Cautions and lessons around development and implementation of scholarly metrics

Stefanie Haustein

NIH Virtual Workshop on Data Metrics | 19.02.2020 | @stefhaustein

Outline

→What are scholarly metrics?

→What can scholarly metrics do?

→What can we learn from bibliometrics?

→How do we develop good data metrics?

What are scholarly metrics?

What are scholarly metrics?

Definition

Scholarly metrics are indicators based on acts related to scholarly documents or scholarly agents.

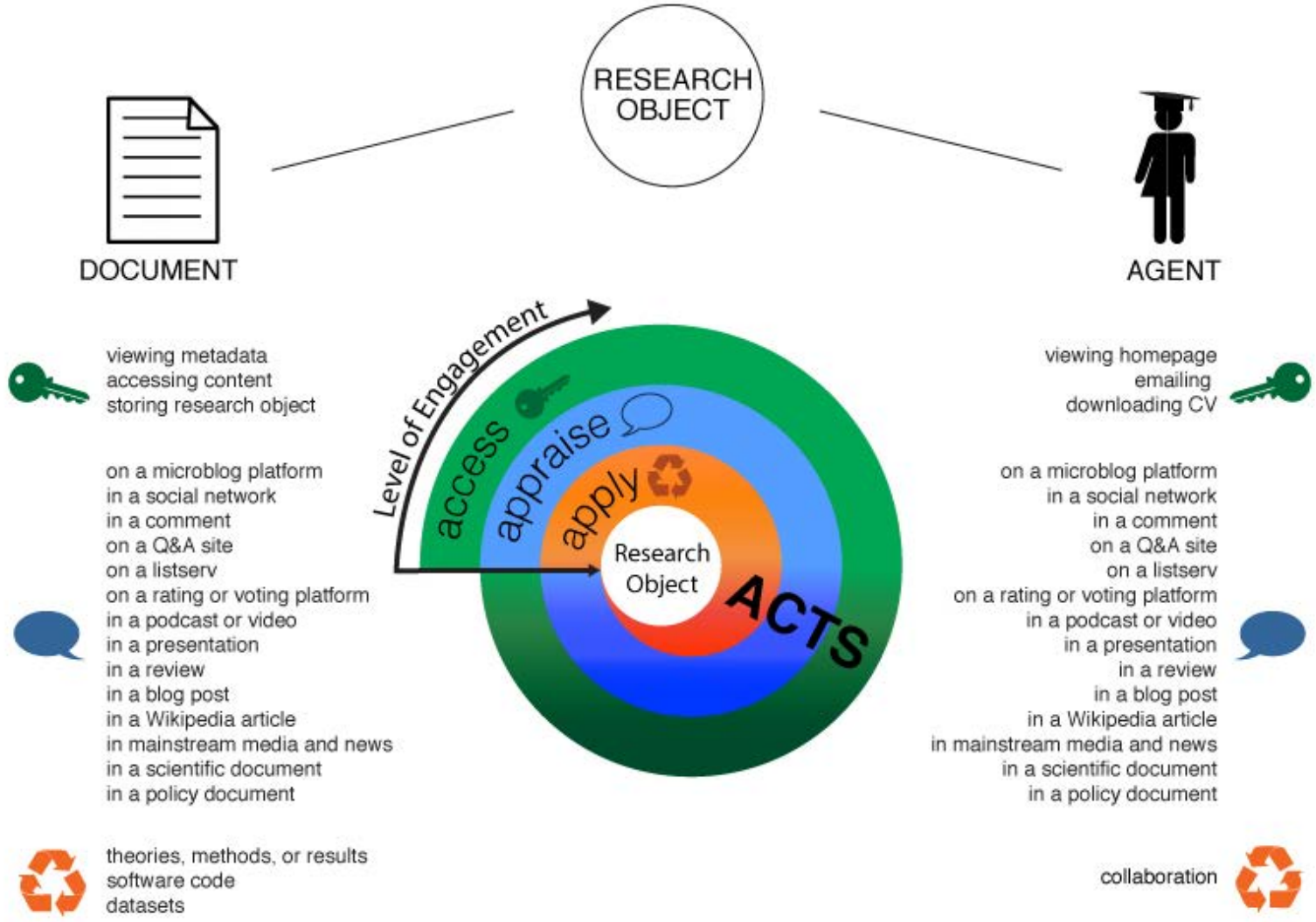
→ Acts include viewing, downloading, mentioning, citing or modifying publications.

→ Scholarly documents include a broad range of outputs from peer-reviewed journal articles and monographs to blog posts or datasets.

→ Scholarly agents include researchers, universities, funding organizations or scientific journals.

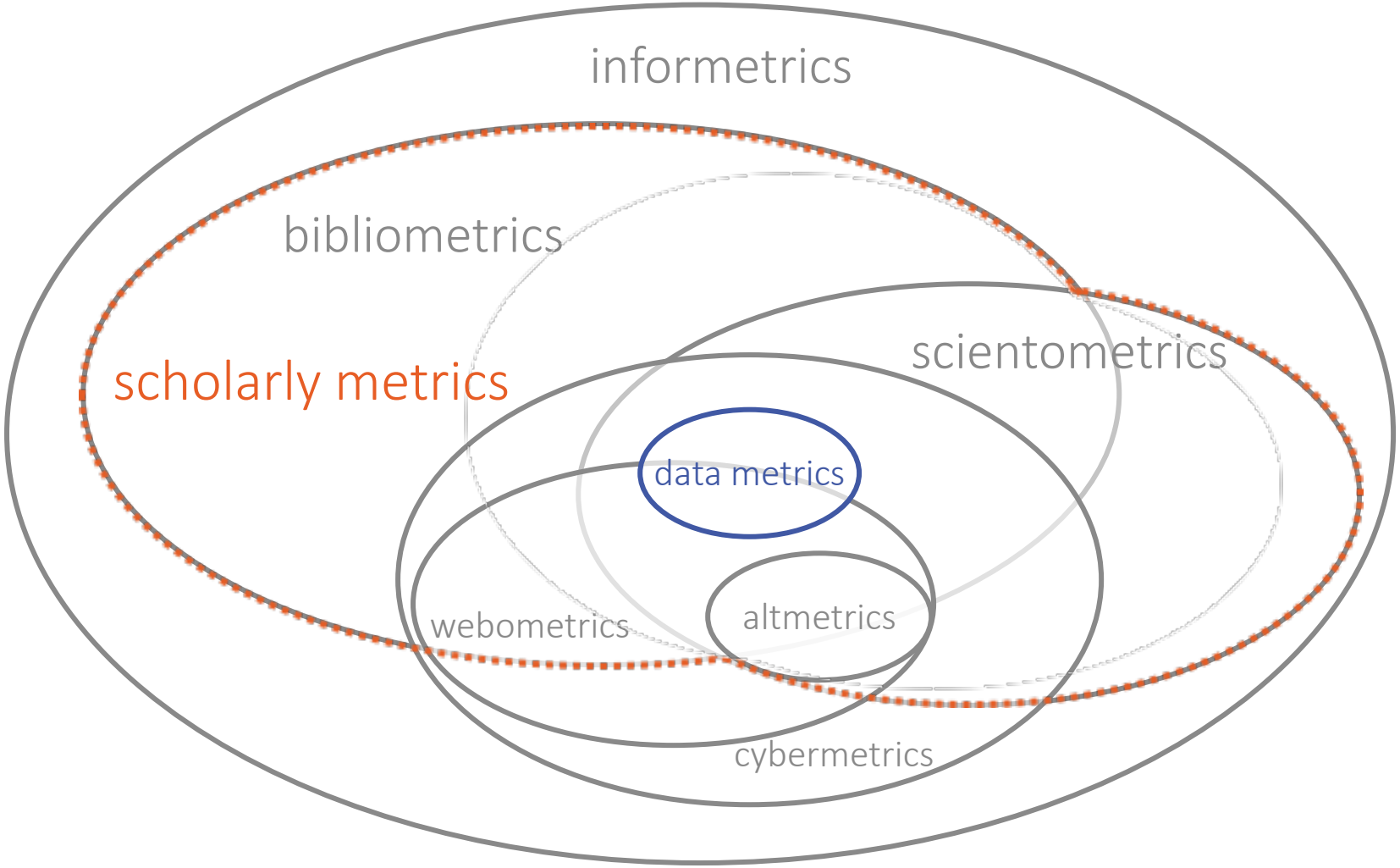
Haustein, S. (2016). Grand challenges in altmetrics: Heterogeneity, data quality and dependencies. *Scientometrics*, *108*(1), 413–423.

What are scholarly metrics?



Haustein, S., Bowman, T. D., & Costas, R. (2016). Interpreting "altmetrics": Viewing acts on social media through the lens of citation and social theories. In *C.R. Sugimoto (Ed.), Theories of Informetrics and Scholarly Communication* (pp. 372-405). Berlin: De Gruyter Mouton

What are scholarly metrics?



Haustein, S. (2016). Grand challenges in altmetrics: Heterogeneity, data quality and dependencies. *Scientometrics*, *108*(1), 413–423. https://doi.org/10.1007/s11192-016-1910-9

What can scholarly metrics do?

What can scholarly metrics do?

Complementing peer review

→Peer review

→Qualitative

→Subjective

→Small scale

→Labor-intensive for experts

→Resource-intensive

→Scholarly metrics

→Quantitative

→Objective

→Large scale

→Labor-intensive for data scientists

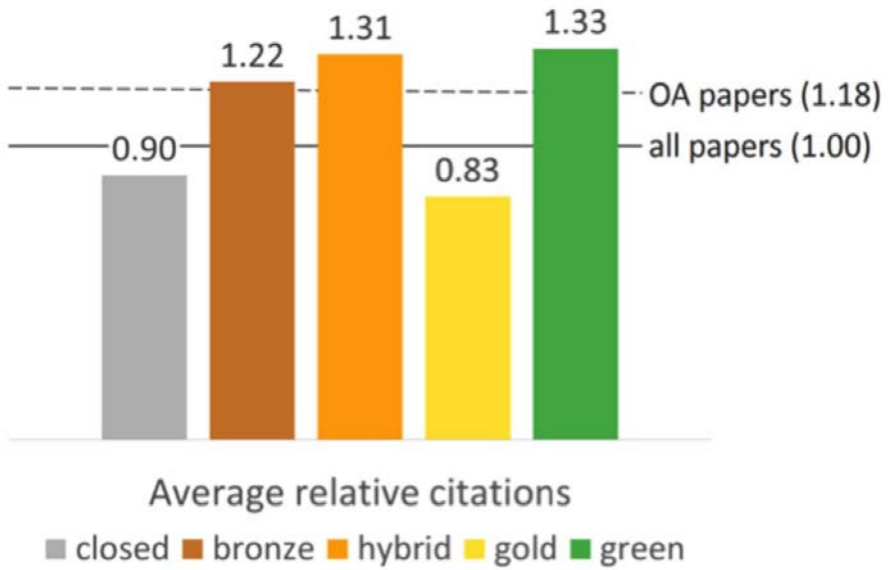
→Moderate resources

What can scholarly metrics do?

Demonstrating productivity and impact

- →Publication output
  - →Publication frequency
  - →Publication behavior
  - →Collaboration patterns
- →Use and impact
  - →Views, clicks and downloads
  - →Scholarly impact
    - → Citations
    - → Awards
  - →Societal impact

- →Incentivizing open scholarship
  - →Open access citation advantage



- →Open data citation advantage?

Piwowar, H. A., Day, R. S., & Fridsma, D. B. (2007). Sharing Detailed Research Data Is Associated with Increased Citation Rate. *PLOS ONE*, *2*(3), e308. https://doi.org/10.1371/journal.pone.0000308

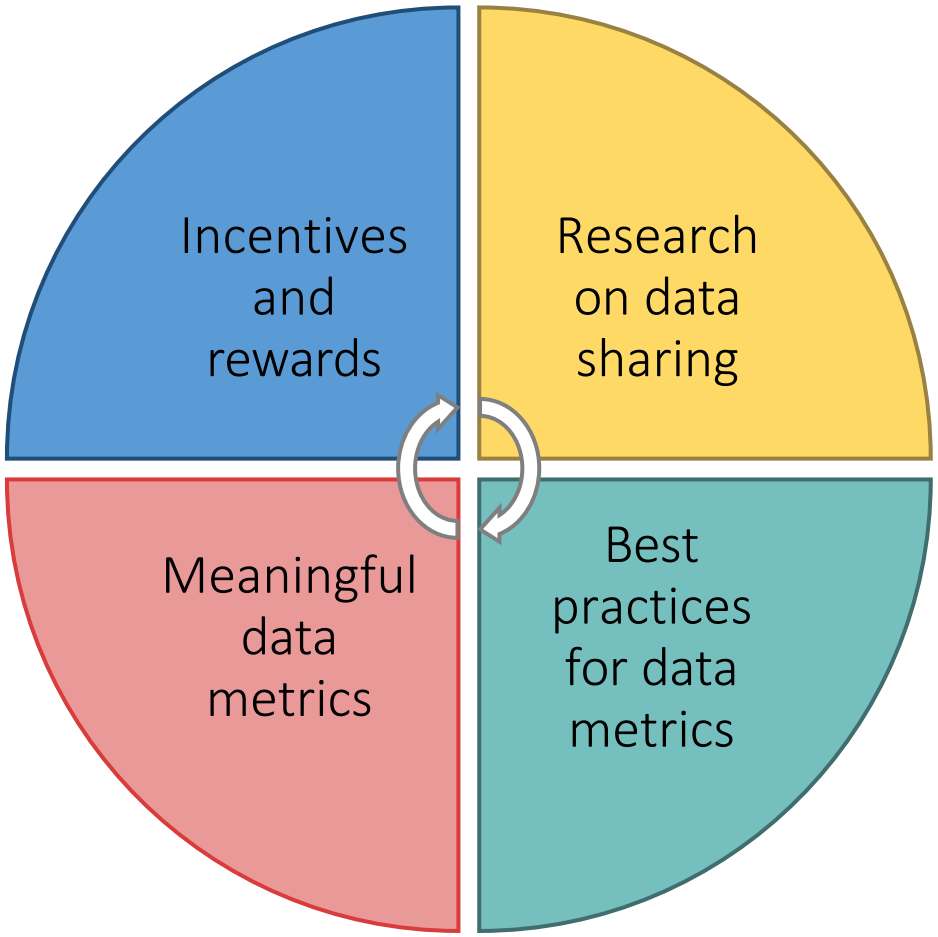
Piwowar, H., Priem, J., Larivière, V., Alperin, J.P., Matthias, L., Norlander, B., Farley, A., West, J., & Haustein, S. (2018). The state of OA: a large-scale analysis of the prevalence and impact of Open Access articles. *PeerJ*, 6, e4375. https://doi.org/10.7717/peerj.4375

Piwowar, H. A., & Vision, T. J. (2013). Data reuse and the open data citation advantage. *PeerJ*, 1, e175. https://doi.org/10.7717/peerj.175

What can scholarly metrics do?

Lack of data sharing incentives – Vicious circle

1. Researchers do not share and cite datasets due to a lack of incentives and rewards in academia
2. Bibliometricians do not study research data as scholarly outputs because of a lack of evidence of data reuse and citations
3. Best practices for bibliometric studies on research data have not yet been developed, as use cases are missing
4. Meaningful data metrics are not developed and not available to incentivize open data practices

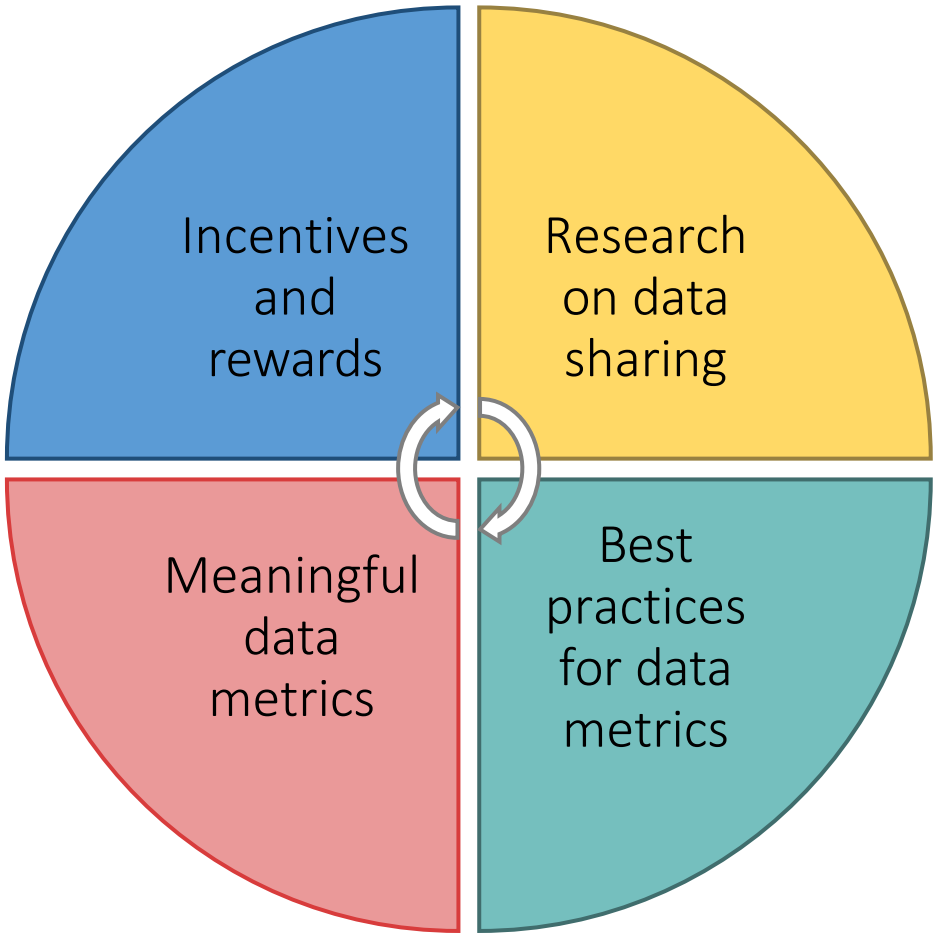


Haustein, S., & Peters, I. (2020). Meaningful data counts. Grant application to the Alfred P. Sloan Foundation Scholarly Communication Program.

What can scholarly metrics do?

Data sharing incentives – Positive feedback loop

1. Researchers share and cite datasets due to incentives and rewards in academia
2. Bibliometricians study research data as scholarly outputs based on evidence of data reuse and citations
3. Best practices for bibliometric studies on research data are being developed, as use cases are shared
4. Meaningful data metrics are developed and available to incentivize open data practices



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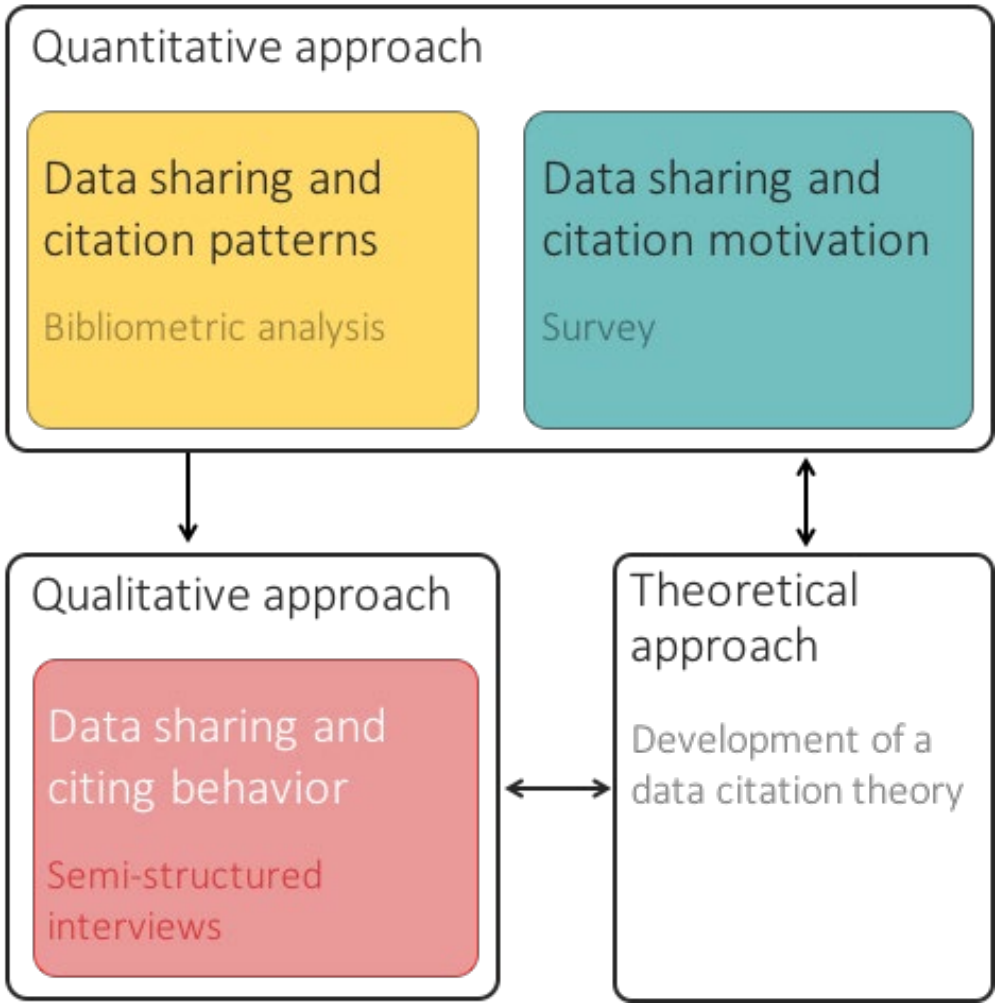
What can scholarly metrics do?

Incentivizing open scholarship

→Research on data sharing

- →Data sharing and citation patterns (i.e., bibliometric analyses)
- →Data sharing and citation motivations (e.g., surveys)
- →Data sharing and citing behavior (e.g., interviews)
- →Data citation theory



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What can we learn from bibliometrics?

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Popular metrics

- →Impact factor
  - →Compares journals
  - →Average number of citations per publication
  - →Developed by Eugene Garfield
  - →Published annually since 1960s
  - →Flawed indicator
- →H-index
  - →Compares individuals
  - →Number of publications with same number of citations
  - →Developed by Jorge Hirsch
  - →Available in citation databases
  - →Inconsistent indicator

Piwowar, H., Priem, J., Larivière, V., Alperin, J.P., Matthias, L., Norlander, B., Farley, A., West, J., & Haustein, S. (2018). The state of OA: a large-scale analysis of the prevalence and impact of Open Access articles. *PeerJ*, 6, e4375. https://doi.org/10.7717/peerj.4375

What can we learn from bibliometrics?

Impact factor

→Created as size-independent metric to select important journals per discipline for inclusion in Science Citation Index

"In view of the relation between size and citation frequency, it would seem desirable to discount effect of size when using citation data to assess a journal's importance. We have attempted to do this by calculating a relative impact factor – that is, by dividing the number of times a journal has been cited by the number of articles it has published during some specific period of time. The journal impact factor will thus reflect an average citation rate per published article."

Garfield (1972, p. 476)

Garfield, E. (1972). Citation analysis as a toll in journal evaluation. Journals can be ranked by frequency and impact of citations for science policy studies. *Science*, *178*(4060), 471-479

What can we learn from bibliometrics?

Impact factor

→ Asymmetry between numerator (all citations) and denominator (citable items only)

$$\mathrm{JIF}(2018) = \frac{Number\ of\ citations\ in\ 2018\ to\ publications\ in\ 2016\ and\ 2017}{Number\ of\ citable\ items\ published\ in\ 2016\ and\ 2017}$$

$$\mathrm{JIF}(NEJM\ 2018) = \frac{24{,}100 + 22{,}189}{328 + 327} = \frac{46{,}289}{655} = 70.670$$

$$\mathrm{JIF}_{all\ documents}(NEJM\ 2018) = \frac{24{,}100 + 22{,}189}{1{,}606 + 1{,}494} = \frac{46{,}289}{3{,}100} = 14.932$$

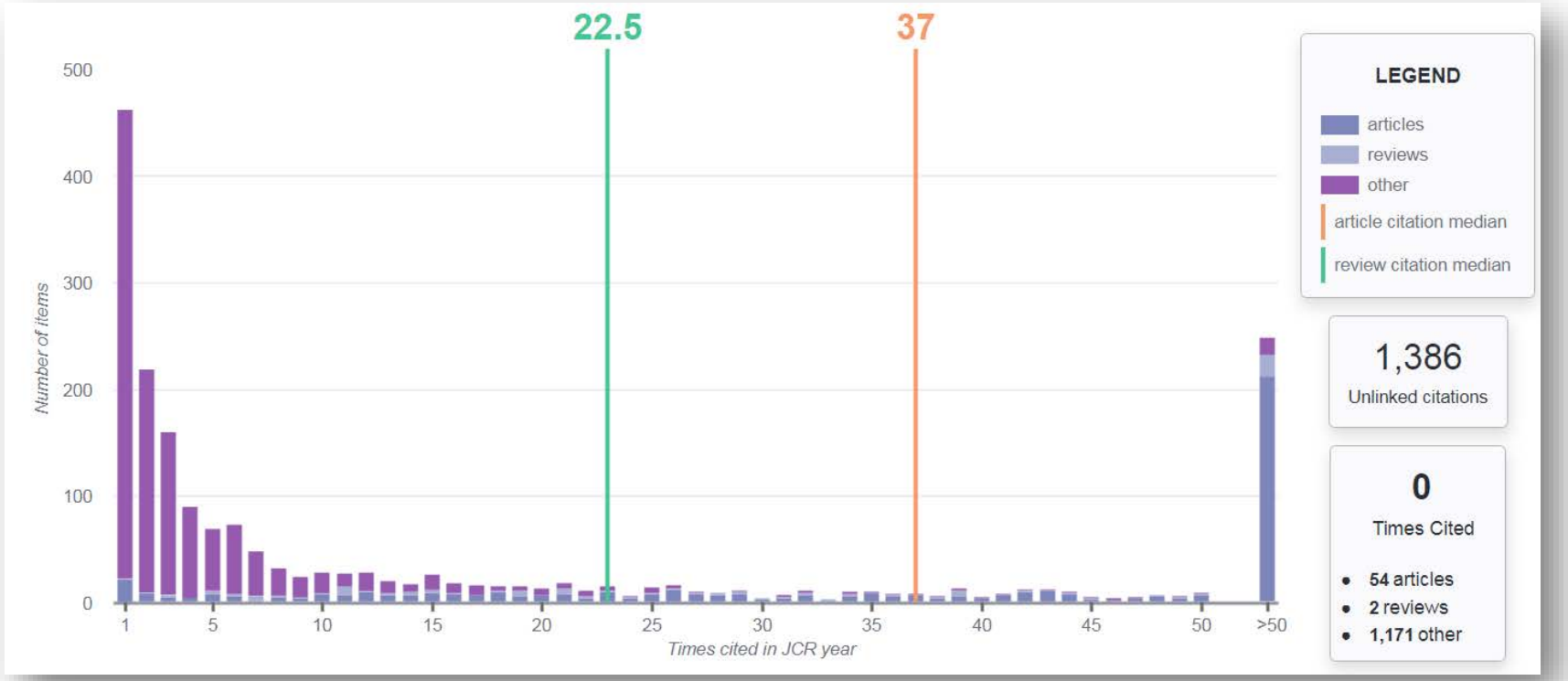
$$\mathrm{JIF}_{citable\ items}(NEJM\ 2018) = \frac{19{,}918 + 18{,}511}{328 + 327} = \frac{38{,}429}{655} = 58.670$$

What can we learn from bibliometris?

Impact factor

→Arithmetic mean representing a skewed distribution

$\mathrm{JIF}(NEJM\ 2018) = 70.670$



NEW ENGLAND JOURNAL OF MEDICINE

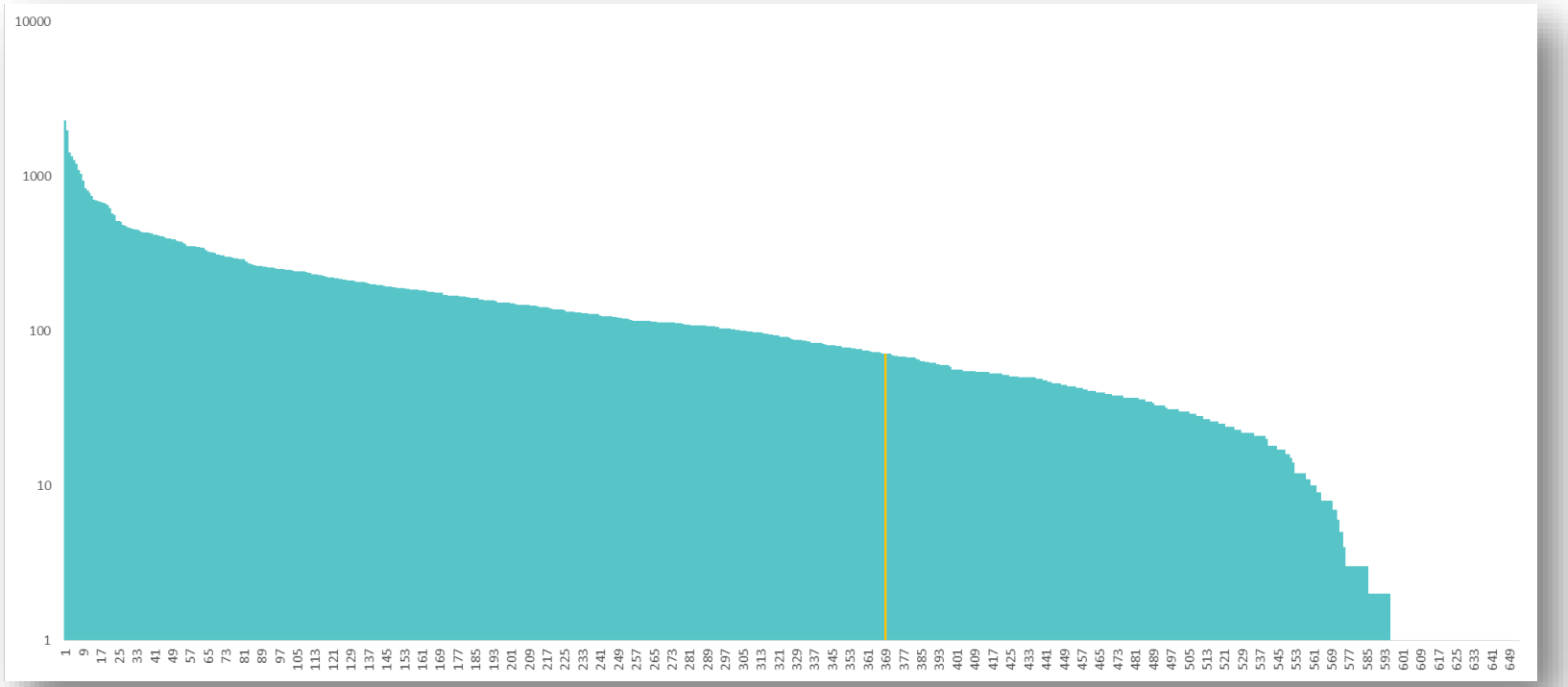
What can we learn from bibliometrics?

Impact factor

→Misuse as substitute for actual citation rate

→Article level

→Author level



What can we learn from bibliometrics?

Impact factor

→Lack of field normalization

Medicine, General & Internal

	Full Journal Title	Total Cites	Journal Impact Factor
1	NEW ENGLAND JOURNAL OF MEDICINE	344,581	70.670
2	LANCET	247,292	59.102
3	JAMA-JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION	156,350	51.273
4	Nature Reviews Disease Primers	4,339	32.274
5	BMJ-British Medical Journal	112,901	27.604
6	JAMA Internal Medicine	15,215	20.768
7	ANNALS OF INTERNAL MEDICINE	57,057	19.315
8	PLOS MEDICINE	30,689	11.048

Information Science & Library Science

	Full Journal Title	Total Cites	Journal Impact Factor
1	INTERNATIONAL JOURNAL OF INFORMATION MANAGEMENT	4,885	5.063
2	Journal of Computer-Mediated Communication	4,671	4.896
3	Journal of Knowledge Management	4,349	4.604
4	MIS QUARTERLY	17,042	4.373
5	GOVERNMENT INFORMATION QUARTERLY	3,430	4.311
6	JOURNAL OF THE AMERICAN MEDICAL INFORMATICS ASSOCIATION	9,319	4.292
7	INFORMATION & MANAGEMENT	7,129	4.120
8	JOURNAL OF STRATEGIC INFORMATION SYSTEMS	1,665	4.000

What can we learn from bibliometrics?

H-index

→Introduced by physicist Jorge E. Hirsch as a parameter to quantify an author's research output and impact

"A scientist has index *h* if *h* of his or her N_p papers have at least *h* citations each and the other (N_p-*h*) papers have ≤ *h* citations each."

Hirsch (2005, p. 16569)

→Conflation of output and impact

→Lack of clear concept

→Inconsistencies

→Lack of field normalization

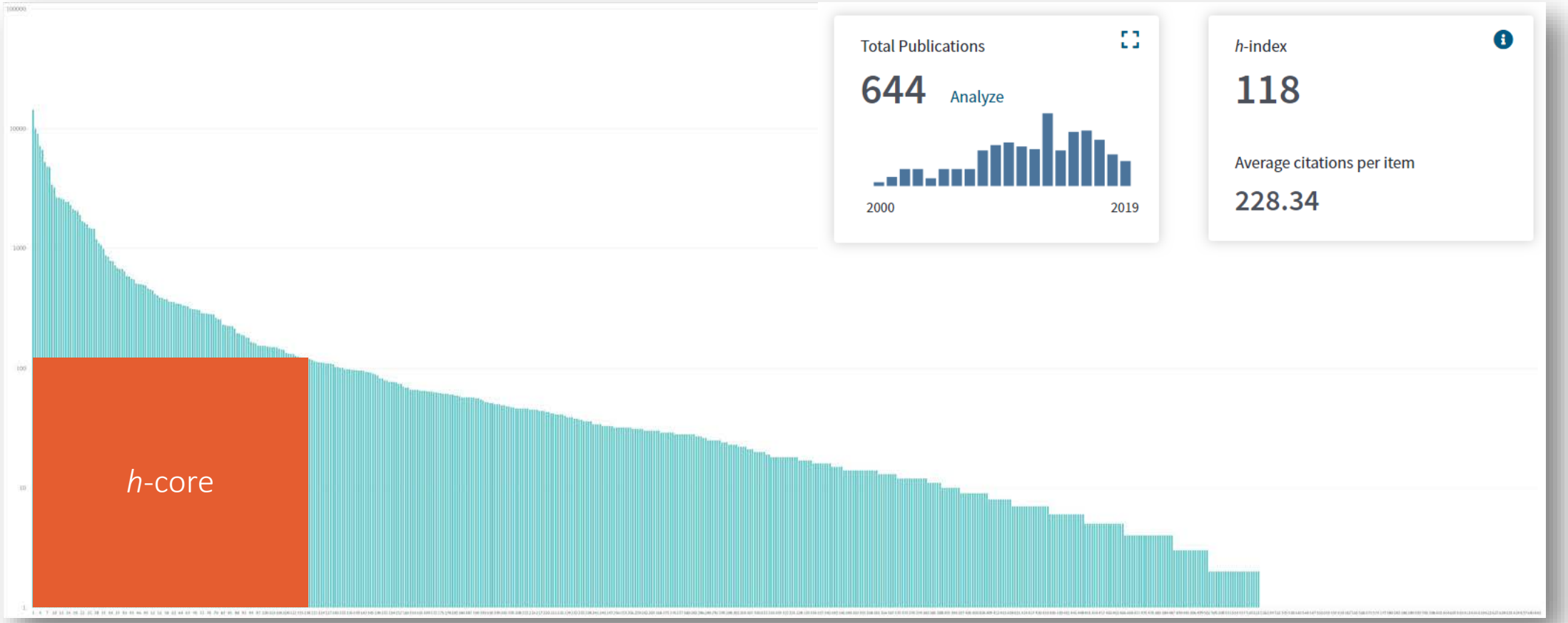
→Bias against early career researchers

Hirsch, J.E. (2005). An index to quantify an individual's scientific research output. *Proceedings of the National Academy of Sciences of the United States of America*, *102*(46), 16569-16572. https://doi.org/10.1073/pnas.0507655102

What can we learn from bibliometrics?

H-index

→Disregards publications and citations outside the h-core



What can we learn from bibliometrics?

H-index

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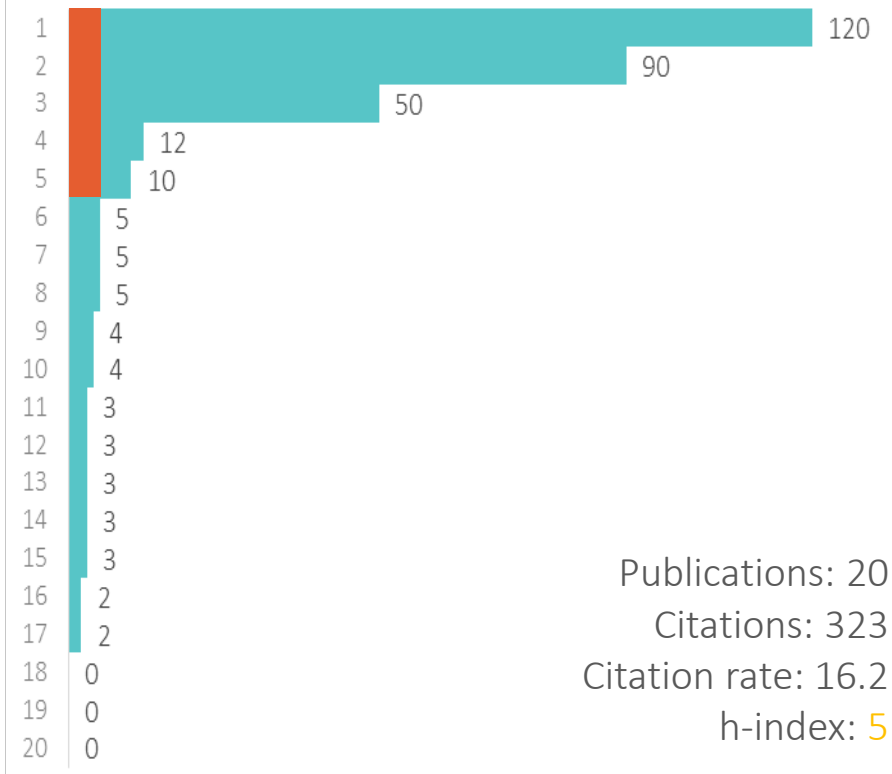
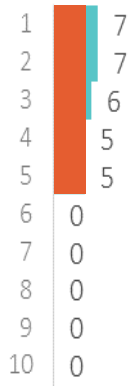


Publications: 20
Citations: 323
Citation rate: 16.2
h-index: 5



Publications: 10
Citations: 25
Citation rate: 2.5
h-index: 5

What can we learn from bibliometrics?

H-index

→ Inconsistencies

The h-index violates the following properties:

- → If two scientists achieve the same relative performance improvement, their ranking relative to each other should remain unchanged.
- → If two scientists achieve the same absolute performance improvement, their ranking relative to each other should remain unchanged.
- → If scientist X1 is ranked higher than scientist Y1 and scientist X2 is ranked higher than scientist Y2, then a research group consisting of scientists X1 and X2 should be ranked higher than a research group consisting of scientists Y1 and Y2.

"[…]from the perspective of measuring the overall impact of a set of publications, the h-index behaves in a counterintuitive way. The mechanism used by the h-index to aggregate publication and citation statistics into a single number leads to inconsistent results. Because of this, our conclusion is that the h-index cannot be considered an appropriate indicator of the overall scientific impact of a set of publications."

Waltman & van Eck (2012, p. 9)

Waltman, L. & van Eck, N.J. (2012). The inconsistency of the h-index. *Journal of the American Society for Information Science and Technology*, *63*(2), 406-415. https://doi.org/10.1002/asi.21678

What can we learn from bibliometrics?

Adverse effects

Campbell's law

"The more any quantitative social indicator is used for social decision-making, the more subject it will be to corruption pressures and the more apt it will be to distort and corrupt the social processes it is intended to monitor."

Campbell (1979, p.85)

→ Increasing publication output
- → "Salami" publishing
- → Honorary authorship

→ Increasing citation rates
- → Excessive self-citations
- → Citation cartels
- → Pressuring authors during peer review to cite one's publications

→ Changing publication behavior
- → Submitting to high-impact journals
- → Collaborating internationally

Campbell, D.T. (1979). Assessing the impact of planned social change. *Evaluation and Program Planning*, *2*(1), 67–90. https://doi.org/10.1016/0149-7189(79)90048-X

How do we develop good data metrics?

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Developing data metrics

→ Generate empirical evidence

- → Research on data sharing and citation patterns
  Quantitative studies
- → Research on motivations to (not) share and cite data
  Qualitative studies

→ Develop evidence-based indicators

- → Standardize data usage counts
  Use COUNTER Code of Practice for Research Data Usage Metrics
- → Field normalization
  Compare dataset use to field-specific benchmark
- → Access type normalization
  Distinguish between open access and mediated access
- → Data type normalization
  Distinguish between different types and sizes of shared data
- → Create complex and multidimensional metrics
  Avoid easy-to-manipulate counts, unidimensional rankings, composite indicators

How do we develop good data metrics?

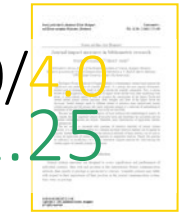
Normalized data citations

Observed citations

5 citations

+25%

5.0/4.0 =1.25



Oncology

5.0/7.5 =0.67

5 citations

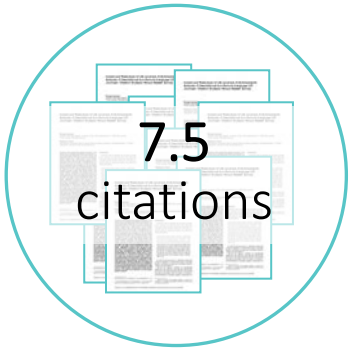
-33%

Pediatrics

Benchmark

Expected citation rate

(per field, year and other relevant characteristic)



How do we develop good data metrics?

Educating metrics users

→Metrics literacies

→Definition

An integrated set of competencies, dispositions and knowledge that empower individuals to recognize, interpret, critically assess and effectively and ethically use scholarly metrics.

→Aim

→ Increasing metrics literacies among researchers and research administrators

→ Reducing the misuse of metrics in academia

→Tools

→ Efficient, effective and high quality open educational resources

→ Short, engaging, non-textual multimedia

scholcommlab

Thank you. Merci. Danke.

@stefhaustein | stefanie.haustein@uottawa.ca

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