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Publication of research results: Use and abuse

Why publish research results?

Scientific research lives of an exchange of ideas, opinions, methods, materials, equipment, software, and experience between researchers, both within a field of science and from different areas of science. Such an exchange can be oral or in written form, the latter mainly in the form of papers published in scientific journals. Because of the sheer size of the community of scientific researchers and its global spread, exchange in written form has gained weight compared to oral exchange. Publication of research results also allows every generation of researchers to stand on the shoulders of previous generations already deceased. This is why reporting of research results, be it positive or negative ones, in the scientific literature is of fundamental importance to the progress of our understanding and knowledge, *i.e.* of science. The scientific literature constitutes the repository of scientific knowledge. In addition, it offers the possibility to check and reproduce research data and results, a basic tenet of the scientific endeavour.

Quality checking of manuscripts

The integrity of published research is of fundamental value to the academic community of scholars. Since the 18th century quality control of research publications has been exerted by peer review: the judgement of scientific reports by academics with equivalent knowledge. Peer review can only function under the umbrella of the ethics of science. This assumes an unbiased examination of the opinion or data based on logical and empirical criteria. It also places trust in the competence and honesty of the reviewers, be they a col-

league or a competitor. A reviewer should formulate an opinion on the quality of a manuscript:

1. Clarity of text, tables and figures.
2. Reproducibility of the results from the data reported.
3. Sound connection between the results and the conclusions (no overstatements).
4. Embedding of the results in the literature (proper referencing).
5. Relation to other methods addressing the same problem.
6. Novelty of the method or results.
7. Relevance of the results to the scientific community.

The quality of the reviewer's report is to be evaluated by the editor who requested it:

1. Apparent knowledge of a reviewer regarding the subject of the manuscript.
2. Validity and consistency of the arguments of a reviewer.
3. Possible bias because of a vested interest of a reviewer.

However, the increasing load of reviewing and editing manuscripts poses problems. Manuscripts are often only superficially read by reviewers and review reports are often only superficially read by editors. Instead of taking time to read a manuscript one observes an increasing reliance on simple so-called "quality" measures or indices when judging the quality of scientific research.

Are so-called "quality" measures or performance indices useful?

The time pressure on persons with the task to review research will inevitably induce them to rely on performance

indicators rather than spending time to investigate in depth the research of a scientist. Yet, "quality" measures or performance indices are definitely not useful, they rather contribute to a degradation of the scientific endeavour.

1. A high-dimensional object (a research project, experiment, theory or model, or a person with its multiple tasks, activities, interactions, *etc.*) is projected onto or reduced to a single number or a one-dimensional object: a line of index values. Anyone who has looked at the projection of a 3-dimensional object (a chair or a house) onto a line (a 1-dimensional object) will understand that performance indices and rankings *etc.* are meaningless in regard to a characterisation of the original 3-dimensional object.
2. Numerical measures or indices measure quantity not quality. It is often assumed that quantity (number of papers, of citations, of downloads, *etc.*) is correlated with quality of research, quod non. Quality cannot be caught in a number.
3. Popularity or widespread use of a theory, method, software, or papers is not correlated with their quality. One only has to compare the quality of the *Bild Zeitung* with that of the *Frankfurter Allgemeine Zeitung*, of the *Blick* with the *NZZ*, or of the *Telegraaf* with the *NRC-Handelsblad*.

It is seductive to compare numbers. But, numbers lead to rankings, and rankings lead to competition. Excessive competition undermines care and rigour, encouraging activities close to or, ultimately, beyond the boundaries set by the ethics of science. The increasing pressure to violate academic principles is illustrated by the mount

ing number of cases of plagiarism and scientific fraud. Focus on quantity as opposed to quality also leads to the aversion of risk: truly difficult and innovative research is shunned. A focus on competition will not enhance the quality of research. Quality measured by metrics alone is an illusion and the cost to society is growing inefficiency.

Is considering performance indices improving the quality of science?

The use of performance or citation indices sets the wrong incentives for researchers:

1. To consider one's own popularity to be more important than exchanging and criticizing research ideas and results of others;
2. To reference papers of oneself or of friends even if these are irrelevant;
3. To bias a review report towards one's own or friend's ideas of what must be correct;
4. To favour short-term (popular) simple research over addressing long-term basic scientific problems;
5. To bias against correct but unpopular theories, procedures or research results.

Thus the increasing use of performance indices tends to harm the quality of research. This implies that such indices are to be ignored. A research institution should not bother to provide data for their calculation. One should not mention, cite or consider them in any context. Indicators such as number of citations of publications, grant money gathered, number of successful students educated, or student satisfaction are only useful to detect extremes. A *curriculum vitae* with more than 1000 research publications must raise questions regarding the true involvement of the person in question in the research and the scope of the issues addressed. On the other hand, a lack of publication activity may indicate a lack of effort, the inability to finalise work, or reflect the difficulty of the research being executed.

If the *curriculum vitae* of an applicant for a professorship lists the number of citations, an *h*-index value or the amount of grant money gathered, one should regard this as a sign of superficiality and misunderstanding of the academic research endeavour, a basic flaw in academic attitude or, at best, as a sign of bad taste.

Recommended literature

Van Gunsteren WF: The Seven Sins in Academic Behavior in the Natural Sciences. *Angew. Chem. Int. Ed.* **2013**, *52*, 118–122, DOI: 10.1002/anie.201204076
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Van Gunsteren WF: On the Pitfalls of Peer Review. *F1000Research* **2015**, *4*, 1244, DOI: 10.12688/f1000research.7342.1

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