Scientometrics or science of science: quantitative, qualitative or mixed one

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Mixed methods are suggested by combing qualitative methods with quantitative ones for scientometric studies. In my point of view, combining these different but complementary methods can upgrade scientometric studies to science of science studies. A fact that has been emphasized by several experts and scholars.

1. Introduction

The terms bibliometrics and scientometrics were almost simultaneously introduced by Pritchard and by Nalimov and Mulchenko in 1969. While Pritchard explained the term bibliometrics as “the application of mathematical and statistical methods to books and other media of communication”, Nalimov and Mulchenko defined scientometrics as “the application of those quantitative methods which are dealing with the analysis of science viewed as an information process” (Pritchard [14]). According to these interpretations the scientometrics speciality is restricted to the measurement of science communication, whereas bibliometrics is designed to deal with more general information processes. The anyhow fuzzy borderlines between the two specialities almost vanished during the last three decades, and nowadays both terms are used almost as synonyms.

It is a common misbelieve that bibliometrics and scientometrics is nothing else but publication and citation based gauging of scientific performance or compiling of cleaned-up bibliographies on research domains.
extended by citation data. In fact, scientometrics is a multifaceted endeavor encompassing subareas such as structural, dynamic, evaluative and predictive scientometrics. Structural scientometrics came up with results like the re-mapping of the epistemological structure of science based, for instance, on co-citation, “bibliographic coupling” or co-word techniques. Dynamic scientometrics constructed sophisticated models of scientific growth, obsolescence, citation processes, etc. These models are not only of theoretical interest but can also be usefully applied in evaluation and prediction.

2. Qualitative and quantitative analysis of science

In recent years, an awareness has emerged that serious attempts should be made to connect the more qualitative kind of sociological theorizing, with its increasing focus on the cognitive aspects of science, with the more quantitative approach of scientometrics, characterized by its increasing awareness of the relevance of institutional factors. This trend caused to multidimensional and multifaceted field under title of “science of science”. Therefore to apply science on science itself, we need to understand the nature of scientific activities, the philosophy and the sociology of science. KDViz (Knowledge Domain Visualization) as pioneer of this filed, has a promising future as a continuous line of multidisciplinary thus research. Researchers in the future should address theoretical as well as practical issues concerning the quality of investigations utilizing visualization tools, such as the coverage of the data, the scope of the topic, the interpretation of results, and triangulations with domain experts through longitudinal and multidisciplinary studies.

A true science of science will have to be theoretically grounded and practically useful. It will support repeatability, economy, mensuration, heuristics, and consilience (Wilson [17]), a view also emphasized by Henry Small [16]. It will increase the reliability of beliefs and assumptions by eliminating or minimizing errors and illusion which obstruct human knowledge while cultivating rather than suppressing doubt. It will combine quantitative approaches (automatic, data driven, providing large-scale but coarse context) and qualitative approaches (manual, interview and survey based, providing small-scale but detailed ‘high resolution inserts’) in the study of science as intended at the very beginning of this field.

Regarding mentioned points the main question of this paper is that why we need qualitative methods as complementary of quantitative methods and how?

As we know scientometrics has quantitative approach and deals with numbers, statistics, inference, and indicators such as citation, impact factor etc. But nowadays expectation of science of science is more and resulted in combining qualitative and quantitative methods.

Depending on the research tradition and field, various aims for qualitative research can be identified

- To understand the world from the point of view of the research participants;
- To interpret the experiences and meanings of people in complex settings (Greening [5]; Mayers and Walsham [11]);
• To discover themes, knowledge, and relationships (Berglund et al., [1]);
• To explicate the ways people in particular settings come to understand, account for, take action, and otherwise manage their day-to-day situations (Miles and Huberman, [13]).

Thus the mixture of quantitative and qualitative research techniques provides broadly consistent data and combines depth (qualitative) with breadth (quantitative).

There are a number of ways in which qualitative research can act as a precursor to the formulation of problems and the development of instruments for quantitative research:

1. Qualitative research may act as a source of hunches or hypotheses to be tested by quantitative research.
2. Qualitative research may also facilitate the construction of scales and indices for quantitative research.
3. The presence of qualitative data may greatly assist the analysis of quantitative data. In their multisite, multi-method science studies this fact is evident.

Therefore by both of them we can know how others see and experience the world e. g. the motivation of citation, its aim, interpreting results to policymaking, decision-making etc. Generally Quantitative and Qualitative Research are Combined in Order to Produce a General Picture so it can be useful for new generation of scientometric researches such as visualization of knowledge domain. Scholars name new approach which is result of combination of qualitative approaches with quantitative ones, “Mixed Methods”.

For example if we suppose that questions that are either openly or implicitly about quantity, about how much or how many, or measuring one thing against another, are going to require quantitative analysis and Questions about meanings require qualitative analysis, the “mixed methods” can analyze both of them.

In other words, the scientometrist who establishes a correlation between two variables, or who believes that a causal connection has been discerned, and is faced with the problem of interpreting the relationship, using mixed method, in addition to calculating his findings (by quantitative analysis), he interprets its results accurately (by qualitative analysis)

Quantitative research may be depicted as relevant to the establishment of findings at the larger scale, macro level but Qualitative researchers on occasions seek to move from the study of apparently small scale phenomena to the micro level. Hence one approach to the bridging of the two levels of analysis is through a combination of quantitative and qualitative research. Such an approach has been suggested by Duster [4], who uses the metaphor of a ladder to show how the distance between macro and micro levels of analysis might be bridged and the combination of macro and micro levels of science is one of emphasize of new science of science researches.

Mixed methods has been the subject of considerable debate in the social sciences and has variously been regarded as anathema, as the outcome of everyday pragmatic research
decisions, or as appropriate in some situations but needing to be carefully justified. Bryman suggests that the epistemological differences between qualitative and quantitative research have become exaggerated. While he concedes that ‘much of the exposition of the epistemological debts of qualitative research helped to afford it some credibility’, he argues that in practice ‘a great many decisions about whether and when to use qualitative methods seem to have little, if any, recourse to these broader intellectual issues’ ([2] p. 108). In other hand using different methods in the one study always carries the possibility of obtaining contradictory findings. This should not in itself be considered a problem. It is, however, a clear indication that further work may be required to understand better what is happening. Also using qualitative approach we can diminish controversies by one of dynamisms originated from qualitative methods.

The mixed methods design designs permit us to develop understandings of the complexities of the social, intellectual and cognitive structure of science represented by co-citation analysis and bibliographic coupling as a quantitative method. Then If we accept small’s idea that co-citation clusters are “consensual networks of concepts” (Small [15] p. 85), we should affirm the interpreting co-citation clusters is a qualitative method. As we know interpreting the results has been controversial from the beginning because The researchers lack complete access to the meanings of the “concept symbols”¹ as used by the members of the internal groups who produce them.

3. Some examples

Literature review shows that some of them underline using “mixed method” (combination of qualitative methods with quantitative one) to complement of their findings. Here I indicate some of them:

One of the oldest examples is a work under title of “qualitative scientometrics” (Callon, Law, and Rip [3]). This phrase is an instance of mixed methods. Because it declares combining quantitative methods (bibliometrics and scientometrics) with qualitative ones.

The reason of Martin [10] using qualitative and quantitative methods in his scientometric research is because of multi-dimensional nature of research that each dimension may require a different evaluation approach and indicators. Martin and Irvine [9] (p. 64) classified these dimensions as followings:

(a) scientific - contributions to the stock of knowledge; (b) educational - contributions in terms of skills and trained personnel; (c) technological - contributions to the development of new or improved technologies; and (d) cultural - contributions to the wider society.

According to Kostoff [7] ”Much of the research evaluation community has come to believe that simultaneous use of many techniques is the preferred approach ” if one wishes to capture the different dimensions of research (p. 118).

Zhao [18] in his paper about ACA emphasizes on its complexity and concludes that in this technique, interpretation of results is complicated. Hei & Hui [6] mention that the

¹Small (1978) has described citation especially co-citation studies as concept symbol
whole process of traditional scientometrics depends very much on human interpretation and interaction. McCain [12] suggests other means for supporting interpretations of author maps, such as consultation with experts, text-based methods of validating results, and other forms of comparison. The danger of misinterpretation is another weakness of researches which shown in such studies.

4. Conclusion

Finally as Leydesdorff [8] mentions idea of qualitative different layers of science pointed to the need of theorizing before we can say which variable is being indicated by what indicator. Thus combining qualitative methods with quantitative ones can improve and upgrade scientometric studies to “science of science”. A field that reveals, visualizes, detects and interprets structure of science in different disciplines, subject areas or specialities.

In this theoretical review paper, I compiled and analyzed viewpoints of scientometric experts in using mixed methods for improving quality, interpretation, and understanding of structure of science by literature review.

References


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