

Faculty Members' Performance Appraisal System: A Bibliometric Analysis of the Scientific Literature

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Abstract

Deciding upon faculty members' promotion or tenure is one of the most important tasks in higher education, and it has piqued the interest of researchers from different fields. This has led to an increased number of deep studies in recent years and resulted in an increasing publication growth rate. So, it seems essential that a comprehensive analytical study be done in this field with a bibliometrics approach aiming to identify research trends and patterns in the field of faculty members' appraisal systems. The Web of Science was utilized for data collection through a search process on August 2, 2022, in which terms related to promotion, evaluation, and faculty members were searched in the topic section of all databases. By identifying research evolution (word and thematic evolution), core journals (Scientometrics), active countries (USA, United Kingdom, and China), types of research collaboration, and leading institutions in this field, policymakers can gain insights into the current state of research in this area and make informed decisions about future directions for faculty evaluations. Policymakers can use the study's findings to identify which institutions are leading the way in faculty appraisal research and collaborate with them to share best practices. Thematic mapping also allows for the identification of emerging research areas and helps researchers develop effective research strategies. Overall, this study's findings can help universities and policymakers develop more evidence-based and effective faculty member evaluation policies that promote academic excellence and contribute to the overall success of higher education institutions.

Keywords: Appraisal System, Promotion, Tenure, Faculty Members, Scientific Productions.

Introduction

One of the most important decisions in higher education, which is important for faculty members and higher education institutes, is the decision over their promotion and tenure. Getting tenure is the most important achievement in faculty members' professional careers since it brings not only job and financial security but also academic freedom (Cogburn & Neely, 2015). Sibbald and Handford (2020) stated that faculty members' tenure process can be divided into different levels, including eligibility, relationship, and independence. Advancement at any level of this process enables us to view faculty members' roles from

different perspectives. An effective appraisal system seems essential to accurately deciding in this field. Despite the significance of the evaluation, the main issue regarding the faculty member's tenure and promotion system is the difference that can be seen in higher education institutions with various education and research functions, which may happen not only in different places and institutions but also in institutions with different missions and objectives. Additionally, the difference in scientific fields and subfields may make a difference in faculty members' appraisal systems. As a result, this system cannot be evaluated with the same indicators.

Employing quantitative indicators for faculty members' performance evaluation has drawn criticism from experts in the field. However, evaluation based on measurable quantities minimizes the effect of groups and personal prejudice. It also limits deep evaluation of the content and performance. Different countries measure the impact of research in various ways. The quality of research, particularly the scientific impact of academic institutions, funding agencies, and other parties, has been evaluated by several methods. The main metrics used for the evaluation of the scientific output include citation analysis, which sometimes presents readership statistics. There are advantages and disadvantages for every measure used for scholarly output evaluation (Moed, 2005; Priem & Hemminger, 2010; Schloegl & Gorraiz, 2011; Mohammadi & Thelwall, 2014; Lavorgna, Ugwudike & Vianello (2023). Some indicators, such as journal-based indicators measuring research quality, have been criticized by world scholars (Xu, Oancea & Rose, 2021).

Evaluation is necessary in every research field, and it demonstrates how well academic research is done. Putting research on a comparative ranking may lead to academic progress. It may also encourage countries to compete globally in terms of research. In the era of the knowledge economy, knowledge is the driving force behind economic growth and is a crucial factor in national progression. In this era, the evaluation of research gets more prominent. Research assessment can be used to track changes in a country's research accomplishments.

Moreover, research evaluation gives direction to policymaking. It also leads to more quality research (Huang & Chang 2008). Through research and the publication of research papers, universities may be crucial in both the development and dissemination of new information (Liang, Gu & Nyland, 2022; Lin, 2023). In the academic context, an attempt has been made to increase the number of research outputs, specifically international ones. This rise in international research has caused growth in academic knowledge. National policies and institutional rules inspire international research ideas and their evaluation of research. Paper counts and impact factors are two indicators used by colleges around the world to track research progress. These indicators are mostly employed for their ease of use and their objectivity, igniting debate in academia and the general public (Chou, 2014, Xu et al., 2021).

Researchers from different fields and from across the world examine the challenges facing research evaluation and faculty members' appraisal systems from different aspects. They also emphasized various levels in the process of faculty members' promotion evaluation and quantitative evaluation of scientific output at a macro level (international level) by employing different Scientometrics indicators. As a result, different aspects of scientific and research performance in faculty members' promotion appraisal system, as well as strengths and weaknesses, are revealed, paving a clear way for decision-making and policymaking in the field. In all, the current comprehensive, longitudinal, and up-to-date bibliometrics study is based on a wide research sample that aims to determine the research patterns and trends concerning

faculty members' appraisal systems. The current analysis Specifically addresses these questions:

- What is the current state of the world's scientific productions in the field of faculty members' appraisal system between 1982 and 2021?
- What is the current state of the journals concerning the field of faculty members' appraisal system according to Bradford's law?
- What is the state of the country's international collaboration based on corresponding authors in the field of faculty members' appraisal system?

Literature Review

The review of previous studies shows that faculty members' performance appraisal system has been investigated through different points of view, which include educational assessment, teaching and research, educational performance, performance evaluation, professors' performance evaluation, evaluation of research productivity, research evaluation criteria, criteria for faculty members' promotion, research performance in humanities, pathology of faculty members' promotion guidelines, evaluation of scientific productions in humanities, evaluating humanities research effectiveness, and Scientometrics indexes in humanities. Although there is a focus on the humanities, these views may also apply to engineering and other fields as well. The existing literature on faculty members' appraisal systems can be categorized into three groups, which will be discussed in this study. These groups are "The pathology of faculty members appraisal systems", "Faculty members' evaluation indicators" and "Evaluating the productivity of education and research in humanities" which will be explained.

The Pathology of Faculty Members' Appraisal Systems

Results of Zhang's qualitative research done in one of China's Universities show that national policies have a significant impact on the promotion criterion. He explains that the focus of promotion criteria should be shifted to teamwork in the faculty rather than teaching. Research criteria should try to incorporate practical knowledge so that content evaluation and the quality of research productions get more prominent in research evaluation. Aslam (2011) investigated issues and challenges facing professors' performance evaluations and concluded that their evaluation method is outdated and unacceptable. Evaluating professors' performance based on quantitative criteria and the number of their papers does not seem to be effective. The author highlights that while performance evaluation is a crucial aspect of academic governance, it is often a contentious issue due to the subjective nature of teaching and the lack of clear evaluation criteria. Examining the requirements for faculty members' promotion in the fields of civil engineering in US universities, Tymvios and Hildreth (2015) found through a survey distributed to faculty members at various universities in the United States that promotion rules (the existing and expected rules) differ according to the type of institution. The authors identified several key factors that were perceived as important for tenure, including research productivity, teaching effectiveness, and service contributions. Civil engineering faculty members believed that in addition to the great emphasis on educational criteria, publishing articles in credible journals, A limited research budget, and low-level students may all act as barriers to taking the position. Klein and Falk-Krzesinski (2017) investigated promotion and tenure policies in interdisciplinary and collaborative work and stated that interdisciplinary and collaborative work

is essential for transformation in the educational system in the twenty-first century. However, there are issues with administrative procedures, financial calculations, and disciplinary cultures in research and instruction. To promote and perpetuate multidisciplinary and collaborative work, their research synthesizes literature and models for practices and policies that recognize interdisciplinary and collaborative work in the promotion and tenure (P&T) process.

The research paper by Kiely, Brennan and Hayes (2019) explores the relationship between senior academic promotions and faculty research metrics in the context of measuring research output in universities. The study uses data from a large Irish university to analyze the correlation between promotion decisions and various research metrics, such as publication output, citation counts, and grant funding. The authors also examine the role of other factors, such as teaching and administrative duties, in promotion decisions. The results of the study suggest that research output is a significant factor in promotion decisions but that other factors should also be considered. The authors argue that a holistic approach to promotion decisions is necessary to ensure fairness and transparency and that universities should develop clear guidelines for evaluating faculty performance that take into account both research output and other important factors. Overall, the study provides valuable insights into the complex process of measuring research output in universities and highlights the need for a more nuanced approach to promotion decisions. They believe that professors' evaluation indicators should be constantly changed, and the art and humanities, as well as engineering fields, should be evaluated with different criteria. Gazerani, Dehnoalian, Gharahzadeh & Tatari (2020), who critically examined the models of faculty members' appraisal systems, believe that indicators used for professors' evaluation are not comprehensive and appropriate. Universities should revise their approaches and performance evaluation techniques. Information sources required for faculty members' performance evaluation should be precise. Also, first-hand information about the members' performance should be provided.

One of the successful models for faculty members' performance evaluation is the Minnesota model. Recent studies such as Azimi Nezhad et al. (2020) have thoroughly analyzed faculty members' promotion policies. In terms of academic policies for faculty members' promotion, educational criteria include employing up-to-date teaching techniques and material, research-based teaching, and understanding teaching and learning concepts in relevant specialized disciplines. In addition to professional qualifications, teaching skills, and scientific research, faculty members should be evaluated according to ethics and their personalities, including discipline, compassion, proper manners, job commitment, and attention to their profession.

Faculty Members' Evaluation Indicators

Elena and Leona (2015) presented a tool for the optimization of faculty members' evaluation methods. This tool considers the scientific power index, teaching quality, professor-student interaction, behavioral attributes, providing up-to-date information, professional ethics, and scientific and research productivity. Cabrera, Roy and Chisolm (2018) believe that with the emergence of social networks and the publication of knowledge and information on these networks, digital tools have enabled a rapid and powerful distribution of data and interaction with users and communities, making access to knowledge possible in universities and among the general public. They considered that one of the most difficult issues in evaluating scientific outputs is determining their quality and effectiveness, which may be time-consuming and easily

manipulated if done using traditional indicators. Thus, altimetric can act as an alternative indicator to overcome this deficiency. Promotion committees should develop a clear framework for using alternative indicators. They stated that although these indicators may not be readily accepted, journal publications and academics admit to the importance of these indicators in the fast and accurate evaluation of research effectiveness.

Similarly, Rice, Raffoul, Ioannidis and Moher (2020) noted that researchers' evaluation based on traditional indicators (e.g., number of publications) may not support quality research and open science. Hence, non-traditional indicators should be considered in the evaluation process. The authors analyzed data from 118 universities in 34 countries, representing over 1,600 faculty members. The study found that research output, including publications and grants, was the most commonly cited criterion for promotion and tenure, followed by teaching and service activities. However, there were significant variations in the weighting given to these criteria across different institutions and countries. The authors also noted that there was a lack of consistency in the definitions and thresholds used for these criteria, which could lead to inequities and inconsistencies in promotion and tenure decisions. Overall, this study highlights the need for greater transparency and standardization in academic promotion and tenure processes, particularly in light of increasing global competition for academic positions.

Evaluating the Productivity of Education and Research in Humanities

Researchers such as Hicks (2004) and Nederhof (2006) studied the differences in humanities and other fields of science as well as the ineffectiveness of traditional and quantitative indicators in research evaluation. Later, researchers analyzed various indicators for the evaluation of humanities and social sciences and suggested alternative indicators. Sivertsen and Larsen (2012) found that the publication pattern in the humanities is more incongruous and heterogeneous compared to other fields of science. In some fields, books (monographs or papers in edited books) may be more important than papers. Citation indicators cannot be applied to social sciences and humanities since a notable part of scientific productions of these fields are not published in international journals but rather in book chapters or monographs. So, they suggested that a comprehensive database, including national journals in the humanities and social sciences, be developed.

Ochsner, Hug and Daniel (2014) acknowledged that the evaluation of research performance in the humanities is complex and challenging. As the evaluation of humanities with quantitative indicators faces some limitations, qualitative indicators can be employed for humanities studies. Díaz-Faes, Bordons and van Leeuwen (2016) studied the relationships between scientific performance and the personal characteristics of the researchers in the humanities and social studies. The results of their studies indicated that for the researchers in humanities, the higher the scientific rank and the age of the researcher, the higher s/he has collaborated in books and papers published in databases but not WoS. In contrast, in social studies, the researcher's high scientific rank cannot predict whether his/her activity is more at the national or international level. Ultimately, they suggested that other scientific databases instead of WoS be regarded and that more precise indicators be developed to evaluate scientific production. The authors argue that traditional bibliometric indicators, such as the number of publications and citations, are insufficient for evaluating research in these fields due to their interdisciplinary and qualitative nature. To address this issue, they suggest integrating multiple metrics, including collaboration networks, funding sources, and impact on society and policy. Overall, this study contributes to

the ongoing debate on research evaluation and offers practical insights for policymakers and research institutions. For accurate evaluation of humanities and social studies, Toledo (2018) suggested employing altimetric indicators rather than bibliometrics and Scientometrics indicators. He argued that the difference between the research methods and research types (interdisciplinary, theoretical, etc.) among humanities, social studies, and other kinds of sciences (natural and basic science) should be considered while evaluating humanities and social studies. Based on the fundamental differences between humanities and other subjects, Reale et al. (2018) provide a comprehensive review of existing literature on evaluating the impact of social sciences and humanities research in terms of its scientific, social, and political significance. They found that quantitative and bibliometric methodologies are not only inadequate indicators for assessing the impact of humanities and social studies but significantly lower the value of research outputs. Overall, this review provides valuable insights for researchers, policymakers, and funding agencies interested in understanding and assessing the broader impacts of social sciences and humanities research.

Materials and Methods

This study is applied research that uses Scientometrics indicators. Since it chose the bibliometrics approach, the Web of Science was used for the data collection. The bibliometric study is an increasingly common method of investigating and analyzing enormous quantities of academic information, which enables an in-depth investigation of the literature in a specific field, recognizing gaps in knowledge, providing novel research concepts, and establishing researchers' aimed contributions (Janik, Ryszko & Szafraniec, 2021). Table 1 shows the main collected information about faculty members' performance appraisal systems in all fields of science., terms related to promotion, evaluation, and faculty members were searched in the topic section of all databases of Clarivate Analytics Web of Science, which included the title, abstract, and keywords to get the required data. The search process occurred on August 2, 2022. To obtain a more comprehensive result and avoid any irrelevant documents being included, Keywords such as "health", "medical", "clinic", and "student" were removed.

Ts=(Tenure OR "Tenure track" OR promotion OR "Tenure track and promotion" OR "Tenure track & promotion" OR "Tenure experience*" OR "research output*") AND TS=(evaluat* OR monitor* OR criteri* OR indicat* OR dimation OR level OR index OR framework OR plan OR model OR assess* OR estimat* OR apprais* OR examin* OR measur* OR pattern OR performance) AND Ts= ("facult* member*" OR Professor* OR scientist* OR researcher* OR scholar* OR researchist*) AND Ts= (universit* OR academ* OR institute OR college OR "research center" OR facult* OR "higher education") NOT Ts=(health* OR medic* OR clinic* OR student).

The obtained documents were then refined according to their types and languages to include only the English journal articles indexed from the beginning time to 2021. This study includes documents from 1982 to 2021, which gives a total of 1454 articles with an average of 18.65 citations/article, an average document age of 8.06, and a total of 49692 references. The sample contained a total of 3459 keywords. The ratio of the number of authors of single-authored documents is lower than the total number of retrieved documents (from 1454 retrieved articles, 370 are written by one single author).

The indicators studied in this study are "scientific publication trend", "most relevant journals", "country's international collaboration", "conceptual structure", "thematic

evolution”, and “co-words analysis” obtained from Clarivate Analytics. This study employed census instead of sampling. Every obtained document’s bibliometrics characteristics included the name of the author(s), authors’ affiliation, the title of the document, keywords, journals’ name, year, volume, pages, editor(s), and the number of citations. We used descriptive statistics and Scientometrics methods for data analysis. RStudio was also utilized for social network analysis.

Table 1

The Main Obtained Information About Faculty Members’ Performance Appraisal Systems in all the field

Description	Results
Main Information About Data	
Timespan	1982:2021
Sources (Journals, Books, etc.)	761
Documents	1454
Annual Growth Rate %	13.93
Document Average Age	8.06
Average Citations Per Doc	18.65
References	49692
Document Contents	
Keywords Plus (ID)	2051
Author's Keywords (De)	3459
Authors	
Authors	3492
Authors of Single-Authored Docs	370
Authors Collaboration	
Single-Authored Docs	384
Co-Authors Per Doc	2.65
International Co-Authorships %	17.33
Document Types	
Article	1454

Results

General status of the world’s scientific publications related to faculty members’ promotion appraisal from 1982- 2021

Figure 1 shows the number of annual scientific publications related to faculty members’ promotion appraisal system. Research related to this topic has grown by %13.93.

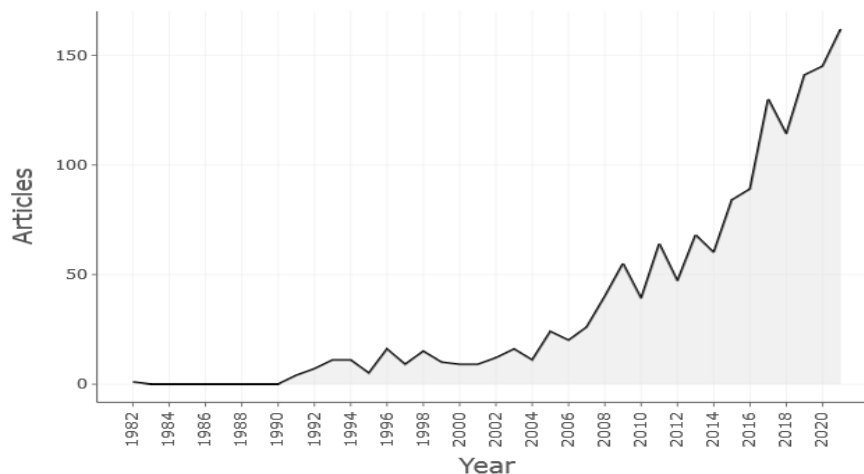


Figure 1: Annual Scientific Production Related to Faculty Members' Promotion Appraisal System

According to the figure, studies related to faculty members' promotion appraisal system started in 1990. drops in publication can be seen in different timespans, such as 2008 to 2010. But this drop is not notable compared to the growth that occurred after 2014. Challenges and other difficulties in this field have encouraged researchers to study with more enthusiasm.

Clustering journals related to faculty members' promotion evaluation system according to Bradford's law

The most relevant scientific-academic journals concerning faculty members' evaluation systems are shown in Table 2. Among the top 5 journals, *Scientometrics* is at the top with 96 articles. *Research Policy* and *Higher Education* journals, with 25 and 22 articles, are standing at the 2nd and 3rd position, respectively. *Journal of Informetrics*, with 22 papers, is at the fourth position, and the *Journal of Social Work Education* is standing at the 5th position with 17 papers.

Table 2

Top 10 journals related to Faculty members' promotion evaluation System

Rank	Sources	Articles
1	Scientometrics	96
2	Research Policy	25
3	Higher Education	22
4	Journal of Informetrics	22
5	Journal of Social Work Education	17
6	Journal of Higher Education	16
7	College & Research Libraries	15
8	Plos One	15
9	Research in Higher Education	15
10	Journal of Academic Librarianship	14

The journals with the highest h-index are displayed in Table 3. Journals with the most impact can also be seen among the top journals related to faculty members' promotion appraisal system, which are listed in Table 2. *Research Policy* and *Scientometrics*, both with an h-index of 21, are ranked 1st and 2nd, respectively, in Table 2, which means each of these journals has

frequently used keywords are “h-index”, and “research productivity”. These keywords are employed by researchers conducting Multiple Correspondence Analysis (MCA) to find research conceptual structure. The main research clusters in the fields of the study can be determined using the abovementioned method.

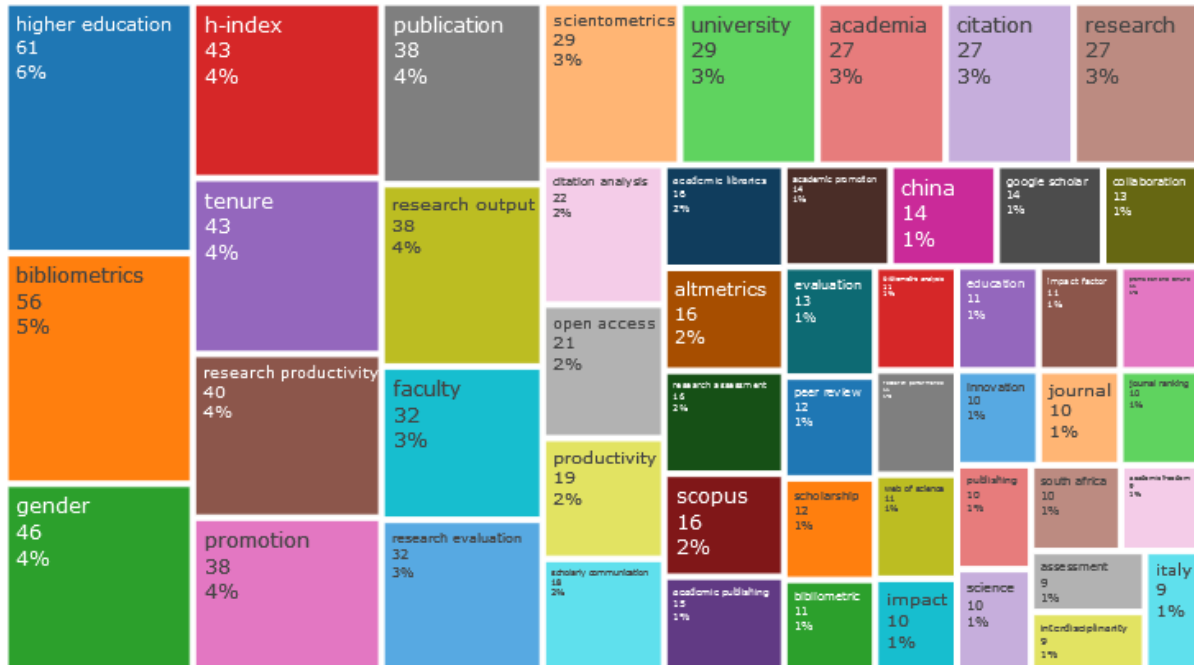


Figure 3: Words tree map (1982-2021)

The status of the country's international collaboration based on corresponding authors in the field of faculty members' promotion evaluation system

The country's scientific publications and collaboration networks are shown in Figure 4. The blue color on the map indicates the publication of a specific country in the field of study. Countries colored grey indicate that there is no field publication in those countries. Dark blue countries are the countries with the most publications. The red lines show the collaboration networks of publications countries.



Figure 4: International collaboration map in faculty members' promotion appraisal system

The USA is the country with the most active collaboration. Authors of this country as the country with the most publications, have a high common scientific productivity. According to Table 4, American authors mostly collaborate with authors from Canada and Britain. Meanwhile, British researchers collaborate the most with Germans. Findings show that most of the research outputs are done by researchers from developed countries. Also, there is a focus on specific regions regarding research collaboration. Thus, the key centers for scientific production in different continents are the USA and Alaska (Northern America), German and Britain (Europe), China (Asia), Australia (Oceanic), and South Africa (Africa). The USA, Britain, and Canada are the three countries with a relatively high scientific capacity for collaboration networks that are not distributed but focused.

Table 4
International Collaboration Status Between Countries

From	To	Frequency
USA	Canada	26
USA	United Kingdom	20
USA	China	12
USA	Germany	10
USA	Netherlands	9
USA	Australia	8
China	Australia	7
United Kingdom	Germany	7
USA	Belgium	7
USA	Korea	7

Figure 5 and Table 5 show the countries to which the corresponding authors of the field under study belong. The corresponding author sends the article to the journal’s editor-in-chief and is responsible for any possible correspondence. Also, the corresponding author’s email is generally shown on the paper’s title page, and s/he takes responsibility for communicating with other researchers (Mattsson, Sundberg & Laget, 2011). In other words, the collaboration between different countries in a field of study can be identified through the author’s affiliation to a country (or the corresponding authors’ address).

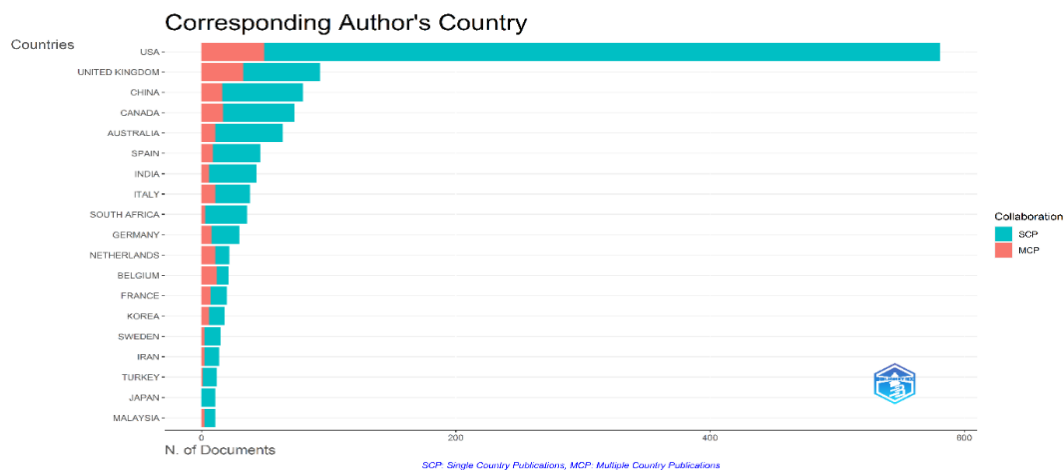


Figure 5: The Status of corresponding authors' Single country Publication and Multiple Country Publication

Among the top countries, the USA is at the top with 581 papers whose corresponding author is a single USA-based researcher. Britain is second with 93 published papers written by 93 corresponding authors. China is Asia's representative, ranked third with 80 papers and 80 corresponding authors based in China. Countries with the highest international collaboration in the field under study are, respectively, the USA, Britain, Canada, and China. The USA is the first country regarding the number of corresponding authors; However, it does not have much international collaboration.

Table 5
Single Country Publications (SCP) & Multiple Country Publications (MCP) indicators

Row	Country	Article Number	Single Country Publications (SCP)	Multiple Country Publications (MCP)
1	USA	581	532	49
2	United Kingdom	93	60	33
3	China	80	64	16
4	Canada	73	56	17
5	Australia	64	53	11
6	Spain	46	37	9
7	India	43	37	6
8	Italy	38	27	11
9	South Africa	36	33	3
10	Germany	30	22	8

Triple-axis map of top sources

In Figure 6, the performance of 10 active countries and institutions with the top 10 publishing sources is illustrated in a triple-axis map. This figure displays the relative institutions' collaboration in overall research in a country.

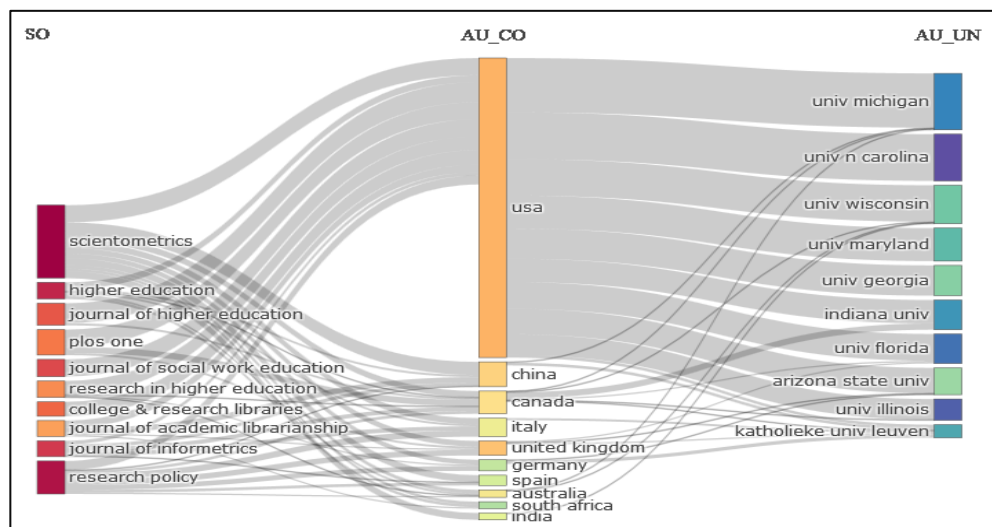


Figure 6: Triple axis map of top journals, countries, and institutions

As the figure shows, in the USA, almost all the top research institutions and universities have a remarkable share in the country's overall publication. While this is not the case in other countries. Amongst active countries, Canada collaborates the most with the world's top universities. Interestingly, there cannot be any collaboration between Spain and South Africa with top institutions in scientific productions. In these two countries, publications are distributed in national institutions. In some countries, such as India, only one top institution (i.e., Indiana University) plays the largest role in their scientific production. Regarding the source of publications (i.e., journals), Scientometrics is the best journal, and it mainly has scientific outputs from all top countries. The remaining journals were distributed among other top countries.

Conceptual Structure Map

We can compare conceptual maps using the diagram's vertical and horizontal axes. The research clusters 2D chart is illustrated in Figure 7, which depicts the conceptual structure of the keywords related to the field of faculty members' evaluation. The horizontal group has a main research area for the faculty members' evaluation system on the diagram's left side and a weak research area for these studies on the right side. The diagram shows that the scientific outputs may be divided into two primary clusters, demonstrating the similarity between words and the research's conceptual structure. In this research, each cluster is explained with some interesting, diversified, and detailed examples.

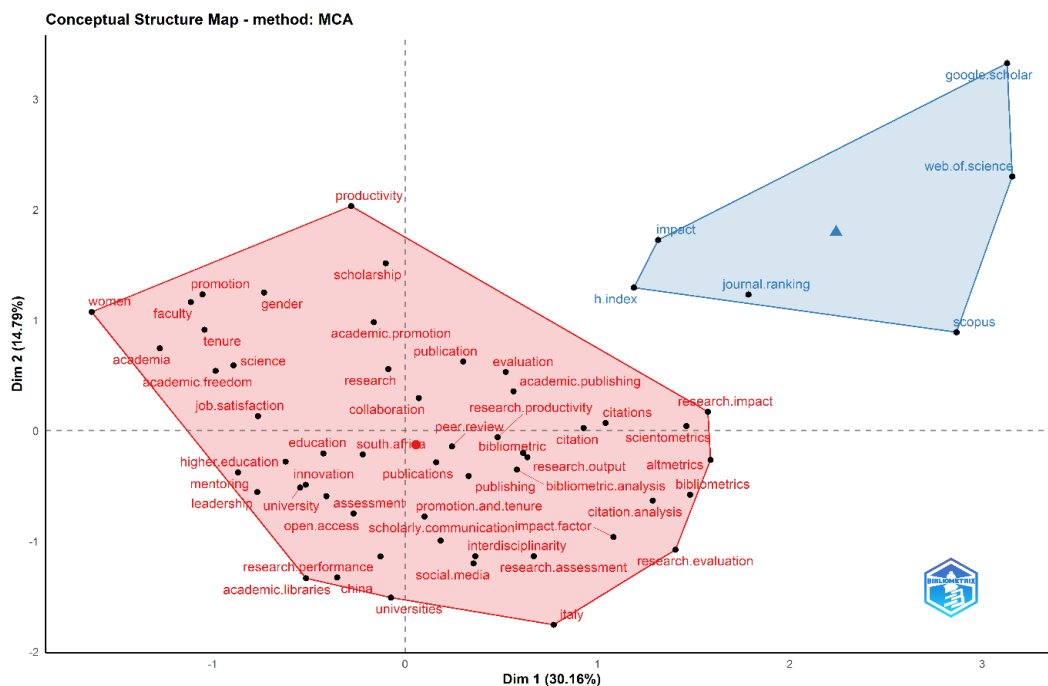


Figure 7: Conceptual Structure map by multiple corresponding analyses (WoS database)

By analyzing Figure 7, we can observe the correlation between different concepts of the research studies. It is worth mentioning that this technique extracts potential keywords from data records. Keywords near the center have been highly considered in recent years (Xie, Zhang, Wu & Lv, 2020). The more similar the keywords are in terms of distribution, the closer

they get to each other in a 2D space based on the keywords' relative position. These keywords may not always be relevant to the study topic. For example, the terms "China" and "Italy" were found in data records. The statistical software extracted these keywords and employed them in its analysis. These keywords may not be related to the topic of the research, but it shows that the researchers' community has paid attention to them, possibly because the keywords "Italy" and "China" appear in paper abstracts or perhaps because these studies utilized data shared by institutions based in these two countries.

Thematic Evolution

The current paper presents the evolution of themes based on different time spans to provide deeper information about different topics. The application of text-mining is divided into two different time stages: 1982-2016 and 2017-2021. The results are presented as strategic diagrams illustrated in Figures 8 and 9.

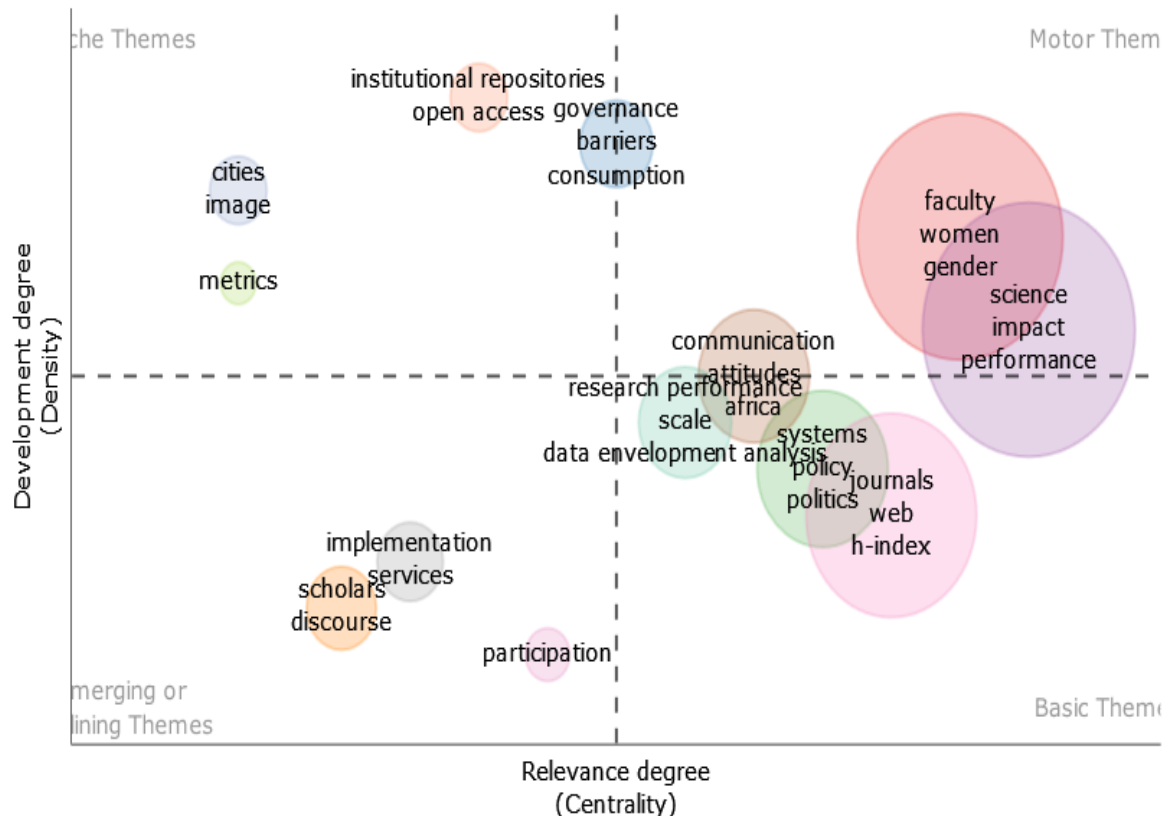


Figure 8: Strategic diagram of the first stage of literature (1982-2016)

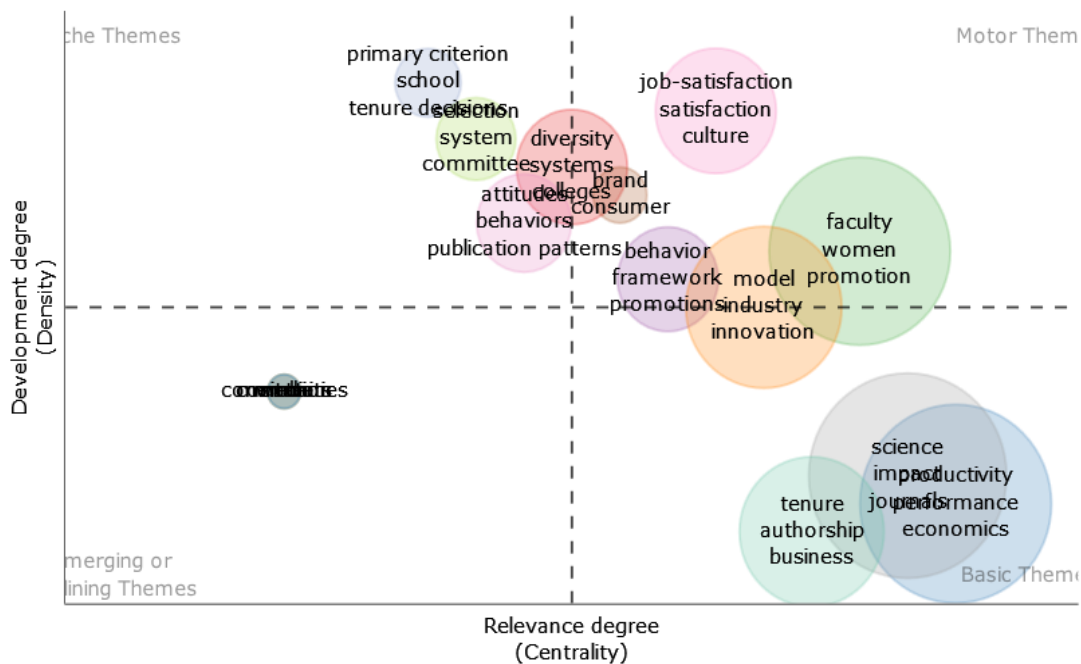


Figure 9: Strategic diagram of the development stage (2017-2021)

The strategic diagram is a 2D space drawing themes based on centrality and density parameters. Density is displayed on the vertical axis and shows the strength of connection between keywords. It can also be used as a parameter to measure the degree of the topic, showing the proportion of existing ties in the network to all the possible ties. Callon density measures the networks' internal strength. Centrality is the other parameter that measures the significance of nodes in networks, and it is shown on the horizontal axis of the diagram, indicating the external strength between themes and other topics. It can be used as a parameter to measure the significance of the theme in the development of the overall research topic. Callon centrality is the interaction of one network with other networks (Cobo, López-Herrera, Herrera-Viedma & Herrera, 2011; López-Herrera, Cobo, Herrera-Viedma & Herrera, 2016; Muñoz-Leiva, Viedma-del-Jesús, Sánchez-Fernández & López-Herrera, 2012; Arroyo Esteban, Urquía-Grande, Martínez de Silva & Pérez-Estébanez, 2022).

To thoroughly investigate the development of the thematic maps, the topics were divided into four themes: motor, basic, niche, emerging, and declining.

The upper right quadrant of the strategic diagram shows the themes with high density and centrality. This indicates how these themes are well-developed and contribute significantly to the formation of a study field. Themes with high centrality but low density can be seen in the lower right quadrant of the strategic diagram. These themes are not well developed but play a significant role in forming the research field and making the basic themes of research. The upper left quadrant of the diagram includes themes with high density but low centrality. It indicated that these themes are well-developed, but they have a limited impact on the research field. Most of these themes are secondary topics or specialized topics. The lower left quadrant of the strategic diagram highlights the low centrality and density. Both the significance and development of these themes are low, so emerging or declining topics may appear in this area.

Keywords Co-occurrence Network

Keywords' co-occurrence in one document shows the content of that document. So, if the co-occurrence is measured, the themes' network of a scientific field can be drawn. Figure 10 shows the authors' keywords network, which is divided into four main clusters (i.e., blue, red, orange, and purple). These clusters show the significance of employing Scientometrics studies and performance evaluation in the field of faculty members' promotion in higher education.

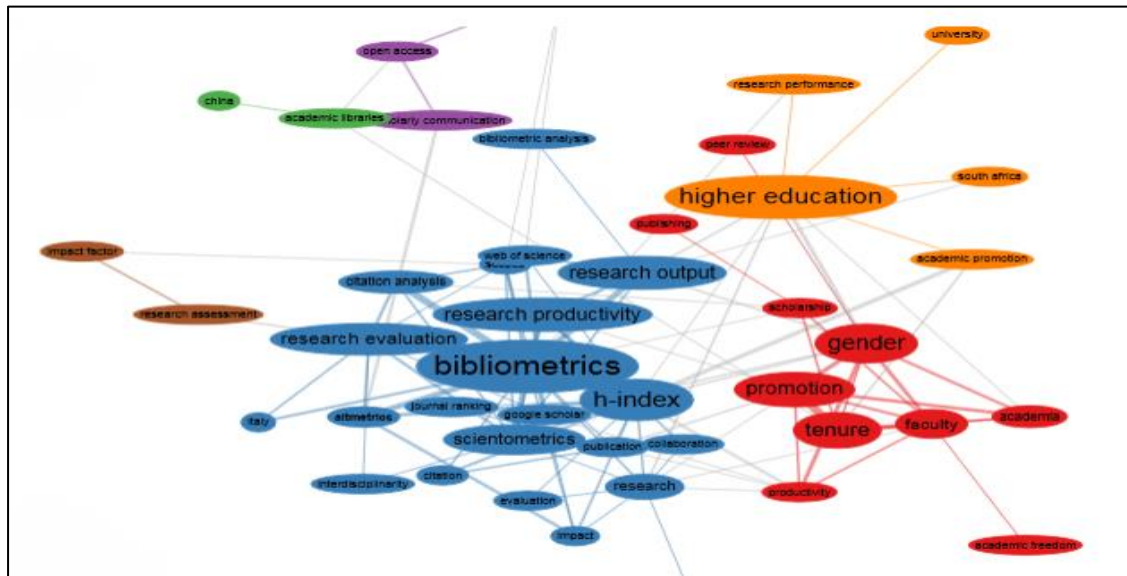


Figure 8: Keywords co-occurrence network

The blue cluster has the keyword “Bibliometrics” as the main keyword and has a close relation to the “h-index”, “Research Productivity”, and “Research Evaluation” keywords. The leading keyword of the red cluster is “Gender” which is close to “Promotion”, “tenure”, “Scholarship”, and “University”. The dominant keyword in the orange cluster is “Higher Education” which has a strong connection to “Research Performance”, “Academic Promotion”, and “South Africa”. Finally, the purple cluster is composed of “Scholarly Communication”, “Academic Publication”, and “Open Access”. The connector role of “output”, “productivity”, and “research evaluation” keywords in these clusters indicates that higher education faculty members can reach promotion and tenure through bibliometrics and Scientometrics indicators.

Discussion

Faculty members' promotion and tenure have long been the topic of discussion in scientific communities, universities, and higher education institutes. This topic is studied in three different areas: education, research, and service. It also has raised challenges in evaluating research and researchers' effectiveness. Choosing quantitative or qualitative indicators in institutions with various functions and missions and in different fields is a topic of dispute among experts. So, researchers from different fields and areas have done several studies that consider faculty members' evaluation systems. They have also studied this system's pathology and defined indicators to evaluate researchers' effectiveness in the best way. According to the researchers' interest in evaluation indicators, the need for a thorough bibliometrics analysis of this field is realized. This analysis must present a comprehensive image of the thematic evolution of the topic to the researchers and science policymakers. The amount of research done

in this field has increased year after year. Obviously, the WoS research growth rate rose between 2014 and 2020. We, therefore, aim to propose a research mapping based on network analysis in this study, in addition to descriptive and functional bibliometrics studies in about 40 years.

The analysis showed that research in this field has been developing since 1990. Journals, including *Scientometrics*, *Research Policy*, *Higher Education*, and *Journal of Information*, have been named as the most effective journals according to Bradford's law and can be employed for future policymaking in the field. "Higher education", "Bibliometrics", "Gender", "h-index", and "Research Effectiveness" are the keywords used with "tenure" the most, according to the MCA. In fact, in most countries, tenure and promotion choices regularly consider a variety of scientometric measures (such as journal impact factors and citation counts) as measures of research caliber and importance (Konkiel, Sugimoto & Williams, 2016). Results of the descriptive and functional analysis showed that the USA, Canada, and Britain possess a remarkable scientific capacity and an effective collaborative network, which results in the most international collaboration. According to the triple-axis map, Canada has collaborated with all the active institutes. *Scientometrics Journal* is one of the main sources in which all the best countries and institutes have published.

Keywords co-occurrence analysis reveals that research literature is mostly related to h-index, research evaluation and effectiveness, promotion, higher education, academic publication, and scientific relations. However, thematic evolution analysis indicates that topics such as research performance, impact factors, and policies have not yet fully developed as basic themes and require additional investigation. In academia, faculty members are often encouraged to quantify their work's value through metrics like publications, citations, journal impact factors, grant dollars, and h-index. However, this approach has flaws, such as not equating to quality, citation counts varying across disciplines, journal impact factors being poor, grant funding being topically dependent, and the h-index being inflated. Recently, a new class of metrics called altmetrics has the potential to assist academics in presenting impact evidence that citation-based metrics may overlook. Some examples of these include the impact of research on culture or public policy, the development of life-saving health therapies, and contributions to innovation and commercialization. But to do that, academic staff at colleges and universities, as well as administrators, need to use metrics for tenure and promotion decisions in a more thoughtful, responsible, and nuanced manner (ibid). Topics such as primary indicators and standards, open accessibility, tenure decisions, and institutional repositories have been identified as niche themes. Recent motor themes are related to job satisfaction, women, promotion, and scientific effect. According to research, despite gender parity in graduation, there are still gaps between the sexes when it comes to job promotion in academia. There are several reasons for this disparity, but little is known about how women fare when it comes to tenure and promotion in academia (Richter et al., 2020; Nocco & Larson, 2021; Zakaras, Sarkar, Bibbins-Domingo & Mangurian, 2021). Emerging or declining themes focus on implementation services and scholars' discourse. The conceptual structure map classified the research of the field under study into two dimensions (i.e., horizontal and vertical). According to this map, themes such as research productivity, collaboration, academic promotion, and research publication have been mostly discussed by researchers in recent years.

Conclusion

Performance evaluation has always been one of the important and challenging issues that higher education institutions and faculty members have not been exempted. A major and far-reaching choice is whether to promote someone to a higher position or give tenure. This is since any great university must have a faculty of the highest caliber. As we have seen, research in this regard has been increasing since the 1990s, and in this study, we attempted to present a comprehensive and analytical image. Considering the difference in evaluation indicators in different countries, perhaps the lack of cooperation between countries is caused by this. Of course, Identifying leading countries and institutions can enable scientific collaboration, which ultimately results in the growth of useful and effective scientific outputs. Thematic mapping and conceptual evolution of this field can lay the foundation for researchers' publication strategy based on motor, niche, basic, or emerging themes and lead future researchers in the direction of science development in the field of science and technology evaluation. This study, like other studies, faced some limitations. According to the results, it is expected that the number of research done in the field of faculty members' appraisal systems in higher education will increase in the next years. Moreover, outdated results are the natural characteristics of bibliometrics and Scientometrics studies. Thus, future studies become essential.

Research Suggestions

According to the results and thematic analysis of research in this field, the scientific directions in this issue were identified. Therefore, to eliminate research gaps and determine research priorities to prevent the wastage of resources, it is suggested that researchers, practitioners, and supporters consider research in the following areas:

1. Develop a comprehensive bibliometric analysis of existing faculty members' evaluation systems. This analysis will identify the most commonly used evaluation criteria, the types of metrics used to measure performance, and the factors that contribute to successful evaluations.
2. Examining the evaluation indicators of faculty members in different academic fields in the universities of the world
3. Investigating gender differences in the promotion and tenure systems of faculty members
4. Bibliometrics study of research effectiveness indicators in different countries
5. Bibliometrics study of education effectiveness indicators in different countries
6. Examining the indicators related to the interdisciplinary activities of faculty members in the promotion and tenure systems
7. One of the limitations is that the bibliometrics analysis has been done based on WoS-indexed studies. Therefore, it is suggested that more investigations be done based on other databases such as Scopus, Google Scholar, and others.

Conflict of Interests

The authors claim to have no conflict of interest.

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