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# A novel Hj-index based model to assess the researchers using scopus database

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**ABSTRACT**

There are many factors that can influence the impact and influence of research, including the quality and originality of the research, relevance and importance of the research, clarity and effectiveness of the research communication, placement of the research in high-impact journals, collaboration and networking, and timing of the research. Identifying active genuine researcher is a sub problem of raising stars in a research area. This problem was addressed by enhancing H-index in Scopus database. Researchers should consider these factors when conducting and communicating their research to maximize its impact and influence. Additionally, there are several metrics used to evaluate the impact and influence of journals and researchers such as H-index, SNIP, CiteScore, and SJR. These metrics take into account different aspects of productivity and impact, and can provide a more comprehensive view of a journal or researcher's influence within their field. In addition to the above metrics, Hj-index was proposed and compared with the H-index to find active genuine researcher in a group.



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## 1. INTRODUCTION

Scopus is a sizable collection of research articles and online sources with abstracts and citations. Elsevier owns it, and researchers, institutions, and other organisations use it to monitor, assess, and gauge the effect of their work. The metrics offered by Scopus may be used to assess the significance and effect of a researcher's work, including. Citation count: The quantity of times other researchers has referenced a certain author's work. The number of citations a researcher's articles have gotten is used to determine their H-index, which is a measurement of their productivity and influence. The H-index of a researcher is the integer h such that each of their h articles has gotten at least h citations. SCImago Journal Rank (SJR): A measurement of a journal's relative prominence within a field based on the amount of citations its publications have gotten and the stature of the journals citing them. Source Normalized Influence per Paper (SNIP) [1] is a measurement of a journal's impact that normalises the number of citations received by the journal's publications as well as the impact of the journals that reference them. CiteScore: An indicator of the typical number of citations per journal-published article. These are just a few examples of the metrics that Scopus offers. Other measures include the quantity of papers published, the amount of citations an author's articles have gotten, and the impact factor of the journals that have published the papers of the researcher. These metrics may be used to compare the effectiveness of various researchers or journals, as well as to assess the productivity and influence of a researcher's work. Scientific journals, conference proceedings, and other types of peer-reviewed

literature may be found in the abstract and citation database Scopus. It is one of the biggest databases that includes numerous academics' works. We can easily locate reputable studies, locate experts, and access trustworthy data, measurements, and analytical tools with the use of just one database. Professors, lecturers, and even students may use this database to do research and get a sense of the quality of the publishers' output. Each author has a set of metrics for assessing their publications, and each of their articles also has specific Scopus features or scores that give us a sense of the quality of the authors' work. It might take a while to manually access all of this data and compare it. The goal is to use Python web scraping [2] and Selenium automation to automate the process of accessing the database and getting the metrics and characteristics. In addition to the metrics listed above, Scopus also provides a number of tools and features for analyzing and visualizing research data. These tools can be used to track the research output of individuals, institutions, or entire research fields. Some examples include:Analyze Results: A tool for visualizing and comparing research data, including citation counts, H-index, and other metrics. Collaboration Map: A tool for visualizing the collaboration networks of researchers and institutions [3]. Author Identifier: A tool for identifying and disambiguating researchers based on their publication record. Journal Analyzer: A tool for analyzing the performance and impact of journals, including citation counts, SJR, SNIP, and other metrics [4]. Institution Identifier: A tool for identifying and disambiguating research institutions based on their publication record. These are just a few examples of the tools and features provided by Scopus [5]. Other features include the ability to search for and access research papers, create alerts to track new research in specific fields, and export data for further analysis [6].

- Problem statement: The paper addresses the challenge of accurately evaluating researchers' impact and influence, specifically focusing on identifying active genuine researchers as a sub-problem of identifying rising stars in a research area [7]. It also identify active genuine researchers as a sub-problem of identifying rising stars in a research area. It addresses the challenge of evaluating researchers' impact and influence accurately, considering factors like research quality, communication effectiveness, journal placement, collaboration, and timing.
- H-index and SNIP: The H-index is a statistic used to quantify the productivity and influence of a scholar's or researcher's published work. It was established by Jorge E. Hirsch in 2005 as a quantitative method for comparing the production and effect of researchers [8]. The H-index is determined by the number of citations obtained by a researcher's papers. In particular, the H-index of a researcher is the number h such that h of their publications have gotten at least h citations each.
- Cite Score and SJR [9]: CiteScore is a statistic supplied by the Scopus database that measures the average number of citations a journal got per article in a given year. It is computed by dividing the number of citations a journal got in a particular year by the number of articles it published in the preceding three years. CiteScore is meant to provide a more thorough indicator of a journal's effect than the Impact Factor, which only considers citations to papers published within the last two years.

## 2. LITERATURE REVIEW

It was helpful to learn how web scraping works and what the various tools available are in Vidhi Singrodia, Anirban Mitra, and Subrata Paul's research paper on the topic, "Web Scraping and its applications [10]." We also utilised the article "Data Analysis by Online Scraping using Python" by Prof. Usha Nandwani, Mr. Ritesh Mishra, Mr. Amol Patil, and Mr. Wasimudin Siddiqui to understand how Python can be used effectively for web scraping and to see a comparison analysis of other renowned publications in this area. The book "Web Scraping with Python and Selenium" by Sarah Fatima, Shaik Luqmaan, and Nuha Abdul Rasheed was the most helpful to us since it explained the process of web scraping and how automation works [11]. Because it was the most pertinent to our research and provided us with a wealth of insights, this paper was the one that was most helpful to us. Anjali Khute, Yash Roy, Yamita, and Yashmeen Xalxo's article "Dynamic Web Scraping Using Python" largely discussed the major terms used in web scraping, such as Beautiful Soup, Selenium, and Python. It also discussed the basic setup, including the libraries that must be installed and the project's environment configuration. In "Web Information Retrieval Using Python and BeautifulSoup," Pratiksha Ashiwal, S.R. Tandan, Priyanka Tripathi, and Rohit Miri discussed how BeautifulSoup functions specifically, how to instal and run it on Python, and how information retrieval is made possible by web scraping using Beautiful Soup. It is a relatively recent endeavour to measure a researcher's or an institution's research productivity [12] and effect using metrics like the H-index, G-index, E-index [13], S-index [14], and M-index [15]. When the performance is evaluated using more than 30 million citations and 2 million pages, it gets more challenging. Another issue is that document or citation numbers are less significant than author reputations at their specific institutions. The following difficulties arise when estimating intellect in this circumstance: Can the citation be measured in terms of time? Can the publications and citations of any institute's papers during the length of the specified time period be used to evaluate the consistency, inconsistency, and uncertainty of that institute? Can the unpredictability of the citation be measured? Does a low H-index, and vice versa, inevitably indicate high-quality research? The H-index may

be used to evaluate an author's or an organization's contribution to research. But as demonstrated by Costas and Bordons, the H-index is inadequate in a number of situations, including those involving lots of co-authors, journal-journal citations, conference-conference citations, and vice versa (2007).

Comparing several research papers on author impact evaluation using different metrics and methods is shown in Table 1. Each row in the table provides a summary of one research study's specifics, including the author, year the paper was published, methodology/algorithm utilised, data set, factors taken into consideration [16], and benefits and drawbacks of the methodology. The articles discuss a variety of measures, including factor analysis, the Google page rank algorithm, the g-Index, performance indicator p, H-index, h/h, P-index, and T-index. The data sets used include simulated situation, Web of Science, Physical Review family papers, and Scopus bibliographic data. The table discusses the benefits and drawbacks of the various techniques.

## 3. PROPOSED HJ-INDEX MODEL

There are many factors that can influence the impact and influence of research. Some of the most important factors include: Quality and originality of the research [17]: Research that is well-conducted and makes a significant contribution to its field is more likely to be cited and have a greater impact. Relevance and importance of the research: Research that addresses important or timely issues is more likely to be widely read and cited. Clarity and effectiveness of the research communication: Research that is clearly and effectively communicated is more likely to be understood and cited by other researchers. Placement of the research in high-impact journals: Research that is published in high-impact journals is more.

The Table 2 provides information about the symbols used in a proposed model for calculating the Hj-index of individuals in an organization as shown in Figure 1. The process described in the input-output is a method for determining the Hj-index of researchers associated with a department or university. Figure 2 describes the flow chart of our model, step-by-step the process is as follows: The symbols and their meanings are shown in Table 2.

The primary goal is to determine each author's J-index, even if we were able to extract all the information in the author page and even the SNIP score of one of their papers. By adding the SNIP scores of each author's most recent ten publications, the J-index of each author can be determined. This requires an automated process that copies the text of inactive links, pastes it in the sources page, locates the link in the results list, clicks on it, and then retrieves the SNIP score. In addition, we may broaden the project's scope by doing research on other authors and automating the retrieval of more metrics that can be used for in-depth investigation. Hj-index=SOCPUS id( $\sum$ i(Jsnip)) Where i ranges from 1 to 10. Detail flow chart and steps for implementation was explained in Algorithm 1 and Figure 2.

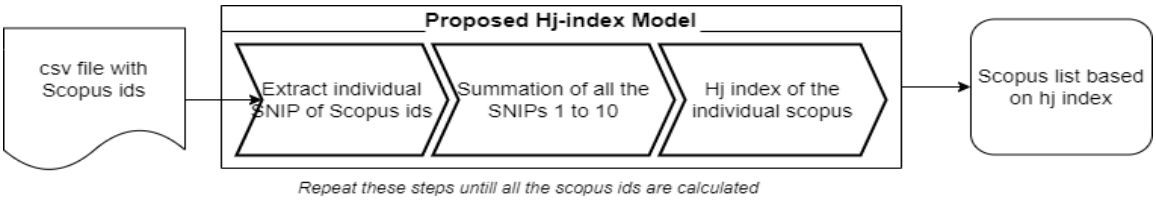


Figure 1. Proposed Hj-index model and its architecture

Algorithm 1. Proposed algorithm

```
Input: Scopus id's in CSV file
Output: Scopus id's sorted in descending order based on Hj index.
Step1: Start
Step2: Identify the list of SCOPUS id's of a Department or University.
Step3: Upload SCOPUS id's in the form of CSV file.
Step4: n=length(List in CSV file)
Step5: for individual SCOPUS id's do
              1 <=i<=n
              Redirect to there respective SCOPUS home page.
                     for every SCOPUS id's do
                           1 <=j<=10
                           Check latest i = 1 to 10 journal
                           extract there SNIP scores of these journals.
                           Hj index score= SNIP(j)+SNIP(j+1)
Step6: For every SCOPUS id, respective Hj index score will be generated.
```

***Step7:*** *Represent SCOPUS id's in descending order to find the best researcher.*
***Step8:*** *Stop*

Table 1. Comparison of researchers with basic components

| Paper id | Author Name | Year | Methodology/ Algorithm | Data set | Parameters | Advantages | Disadvantages |
|---|---|---|---|---|---|---|---|
| [18] | Egghe | 2006 | g-Index | Two authors | TC, RANK (r), r2,∑TC | It represents the rank as g index | The new g-index will be investigated further and applied in real-world evaluations. |
| [19] | Gupta | 2010 | performance indicator p and the citation parameter (C), a metric of quality. | 50 universities Scopus bibliographic data | P,C,C/P,TICP, H-Index | 'nodality' of each University | New methodology parameters can measure more than this accuracy |
| [20] | Hirsch | 2019 | h/hα | Web of Science for the bibliometric data | H index, hα, rα =h/hα, publications, m=h/years | Scientific leadership in group | Even Junior scientists in leading in group but their rα may be less, h index may increase by time also |
| [21] | Senanay ake *et al.* | 2014 | P- Index using 3 simulated scenarios | Authors ids, Papers ids | $A_{i,j}$ , $k_{out(j)}$, α | The p-index is significantly more equitable and recognises both individual genius and paper quality. | It did not compute the p-index using the actual citation network and compare it to the authors' temporal H-index values. |
| [22] | Singh | 2022 | t-Index using Shannon entropy and annual mean H-index | Scopus data in computer science domain | T, $P(C_i)$, $C_i$, $C_t$, $h_y$, $h_i$ | claims to compare scientists of various scenarios fairly. | Proposed method cannot find the innovator of an idea in a group of authors when the paper is published by them. |
| [23] | Singhorcid | 2022 | hybridization of time-based h-index and the Shannon entropy T-index | Scopus data | T, $P(C_i)$, $C_i$, $C_t$, $h_y$, $h_i$ | In document publications and citations, it measures randomness and uncertainty. | The introduction of a new method to be used for a thorough evaluation of any author institute's performance using the Scopus data set. |
| [24] | Thelwall | 2019 | six-section structure used | dataset (2,177,956 documents from 8525 journals) | Introduction, Background, Methods, Discussion, Results and Conclusion | Research that has examined various citation categories or recorded the number of citations per section is covered in this section. | It seems that no one has ever discussed the purpose of this document. |
| [25] | Fazel *et al.* | 2024 | Dot estimation task to prime social hierarchy followed by Go/Nogo task with social rank stimuli. EEG recorded during tasks. | 43students (22 males, 21 females) with a mean age of 26.8 years (SD=4.08) | Behavioral: Reaction time, response accuracy. Electrophysiol ogical: N200 and P300 event-related potentials. | Controlled experimental design. - Clear distinction between high, middle, and low social ranks. | Limited generalizability to real-life social hierarchies. - Small sample size. |

Table 2. Notations in proposed model

| Symbol | Meaning |
|---|---|
| SCOPUS id | SCOPUS identification number |
| N | Total number of SCOPUS identification numbes |
| I | Scopus id of 1to n |
| J | Latest published Journalfrom 1 to 10 |
| ∑ | Sumation of latest 10 journals |
| Jsnip | Individual journal SNIP value |
| Hj-index | Individual SOCUPS id Score |

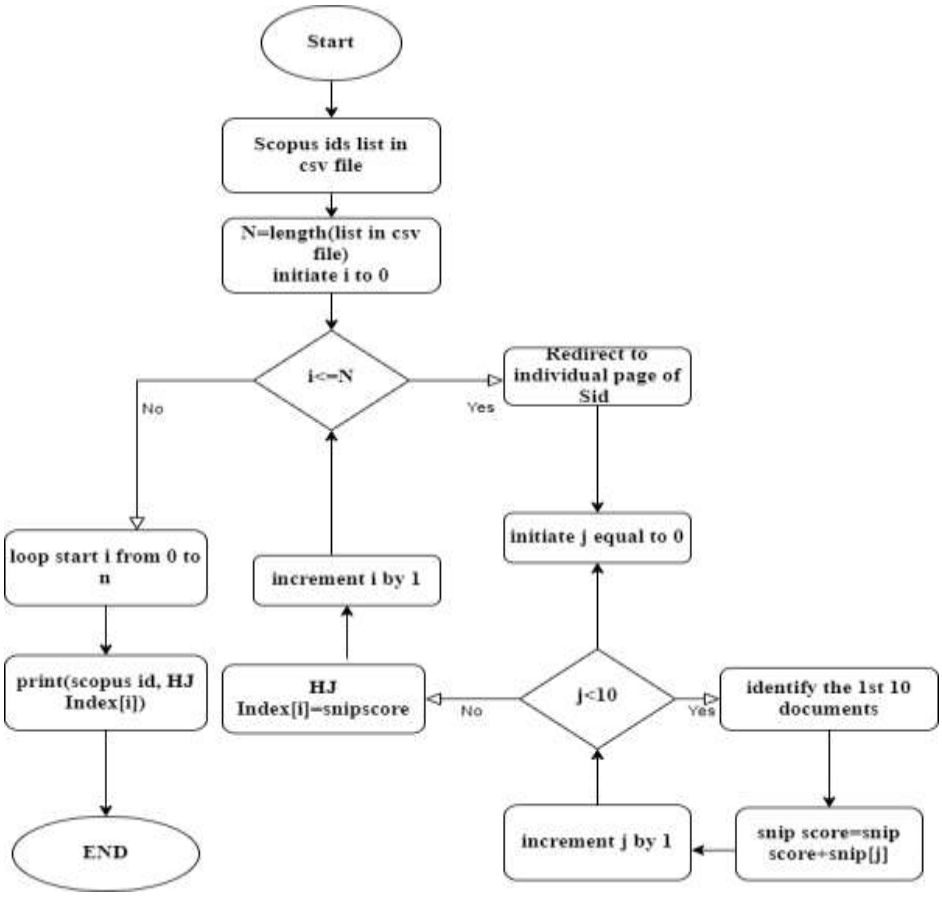


Figure 2. Flow of proposed Hj-index model

## 4. RESULTS AND DISCUSSION

Using Scopus data to find the best researcher in an organization or institute is a good way to evaluate their productivity and impact. However, it is important to note that the H-index can be manipulated by increasing self-citations. A better metric to use is the Hj-index, which takes into account the SNIP score of a researcher latest 10 publications. This metric is based on the journal quality and specific subject field and cannot be manipulated. Comparing the H-index and Hj-index can reveal variations and provide a more accurate representation of a researcher's capacity and impact.

Results achieved:

a) The comparative analysis between the traditional H-index and the proposed Hj-index revealed that the Hj-index provides a more comprehensive assessment of researchers' impact and influence by considering both recent publications and journal impact factors.
b) Previous methods primarily relied on traditional metrics like the H-index, SNIP, CiteScore, and SJR to evaluate researchers' impact, but these metrics had limitations in capturing the full extent of a researcher's influence.
c) The introduction of the Hj-index as a novel metric represents a significant advancement in accurately assessing researchers' impact, particularly in identifying active genuine researchers within a specific research area.

When arranging the researchers in descending order based on the Hj-index, the researcher who is top based on H-index may move to the middle of the Table 3. This demonstrates the significance of employing the Hj-index in addition to the H-index to proclaim a researcher's ability. Scopus IDs (unique identifiers for academic papers in the Scopus database) are included in the Table 3, along with metrics such as the number of documents, citations, H-index, and Hj-index for each Scopus ID. The H-index is a statistic that seeks to assess the productivity and influence of a researcher's articles by combining the number of publications and the number of citations they have earned. Calculated by ordering a researcher's papers in decreasing order of the number of citations they have received, and determining the H-index as the greatest number of articles with at least h citations each.

Table 3. Comparison of researchers with basic components

| S.no | Scopus id | Documents | Citation | H-index | Hj-index | Collabaration (in%) | Docs in top citation percentile (In%) | Documents in top 25% Journals by (in %) | FWCI |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 5553270**** | 43 | 408 | 11 | 27 | 40.6 | 40.6 | 71.4 | 1.16 |
| 2 | 5720922**** | 10 | 264 | 7 | 27 | Nill | 87.5 | 100 | 1.91 |
| 3 | 5558358**** | 64 | 699 | 14 | 25 | 35.8 | 22.6 | 47.2 | 1.22 |
| 4 | 5720317**** | 27 | 510 | 9 | 14 | 16.7 | 66.7 | 36.4 | 2.30 |
| 5 | 5720862**** | 12 | 36 | 5 | 11 | 80 | Nill | 40 | 0.90 |
| 6 | 5721175**** | 91 | 897 | 15 | 11 | Nill | 45 | 61.5 | 2 |
| 7 | 5607975**** | 52 | 490 | 13 | 11 | 70 | 40 | 28.6 | 1.52 |
| 8 | 5720916**** | 26 | 468 | 9 | 10 | 13 | 39.1 | 47.4 | 1.31 |
| 9 | 5720009**** | 46 | 1018 | 17 | 10 | 62.5 | 71.9 | 22.2 | 4.8 |
| 10 | 700334**** | 207 | 6511 | 44 | 9 | 25 | 25 | 75 | 0.38 |
| 11 | 650694**** | 34 | 94 | 6 | 3 | Nill | 4.3 | Nill | 0.50 |
| 12 | 5721695**** | 6 | 20 | 3 | 3 | Nill | 33.3 | Nill | 0.5 |
| 13 | 5720328**** | 8 | 17 | 3 | 3 | Nill | Nill | 33.3 | 0.85 |
| 14 | 5722314**** | 35 | 796 | 19 | 2 | Nill | 96.7 | Nill | 12.83 |
| 15 | 5719093**** | 26 | 159 | 9 | 2 | 9.1 | 22.7 | 6.3 | 1.18 |

Comparing researchers based on their Hj-index and H-index, Researcher 5553270****, with a top Hj-index, showcases substantial collaborative impact, as indicated by a high Hj-index (27), moderate H-index (9), and significant collaboration percentage (40.6%). Despite a slightly lower individual productivity reflected in the H-index, their work is highly cited (226), with a considerable portion in the top citation percentile (40.6%) and prestigious journals by (71.4%). On the other hand, Researcher 700334****, with a top h-index, demonstrates substantial individual impact (H-index: 44), albeit with a lower Hj-index (11) indicating collaborative impact. Although their citation count is high (6511) and a significant portion of their work is in the top citation percentile (25%), fewer documents are in top journals by (75%). This comparison suggests that while the H-index may emphasize individual productivity, the Hj-index provides a more comprehensive assessment of researcher quality it can be observed by comparing with other collaboration and additional quality metrics, making it better suited for identifying the best quality researcher. The Hj-index can be a helpful alternative to the H-index, as it considers both the quantity and quality of a researcher's publications. By incorporating the SNIP score of the journals, a researcher has published, the Hj-index provides a more nuanced view of their impact and can help mitigate the potential for self-citation manipulation. However, it's worth noting that the SNIP score is just one metric for assessing the quality of journals, and there may be other factors that should be considered as well. While the Hj-index can provide a more accurate picture of a researcher's impact, there may be better metrics for some fields or subfields. Researchers should carefully consider the strengths and limitations of different metrics when evaluating their work and that of others. However, it's important to remember that metrics are just one tool for assessing research impact and should be used in conjunction with other qualitative and quantitative assessments. Figure 3 compares the H-index and Hj-index, two bibliometric indexes used to evaluate the productivity and impact of researchers. As you mentioned, the H-index considers both the number of publications published and the number of citations received. At the same time, the Hj-index also finds the number of years since the articles were published and the SNIP score of a researcher latest ten publications. Comparing the two indices can provide insights into the strengths and limitations of each metric, as well as their utility for evaluating a researcher's impact.

The results of Figure 3 may suggest that the Hj-index provides a more thorough or accurate representation of a researcher's influence than the H-index, or it may indicate that the two indices have different strengths and limitations and should be used in tandem for a more comprehensive assessment of a researcher's impact. However, the comparison of bibliometric indices like the H-index and Hj-index can be a valuable tool for evaluating the productivity and impact of researchers. Still, it is important to use these metrics in a thoughtful and nuanced way and to consider additional factors like the quality and originality of a researcher's work, their collaborations, and their broader impact on their field. The Hj-index is an extension of H-index which takes into account the number of citations received by an author’s top-j publications and the number of publications that received at least j citations. The table provided lists several Scopus IDs along with their corresponding H-index and Hj-index values. The H-index is a measure of a researcher's productivity and influence, calculated by the number of articles that have received at least that many citations. The Hj-index is a similar measure, but takes into account the number of citations received by an author's top-j publications and the number of publications that received at least j citations. By comparing the H-index and Hj-index values for each researcher, it is possible to get a sense of the researcher's productivity and influence in their field. However, it is important to note that these metrics are not perfect and have limitations and potential biases.

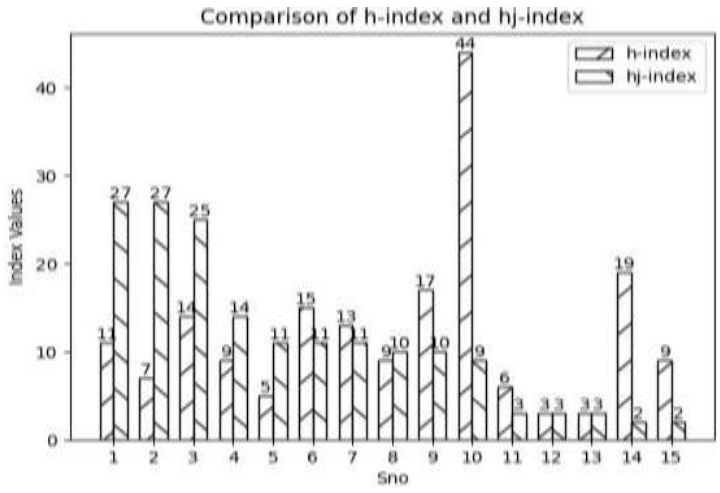


Figure 3. Comparative analysis of h index and Hj index of different Scopus ids

## 5. CONCLUSION

Scopus is a valuable resource for scholarly research as it contains a large number of academic works and allows users to easily locate reputable studies, locate experts, and access trustworthy data. Using Python web scraping and Selenium automation can automate the process of accessing the database and getting the metrics and characteristics for each author. The Hj-index is a useful metric to rank researchers as it takes into account the number of citations received by an author's top publications and the number of publications that received at least j citations. This is less prone to manipulation than H-index. Additionally, comparing the H-index and Hj-index can reveal variations and can provide a more accurate representation of a researcher's capacity and impact. When evaluating researchers' quality, the Hj-index proves to be a more comprehensive metric compared to the H-index alone. This is evidenced by the case of Researcher 5553270****, who despite a slightly lower H-index, demonstrates substantial collaborative impact and produces highly cited work published in prestigious journals. While the H-index emphasizes individual productivity, the Hj-index accounts for collaboration and additional quality metrics such as citation counts and journal prestige, providing a more nuanced assessment of researcher impact. Thus, in today's collaborative research landscape, the Hj-index emerges as a valuable tool for identifying the best quality researchers.

## 6. FUTURE WORK

In the future, utilizing machine learning techniques can improve author assessment by analyzing diverse metrics such as journal quality, citation analysis, and more. These techniques can develop models that consider traditional metrics alongside factors like author collaboration, publication trends, and citation context. This holistic approach offers a nuanced evaluation of author quality. Additionally, machine learning can enable predictive models for forecasting future trends and identifying emerging research leaders, revolutionizing academic author assessment.

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