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Short communication

Understanding research productivity in the realm of evaluative scientometrics

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The combination of a variety of inputs (both tangible and intangible) enables the numerous outputs in varying degrees to realize the research productivity. To select appropriate metrics and translate into the practical situation through empirical design is a cumbersome task. A single indicator cannot work well in different situations, but selecting the 'most suitable' one from dozens of indicators is very confusing. Nevertheless, establishing benchmarks in research evaluation and implementing all-factor productivity is almost impossible. Understanding research productivity is, therefore, a quintessential need for performance evaluations in the realm of evaluative scientometrics. Many enterprises evaluate the research performance with little understanding of the dynamics of research and its counterparts. Evaluative scientometrics endorses the measures that emerge during the decision-making process through relevant metrics and indicators expressing the organizational dynamics. Evaluation processes governed by counting, weighting, normalizing, and then comparing seem trustworthy.

Keywords: Evaluative scientometrics; Research productivity; Institutional performance; Research evaluation

Introduction

The most fundamental idea of socialization of science is the publication of research results, which allows researchers to exchange thoughts and reliably receive critical responses on their work. A researcher acquires recognition, subsequently achieves reputation, and fulfills esteem value through publishing. Positions and rewards in academia are usually determined by scholarly behavior and publication output as well.

Evaluation is important to every scientific institution and enterprise. Although there is no clear consensus about an absolute technique of measuring scientific productivity, quantitative measures are still well-retained in evaluative scientometrics. While quantitative techniques are inevitable for assessment, the quality-weighted dimensions of quantity may be effective in evaluating scientific productivity.

The concept of productivity is quite ambiguous and limited to a situation. Generally, it means ‘the effectiveness of activities performed’ or ‘the state of being effective to perform a task’. In the production industry, “the rate of output per unit of input” defines productivity. But in scientific endeavors, often this term is used to mean ‘the capacity of rendering efforts to produce publications’. Instead of the input/output ratio, Fincher[1] defined productivity as something about a trait (quality) of accomplishing objectives (effective) in a timely manner (efficiency). Three parenthesized components “would seem to be essential for assessing productivity, where ‘quality’ has an intuitive appeal that the institutions cannot ignore”. Pratap[2-3] viewed the productivity employing the concept of ‘quasity’ that combines quality, quantity, and consistency.

Since the research is a process of knowledge generation; it utilizes intangible input (human intellect) to produce a tangible output (publication). Primarily, it requires accumulated knowledge, social networks, cognition, motivation, and thought process alongside a few tangible inputs viz., learning resources, laboratory equipments, dataset, salary, incentives, etc. In addition to publications (tangible), some intangible outputs like tacit knowledge, new perception/insight, guidance, recognition, and social welfare are also generated. Thus, several factors in varying degrees co-exist to enable this production process[4].

Paradoxical views on productivity

Measuring research productivity, therefore, involves the co-existence of numerous factors at the input and output levels. However, both the input and output factors can be tangible and/or intangible. No specific or particular can produce the best output in multiple situations. Rather, a combination of a variety of inputs enables in achieving optimum productivity. Organizational superfluity cannot always be incremental to improve research productivity[5]. In reverse, the economic sorrow (cause to lose of valuable assistance) may not have any adverse effect on the research performance; if adequate motivation persists.

The motivational spirit thus can be a dominating factor in the cognitive structure of a scientific organization. As such, institutional culture and practices thereby management policies, operating principles, functional integrity, and interpersonal relations may also be considered in realizing productivity. Certainly, the institutional performance further correlates to the empowerment and status of working researchers. So, the productivity of the scientists closely associates the theory of accumulative advantages[6]. Scientific performance, scholarly contribution, publication output, and similar other expressions are often treated as synonymous to 'research productivity'.

So, one may presume that the process of research evaluation is complex. Evaluators many times depend on the assumptions and approximations while measuring research productivity. Quite common approximations are the 'amount of knowledge consumed' and 'forms of knowledge produced' in the research process. The usual assumption is that the same amount of knowledge and intellect has been used (invested) to produce each of the publications. Further assumption considers that; scientific publication is the only form of output in research, where all publications are having equal weightage irrespective of their intent and content.

But practically, the thought content of scientific papers varies with the specialty of research. An exemplary research in space science cannot be equal that with a social survey. Publications dealing with scientific experiments can be more acceptable than theoretical explanations. Very generally, the basic research involves rigorous mental exercises (thought process) as compared to hands-on work (with technical skills) required in applied research. The conference paper is usually an early version or preceding form of a publication. Therefore, the conference papers (working or discussion papers) may be discarded from the research evaluations to minimize errors of double-credit for the same contribution[4].

Since the intensity, frequency and citation score of publications differ with the field of research[7-8], the researchers compare publications only within the field or even a subfield. Aggregated rankings are best avoided. Evaluators require an authoritative list of fields and subfields of research, to be used for domain-specific rankings. But unfortunately, we do not have any comprehensive guide to classify the researchers by their field and/or subfields. Many evaluations use the Web of Science (WoS) subject classification as an immediate alternative. But the WoS cannot recognize the researchers at the micro-level.

The evaluation problem gets magnified when a researcher is dealing with the interdisciplinary areas of research. Statisticians typically pursue their research in different dimensions; so as to publish their papers in statistical journals as well as in other fields. Applied statisticians are involved in the research areas like biometry, psychometry, sociometry, econometrics, medical statistics, computational simulations, quality control, and so on. Indeed the transdisciplinary areas viz., data-science, nano-technology, etc., may stimulate researchers to publish their research across the traditional boundaries. Such interdisciplinarity and transdisciplinary research output can affect the evaluation process.

Moreover, to ensure reliability in citation score, an appropriate "citation window" needs to be followed. Citation window refers to a consistent period allowed to receive the citations of a publication dataset. Ambro et al[9] argued for using a field-specific citation window. Nederhof et al[10] opined that a longer window certainly gives better results and also suggested to observe at least five years in case of hard sciences. Combining the aforesaid insights, Wang[11] viewed that a larger citation window produces a more accurate result at the time of evaluation. But no such resolution has been found for interdisciplinary research areas. Alternatively, one should normalize the citation score by the age of publications (yearly-average).

So, it appears that the assessment of institutional productivity considering all factors is almost impossible. It is difficult to normalize the research output corresponding to the inputs utilized by individual unit, field, and researcher. Utilization of library facilities and services, cost and time involved in acquiring research-data (experiments, survey, etc.), the researcher-wise expenditure of allocated resources, share-value of collaborative efforts, and field-normal value of publications are critical concerns while measuring the productivity. However, the investment of intellectual efforts and time spent on the consolidation of ideas delivered in a publication is yet another agenda. Classifying the researchers (as well as publications) of interdisciplinary areas forms a confusing array with the hierarchy of complexity in research.

Re-calling approximations

Therefore, instead of all factor productivity, scientometric methods often endorse productivity measures based on tangible output (publications) only. It means an approximated rather partial value of productivity has been observed; leaving no room for input factors, assuming they are equal for each of the publications. As such, scientometric studies render macro-level assessment; hence produces tentative results. So the inferences from such studies may be drawn very carefully. But scientometric assessments would only be a complement to the peer-evaluation process to get conclusive decisions at the micro-level.

Quite often academic directors like to assess (rather compare) the productivity across the research units. They are interested to derive the average number of publications and corresponding citation average per researcher (thereby per research unit or division) assuming that the rest of the factors are fairly equal. Although they typically vary, but notionally all these factors viz., resources (assets), salary (labor cost), seniority (age), and rank (position) of the researchers are treated as the same. Such approximations hardly make any sense; still, the evaluation process becomes indicative for disclosing relevant information viz., inclination of productivity, unproductive units, prolific researchers, profound collaborators, prevalent topics, preferred journals, citation laurels, and so on[12].

Conclusion

Scientific enterprises define productivity in their own ways, often based on the preset objectives and goal-setting. Most of the research funding and performing institutions have put their interest in evaluating research productivity; either to establish evidence of accountability, or to consult the scholarly behavior and performance. Although a single indicator cannot work well in many situations, it does not mean, dozens of indicators would be necessary; but implies that, performance indicators should be appropriately used in the decision-making process. Evaluative scientometrics endorses the measures that have gone through relevant metrics and indicators expressing the organizational dynamics. However, the evaluation processes governed by counting, weighting, normalizing, and then comparing are trustworthy.

Research evaluations may also consider peer perceptions, as adopted in NIRF (2015)[13]. Sharing of scientific knowledge with social commons could be imparted to the research evaluations. The Government of India has already framed a policy, where it is mentioned that "credit for Scientific Social Responsibility (SSR) efforts will be given to researchers in their performance evaluations"[14].

It is essential to avoid distorted ranking of researchers. Evaluative scientometrics is an interesting but critical area of concern to science administrators, policy-makers, funding agencies, and researchers too – a quintessential need for research institutions and scientific enterprises worldwide.

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