The inspection of the papers that "cited" the aforementioned study revealed that the paper was not cited nor it contained the same or similar title (which was our assumption on why the algorithm incorrectly picked these citations) or similar names of authors.

4. Discrepancy in citation ratio between GS, Scopus, and WoS

The largest group of unbalanced profiles (nine GS profiles) belonged to the category of unbalanced profiles due to discrepancy in relation to ratio of GS citations to Scopus and/or WoS citations. Out of these, four researchers had unbalanced profile for both GS citations/Scopus citations ratio and GS citations/WoS citations ratio Four researchers had unbalanced profiles for GS citations/WoS citations and one researcher had unbalanced profile for GS citations/Scopus citations.

DISCUSSION

The goal of the present paper was to evaluate the GS profiles of top 100 researchers from the University of Sarajevo and to conduct an in-depth analysis of unbalanced GS profiles. Unbalanced profiles were defined as profiles that were identified as outliers according to the distribution of GS citations ratio to Scopus/WoS citations. We identified four types of unbalanced profiles from these 100 researchers.

The first type of unbalanced GS profiles is related to the publications that do not belong to the authors but were still listed in their GS profiles. Although this is most likely inadvertently done by the authors, it is still the responsibility of the authors to keep their GS records correct. Moreover, in this particular case, the authors' top publication in their GS profile was not their publication. It is easy to delete these incorrect records from GS and authors should do every effort to correct these mistakes as it can affect not only them as individual researchers but their institution as well. For example, it is well-known that Webometrics system disqualifies an institution from World University Ranking system if that institution contains GS records that are not correct.

The second type of unbalanced profiles seems to be related to the academic field. Researchers in the fields of language, sociology, law, and political science did not publish in the outlets covered by Scopus and WoS. An additional obstacle is that some of widely cited articles from these researchers were written in Bosnian/Serbian/Croatian language which are underrepresented in Scopus and WoS. However, it is evident that GS has once again demonstrated its usefulness in relation to these types of researchers. These authors' work and citations are recognized and visible thanks to GS. Earlier studies have shown the important role of the GS in literature search including thesis, dissertations, books, etc.,[18,19] a finding that is supported by our research. It is again shown that some fields are not well represented by Scopus and WoS.

The third identified type of outliers is related to the error in the GS algorithm. In this particular case, a publication from 2018 written by, among other authors, three authors in top 100 researchers from the University of Sarajevo was cited many times. However, an inspection of the citations has shown that citations retrieved were not correct as they dated back to 2009. We initially thought that the error stemmed from the similarity in title and/or author name automatically retrieved by Google but that was not the case. By examining articles that "referenced" authors from the University of Sarajevo, we discovered that references in those articles did not contain the similar article titles or similar author names to those of the researchers from the University of Sarajevo. All incorrect citations were from Iranian journals/sources (sbu.ac.ir). This indicates some systematic error in GS algorithm. Many errors in the GS were identified in previous literature, such as those related to coverage, parsing, matching, and searching and browsing (Orduña Malea, Martín-Martín, and Delgado-López-Cózar 2017).[20] Given the importance of GS use in evaluation of researchers, it is of utmost importance that data provided by Google are accurate.

The fourth identified obstacle is the discrepancy in citation ratio between GS, Scopus, and WoS. It is evident that there are researchers who mainly publish papers in journals covered in Scopus and are getting citations for these papers. However, that number is not reflected by WoS citations. This fourth type of outliers is similar to the second type of outliers regarding the academic field. However, we separated the two categories because in this fourth category were researchers from the fields that are well-represented in Scopus and WoS, such as medicine. Of course, these are not the only the only GS pitfalls. Jensenius, Francesca R., Mala Htun, David J. Samuels, David A. Singer, Adria Lawrence and Michael Chwe[21] have found GS to have bias towards certain disadvantaged

groups including women, younger scholars, scholars in smaller research communities. The identification of outliers and deeper inspection of unbalanced profiles might point to potential errors when using these criteria for evaluation purposes (tenure, grants, etc.)

Accurate GS profiles of researchers are very important for both researchers themselves and the institutions they represent. Thus, it is of crucial importance to identify potential inaccuracies in researchers' profiles and by finding the errors, we will be able to rectify them. Of course, there are numerous reasons beyond those mentioned in this paper on why there might be an error in citations count. In this paper we were only interested in unbalanced scholar's profiles and no other potential reasons of inaccuracy. For example, we did not consider the issue of duplicate citations that were previously reported as one of the major issues in the correctness of GS citations.[22]

Number of citations and *h*-index are often regarded as a valid measure of researcher academic rank.[23] Moreover, *h*-index has been shown to be positively correlated with the grants received and is able to capture researchers' productivity.[24] Given the high correlations of these indices, it seems irrelevant which of the three measures will be used, GS, Scopus, or WoS. The correlations between different metric indices were high even when the outliers were included in the analysis. However, this conclusion seems to be valid for top researchers from the University of Sarajevo. We do not know whether the same patterns of correlations would be valid for researchers who are placed in the middle or bottom of GS list. It would be of interest to examine these patterns not only in relation to researchers' GS rank but also in relation to their gender and academic field. Earlier studies have also found a strong correlation between GS, Scopus, and WoS. In a study by Martín-Martín, Alberto, Enrique Orduna-Malea, Mike Thelwall and Emilio Delgado López-Cózar,[25] the authors found correlations between GS, Scopus, and WoS, to be strong across subjects, and the size of correlation was between .78 and .99, very similar to our findings. In a study by Aghaei Chadegani, Arezoo, Hadi Salehi, Melor Yunus, Hadi Farhadi, Masood Fooladi, Maryam Farhadi and Nader Ale Ebrahim,[26] the authors found strong association between Scopus and WoS. Similarly, Watkins, Marley W. and Christina Y. Chan-Park[27] have found correlations between GS *h*-index and Scopus *h*-index. Although GS, Scopus, and WoS are highly correlated measures, researchers suggest using more than one measure for the reliable assessment of the researcher's impact.[28]

Although many objections to *h*-index have already been raised, such as its dependence on old publications,[29] potential underestimation of accomplishments of certain researchers,[30] and low degree of discrimination of performance,[31] we believe the greatest obstacles in fairly assessing researchers are related to individual article-level metrics. How many authors authored the article? What is the author's position in the paper? Is the author first or corresponding author? We raise this issue as several of these top 100 analyzed researchers are not the first or the corresponding authors of any of the papers listed in their GS profile. The issue of authorship has been widely explored in the scientific literature[32] but the attempts to account for it in scientometrics analysis have been sporadic. One measure that has been proposed is the "z-score", which discourages the inclusion of authors who did not make a significant contribution to the manuscript.[33] Future studies should aim to create better indices of academic performance that will take all these factors into account. It would also be useful to combine various metrics in order to obtain more accurate measure of academic performance. Some authors have proposed machine learning approach for evaluating researchers[34] as such an approach would eliminate subjectivity. We believe that combining data from these three sources (Google Scholar, Scopus, and Web of Science) might provide a basis for creating an algorithm for calculating individual researcher's "science score".

Science is an essential element in the progress of developing nations.[35] Thus, much more incentives on the side of local stakeholders in Bosnia and Herzegovina must be made in order to increase the scientific production. Some of the effective ways to increase the scientific production are through funding novel research and modified tenure system.[36]

This study is not without limitations. The first one is related to the selection of researchers whose GS profiles were identified as "unbalanced profiles" or outliers. They were identified through the distribution of ratio of GS citations to Scopus citations and WoS citations. There were probably other researchers whose profiles were "balanced" but were in some other way incorrect, such as through the number of duplicate publications etc. Another limitation regarding this issue is the arbitrary selection of outliers (though visual inspection). It would be useful to find a more objective measure for determining outliers. Future studies should aim to find other ways of identifying potential errors in GS profiles. Second limitation regards the generalizability of these findings. We do not know whether the same pattern of correlations of GS, Scopus and WoS is present for researchers who are in the middle or bottom of the GS list. Thus, future studies should aim to include random sample of researchers and from different institutions in order to increase the generalizability of the findings. We hope that the findings of this study will be useful for the more objective evaluation of the scientific performance of researchers in Bosnia and Herzegovina.

CONCLUSION

There are numerous things to consider when assessing scholarly impact of the researchers. In this study we showed how citations count can be evaluated and the relationship between GS, Scopus and WoS citations count. We have also showed that it is necessary to perform a more in-depth analysis of the outliers in these citations count as they provide valuable information as well. In addition, in evaluating one's scholarly impact, one must take into the account the academic field of the researcher. In this study we found that the median ratio of GS citations to Scopus citation is 1.92, and the ratio of GS citations to WoS is 2.7. The correlations between GS citations, GS *h*-index, Scopus citations, Scopus *h*-index, WoS citations, and WoS *h*-index were large in size and statistically significant. The analysis of researchers who had unbalanced GS profiles revealed four types of outliers due to: a) incorrect GS profiles; b) academic field; c) error in GS algorithm; and d) discrepancy in citations ratio between GS and Scopus/WoS.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

1. Cadez S, Dimovski V, Zaman Groff M. Research, teaching and performance evaluation in academia: the salience of quality. Studies in Higher Education. 2017;42(8):1455-73.
2. Memisevic H, Taljic I, Hadziomerovic AM. Making use of *h*-index: The shape of science at the University of Sarajevo. Acta Informatica Medica. 2017;25(3):187-90. doi: 10.5455/aim.2017.25.187-190, PMID 29114112.
3. Seglen PO. Why the impact factor of journals should not be used for evaluating research. The BMJ. 1997;314(7079):498-502. doi: 10.1136/bmj.314.7079.497, PMID 9056804.
4. Ruscio J, Seaman F, D'Oriano C, Stremlo E, Mahalchik K. Measuring scholarly impact using modern citation-based indices. Measurement: Interdisciplinary Research and Perspectives. 2012;10(3):123-46. doi: 10.1080/15366367.2012.711147.
5. Fang H. A theoretical model of scientific impact based on citations. Malaysian Journal of Library and Information Science. 2017;20(3):1-13.
6. Hirsch JE. An index to quantify an individual's scientific research output. Proceedings of the National Academy of Sciences of the United States of America. 2005;102(46):16569-72. doi: 10.1073/pnas.0507655102, PMID 16275915.
7. Barnes C. The *h*-index Debate: An Introduction for Librarians. The Journal of Academic Librarianship. 2017;43(6):487-94. doi: 10.1016/j.acalib.2017.08.013.
8. Sharma B, Boet S, Grantcharov T, Shin E, Barrowman NJ, Bould MD. The *h*-index outperforms other bibliometrics in the assessment of research performance in general surgery: A province-wide study. Surgery. 2013;153(4):493-501. doi: 10.1016/j.surg.2012.09.006, PMID 23465942.
9. Alonso S, Cabrerizo FJ, Herrera-Viedma E, Herrera F. *h*-index: A review focused in its variants, computation and standardization for different scientific fields. Journal of Informetrics. 2009;3(4):273-89. doi: 10.1016/j.joi.2009.04.001.
10. Ciaccio EJ, Bhagat G, Lebwohl B, Lewis SK, Ciacci C, Green PH. Comparison of several author indices for gauging academic productivity. Informatics in Medicine Unlocked. 2019;15. doi: 10.1016/j.imu.2019.100166, PMID 100166.
11. Pitsolanti M, Papadopoulou F, Tselios N. A Scientometric evaluation of 50 Greek science and engineering university departments using Google Scholar. Journal of Scientometric Research. 2018;7(1):9-18. doi: 10.5530/jscires.7.1.2.
12. Memisevic H, Pasalic A, Mujkanovic E, Memisevic M. In Search of a Silver Bullet: Evaluating Researchers' Performance in Bosnia and Herzegovina. Journal of Scientometric Research. 2020;8(3):125-30. doi: 10.5530/jscires.8.3.27.
13. Martín-Martín A, Orduña-Malea E, López-Cózar ED. Author-level metrics in the new academic profile platforms: The online behaviour of the bibliometrics community. Journal of Informetrics. 2018;12(2):494-509. doi: 10.1016/j.joi.2018.04.001.
14. Aguillo IF, Ortega JL, Fernández M. Webometric ranking of world universities: introduction, methodology, and future developments. Higher Education in Europe. 2008;33(2-3):233-44. doi: 10.1080/03797720802254031.
15. Halevi G, Moed H, Bar-Ilan J. Suitability of Google Scholar as a source of scientific information and as a source of data for scientific evaluation—review of the Literature. Journal of Informetrics. 2017;11(3):823-34. doi: 10.1016/j.joi.2017.06.005.
16. Harzing AW, Van der Wal R. Google Scholar as a new source for citation analysis. Ethics in Science and Environmental Politics. 2008;8(1):61-73. doi: 10.3354/esep00076.
17. Marusic A, Marusic M. Small scientific journals from small countries: breaking from a vicious circle of inadequacy. Croatian Medical Journal. 1999;40(4):508-14. PMID 10554353.
18. Haddaway NR, Collins AM, Coughlin D, Kirk S. The role of Google Scholar in evidence reviews and its applicability to grey literature searching. PLOS ONE. 2015;10(9):e0138237. doi: 10.1371/journal.pone.0138237, PMID 26379270.
19. Falagas ME, Pitsouni EI, Malietzis GA, Pappas G. Comparison of PubMed, Scopus, Web of Science, and Google Scholar: strengths and weaknesses. The FASEB Journal. 2008;22(2):338-42. doi: 10.1096/fj.07-9492LSF, PMID 17884971.
20. Orduña-Malea E, Martín-Martín A, López-Cózar ED. Google Scholar como una fuente de evaluación científica: una revisión bibliográfica sobre errores de la base de datos. Revista española de documentación científica; 2017;40(4). doi: 10.3989/redc.2017.4.1500.
21. Jensenius FR, Htun M, Samuels DJ, Singer DA, Lawrence A, Chwe M. The benefits and pitfalls of Google Scholar. Political Science and Politics. 2018;51(4):820-4. doi: 10.1017/S104909651800094X.
22. Doğan G, Şencan İ, Tonta Y. Does dirty data affect google scholar citations?. Proceedings of the Association for Information Science and Technology. 2016;53(1):1-4. doi: 10.1002/pra2.2016.14505301098.
23. Patel VM, Ashrafian H, Bornmann L, Mutz R, Makanjuola J, Skapinakis P, Darzi A, Athanasiou T. Enhancing the h index for the objective assessment of healthcare researcher performance and impact. Journal of the Royal Society of Medicine. 2013;106(1):19-29. doi: 10.1258/jrsm.2012.120253, PMID 23358276.
24. Saleh A, Cao F, Selek S. Comparison of h and m indices among departments in McGovern Medical Collage. Journal of Scientometric Research. 2020;9(1):77-81. doi: 10.5530/jscires.9.1.9.
25. Martín-Martín A, Orduna-Malea E, Thelwall M, López-Cózar ED. Google Scholar, Web of Science, and Scopus: A systematic comparison of citations in 252 subject categories. Journal of Informetrics. 2018;12(4):1160-77. doi: 10.1016/j.joi.2018.09.002.
26. Aghaei Chadegani A, Salehi H, Yunus M, Farhadi H, Fooladi M, Farhadi M, Ale Ebrahim N. A comparison between two main academic literature collections: Web of Science and Scopus databases. Asian social science. 2013;9(5):18-26. doi: 10.5539/ass.v9n5p18.
27. Watkins MW, Chan-Park CY. The research impact of school psychology faculty. Journal of School Psychology. 2015;53(3):231-41. doi: 10.1016/j.jsp.2015.03.003, PMID 26054816.
28. De Groote SL, Raszewski R. Coverage of Google Scholar, Scopus, and Web of Science: A case study of the *h*-index in nursing. Nursing Outlook. 2012;60(6):391-400. doi: 10.1016/j.outlook.2012.04.007, PMID 22748758.
29. Schreiber M. A variant of the *h*-index to measure recent performance. Journal of the Association for Information Science and Technology. 2015;66(11):2373-80. doi: 10.1002/asi.23438.
30. Costas R, Bordons M. The *h*-index: Advantages, limitations and its relation with other bibliometric indicators at the micro level. Journal of Informetrics. 2007;1(3):193-203. doi: 10.1016/j.joi.2007.02.001.
31. Ding J, Liu C, Kandonga GA. Exploring the limitations of the *h*-index and *h*-type indexes in measuring the research performance of authors. Scientometrics. 2020;122(3):1303-22. doi: 10.1007/s11192-020-03364-1.
32. Gaeta TJ. 'Authorship: "Law' and order. Academic Emergency Medicine. 1999;6(4):297-301. doi: 10.1111/j.1553-2712.1999.tb00393.x, PMID 10230981.
33. Zerem E. The ranking of scientists based on scientific publications assessment. Journal of Biomedical Informatics. 2017;75:107-9. doi: 10.1016/j.jbi.2017.10.007, PMID 29031596.
34. Rokach L, Kalech M, Blank I, Stern R. Who is going to win the next Association for the Advancement of Artificial Intelligence Fellowship Award? Evaluating researchers by mining bibliographic data. Journal of the American Society for Information Science and Technology. 2011;62(12):2456-70. doi: 10.1002/asi.21638.
35. Salager-Meyer F. Scientific publishing in developing countries: Challenges for the future. Journal of English for Academic Purposes. 2008;7(2):121-32. doi: 10.1016/j.jeap.2008.03.009.
36. Shu F, Quan W, Chen B, Qiu J, Sugimoto CR, Larivière V. The role of Web of Science publications in China's tenure system. Scientometrics. 2020;122(3):1683-95. doi: 10.1007/s11192-019-03339-x.