Research impact beyond scholarly communication – The big challenge of Scientometrics 2.0

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Structure of presentation

1. Introduction
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Glänzel, W., Chi, P. S. & Debackere, K. (2020). Measuring the impact of research – from scholarly communication to broader impact, in: R. Ball (ed.): Handbook Bibliometrics, Berlin, Germany, 135-148.

- which is based on previous works published in ISSI Newsletter (Glänzel and Chi, 2016) and presented at the 19th COLLNET meeting in Macau, China (Glänzel and Chi, 2018) and the 17th ISSI Conference in Rome, Italy (Glänzel and Chi, 2019).

1. Introduction

- What is scientometrics?
  - Scientometrics (or bibliometrics) is a sub-discipline of information science.
  - "*the application of quantitative methods which are dealing with the analysis of science viewed as an information process*" (Nalimov & Mulchenko, 1969)
  - emerged as a tool and extension of scientific information.
- Scientometrics can be used to develop and provide tools to be applied to research evaluation
  - but is not designed to directly evaluate research performance
- From Information to Evaluation - Scientometrics 1.0
- Extensions towards applied sciences, SSH and technology - Scientometrics 1.x
- Extensions towards the measurement of "broader impacts" of research - Scientometrics 2.0

2. The first version – Scientometrics 1.0

- The mission of the Scientometrics 1.0 version was to model and measure documented scholarly communication in basic science and impact on scientific communities.
  - Development of methods, indicators (metrics) for monitoring and measuring quantitative aspects of scholarly communication.
    - Developed for the basic sciences
    - First applications in the framework of scientific information
  - Increasing demand for indicators in research evaluation (perspective shift)
    - Change in application context and interpretation of indicators and measures
    - First limitations and source of misuse

3. Scientometrics 1.x-Extensions towards applied sciences, SSH and technology

- Extension of data sources and partially broadening the scope of scientometrics resulted in what can be considered 1.x versions.
- Two main characteristics: "perspective shift" and meso- level & individual level bibliometrics (Wouters et al., 2013)
- Advanced features and challenges
  - New data sources (proceedings, books, national databases, the web)
  - Database-related issues, data coverage
  - Big data issues: Data cleaning, name disambiguation, redundancies
  - Citation cultures
  - Subject-specific different communication behaviour (publication types and channels, role and function of citations)
  - Meso and micro-level specific issues: e.g., co-authorship, gender, OA

4. Scientometrics 2.0 – Promises, challenges and limitations

- The intra-scientific, societal, policy-driven and technical demands through policy and society needs lead to the evolution of a new concept called "Scientometrics 2.0" (Priem & Hemminger, 2010).
  - Priem and Hemminger considered **open science, social media metrics and alternative metrics** groundwork and components for this new concept.
- Promises
  - Sugimoto (2016) pointed to the increasing demand for showing impact of research beyond academia
    - and democratizing the impact construct by giving greater voice and vote to underrepresented groups (gender, ethnicity, disability, geographic etc.) in determining impact
  - Network-based approaches based on social media data may also contribute to a more diversified system of scientific impact assessment
    - by adding a relational and social capital-based perspective (Hoffman et al., 2014).

4. Scientometrics 2.0– Approaches

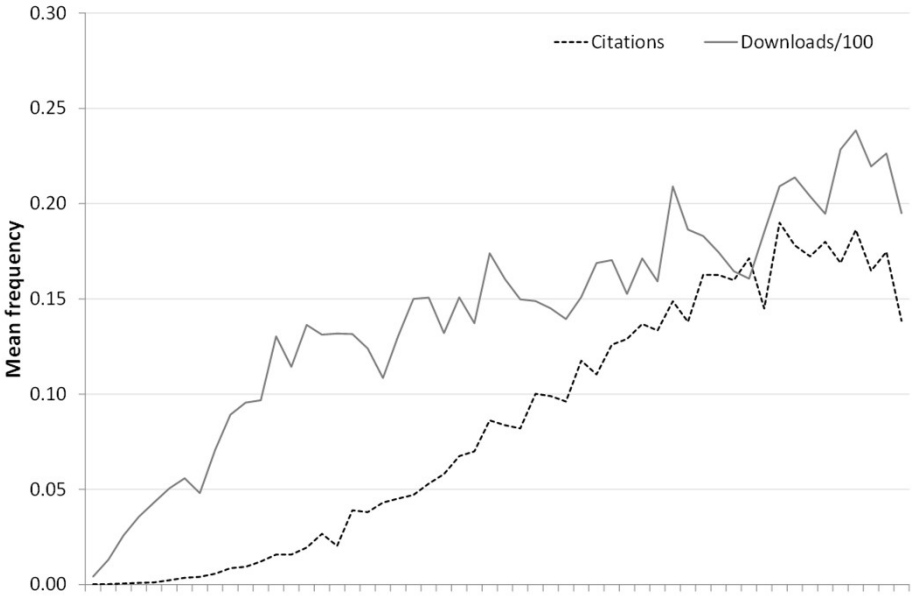
- Altmetric indicators calculate the scholarly impact based on diverse online research output
  - Cave (2012) categorized Altmetrics in the following five ways: Usage, Captures, Mentions, Social media, and Citations.
- Most of the previous studies have found some degree of correlation between altmetrics and citation indicators,
  - suggesting that these two approaches are somehow related but not the same,
  - and support the hypothesis that they should rather be considered as complementary sources providing different points of view (Zahedi, Costas, and Wouters, 2014; Costas, Zahedi, and Wouters, 2015; Gorraiz, Blahous, and Wieland, 2018).

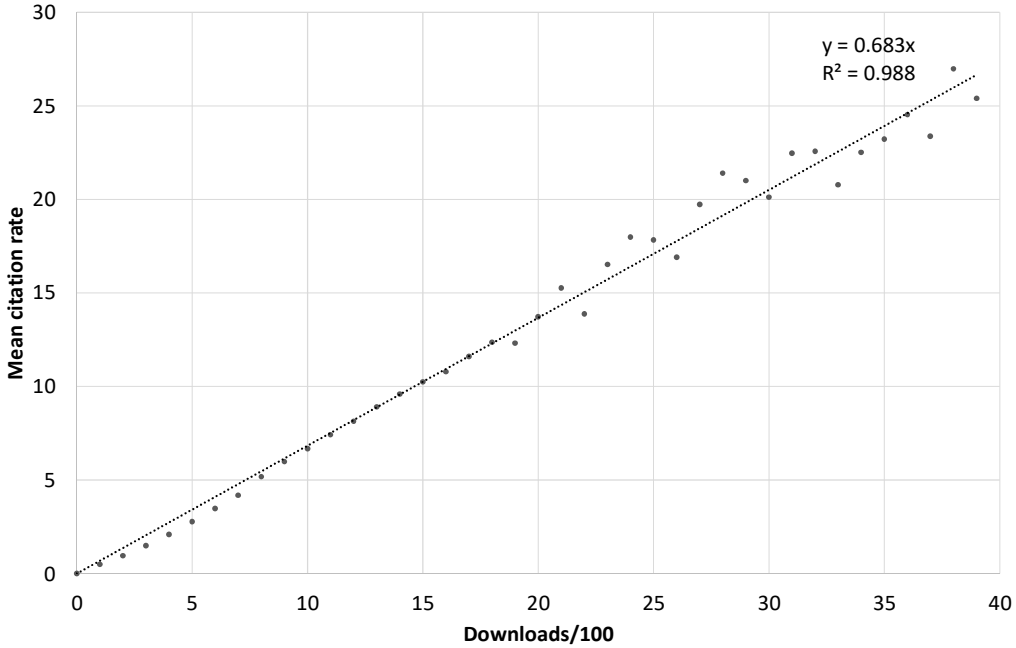
5. Previous Results – Downloads

- Downloads were one of the first statistics to supplement citation indicators (Bollen et al., 2005)
  - are considered measures of the intention to use something than their actual usage (Gorraiz et al., 2014).
- Downloads are of about two orders of magnitude more frequent than citations in an initial phase (Glänzel and Heeffer, 2014).
  - Glänzel and Chi (2018) stressed that this implies that one citation roughly corresponds to about 100 (full text) downloads in the Elsevier sample of 80,000 journal documents put online in 2008.
- However, downloads are not closely related to documented scholarly communication as citations are by nature.

Downloads vs. citations

conditional expectation E(n(t)|f(t)) against f(t), where n represents the download counts and f stands for the citation rates.





Monthly evolution of downloads vs. citations (left) and conditional mean citation rates as a function of downloads five years after online availability (right) of the 80,000 documents of the Elsevier set (Glänzel & Heeffer, in Noyons (Ed.), Proceedings of the STI Conference 2014, Leiden, p. 208)

5. Previous Results –WoS usage statistics

- The correlation between the impact and the usage measure proved very strong, which partially confirmed results of earlier studies by others (e. g., Moed, 2005; Brody et al., 2006; Thelwall, 2012).
  - Further studies by Chi and Glänzel (2018; 2019) and Chi et al. (2019) could confirm and deepen these results.
    - These studies focusing on WoS usage statistics and other PlumX metrics by the ECOOM team also showed that traditional concepts and methods can be integrated into the new metrics.

WoS usage vs. Other metrics

Spearman correlation between twelve metrics for the 18,729 documents in public health (Glänzel & Chi, 2020, Scientometrics 125, Table 1 & Table 2, pp. 1015-1016, © Akadémiai Kiadó)

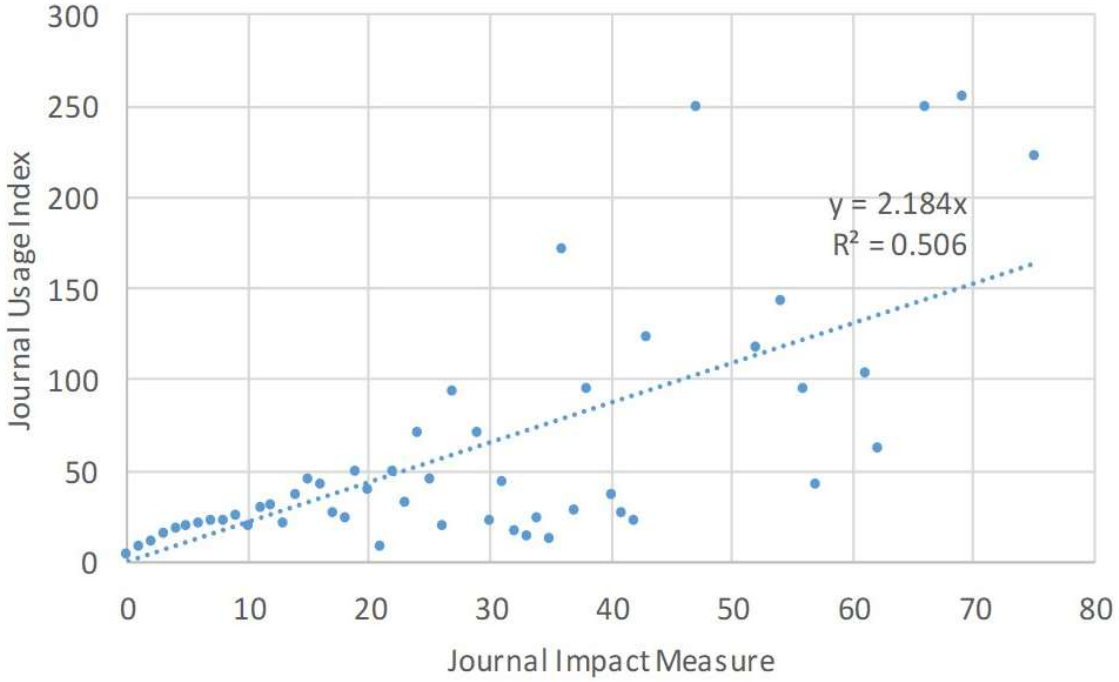
Overall categories	Specific metrics	Sources
Usage	EBSCO Abstract-views EBSCO full text views EBSCO link-outs	PlumX
	Usage Counts	WoS
Captures		PlumX
Social Media	Tweets Facebook	
Citations	Scopus citations CrossRef citations	
	Times Cited	WoS

	Usage	Abstract Views	Full tekst Views	Link-outs	WoS Usage	*Captures*	Scopus Cites	Cross Ref	WoS Cites	*Social Media*	Twitter	Facebook
Usage	-	0.83	0.56	0.60	0.31	0.62	0.19	0.23	0.18	0.19	0.18	0.10
Abstract Views		-	0.56	0.75	0.38	0.74	0.28	0.33	0.26	0.24	0.26	0.10
Full tekst Views			-	0.21	0.13	0.40	0.08	0.11	0.06	0.11	0.11	0.05
Link-outs				-	0.44	0.68	0.31	0.36	0.29	0.24	0.25	0.13
WoS Usage					-	0.49	0.43	0.42	0.42	0.24	0.24	0.14
Captures						-	0.46	0.47	0.44	0.33	0.33	0.17
Scopus Cites							-	0.88	0.94	0.32	0.32	0.18
CrossRef								-	0.86	0.32	0.31	0.19
WoS Cites									-	0.31	0.31	0.17
Social Media										-	0.89	0.61
Twitter											-	0.30
Facebook												-

5. Results –Journals Usage Index

- Could appropriate journal indicators be devised based on usage?
  - Journal Impact Measure vs. Journal Usage Index (Chi and Glänzel, 2018)

The conditional expectation **E(n(t)|f(t)) against f(t),** where n represents the usage counts and f stands for the citation rates.



The plot of usage index vs. citation impact based on conditional means for journals with at least 100 citable publications for all fields combined (2013 with 3-year observation window) according to (Chi & Glänzel, 2018, Scientometrics 116, Fig. 4, p.550 , © Akadémiai Kiadó)

5. Previous Results –WoS usage statistics

What did we learn from **journal** bibliometrics (mean values; Chi & Glänzel, 2017)?

A. Sciences
B. Social Sciences

Correlation strength and slope usages vs. cites

- Varying strength from moderate to strong with "translation" factor ranging between ~2 to 5.

Citation and usage statistics of three selected counties (Chi & Glänzel, 2017, Scientometrics 112, Table 1, p. 405 , © Akadémiai Kiadó)

		Total number of papers	Mean citation rate	Mean usage rate
Chemistry	BEL	3,165	11.98	41.44
	ISR	1,510	11.18	43.27
	IRN	8,709	7.48	24.95
Clinical & Experimental Medicine II	BEL	5,927	8.41	9.53
	ISR	3,550	6.16	7.20
	IRN	3,232	3.50	6.49
Mathematics	BEL	908	4.63	11.29
	ISR	921	3.18	4.80
	IRN	1,808	4.42	8.44
Neuroscience & Behavior	BEL	1,839	8.87	17.61
	ISR	1,703	6.09	12.33
	IRN	494	5.82	10.32
Social Sciences II	BEL	1,072	4.85	21.79
	ISR	588	4.06	18.09
	IRN	132	5.86	23.59

5. Previous Results –WoS usage statistics

Scatter plots of MCR vs. MUR of countries with at least 100 papers in six fields (Chi & Glänzel, 2018 Scientometrics 116, Fig. 1, p.540 , © Akadémiai Kiadó)

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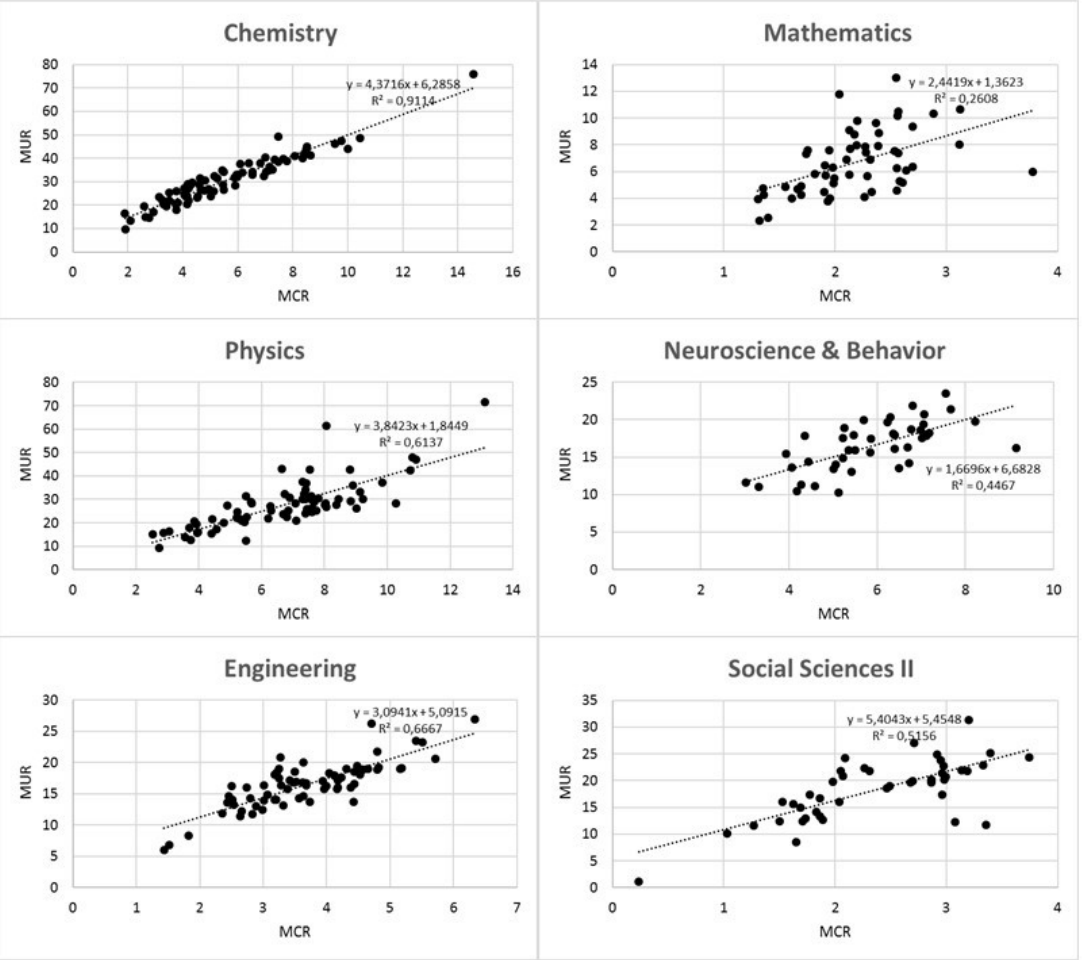

6. Interpretation and significance of altmetrics

- Context of altmerics is even more important for the interpretation of the measures than for traditional citations.
  - Social media metrics are heterogeneous and partially just express acknowledgements and simple comments (cf. Tweets).
- Altmetrics are more prone to inflationary effects than traditional bibliometrics (cf. Persson et al. 2004).
- Altmetrics data show a strong effect of the often discussed zero-inflated data phenomenon (cf., Bornmann and Haunschild, 2018)
  - low coverage of papers on social media platforms (cf. Zahedi et al., 2014), low visibility, restricted access for public use or unmatched data

6. Further Challenges and Limitations

- In our previous papers (e. g., Glänzel and Chi, 2020; Chi et al., 2019; Chi and Glänzel, 2019), we have found some lack of consistency in these measures.
  - Removing repositories or databases may result in dramatic changes and may turn local or regional effects into global phenomenon.

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- Significance and robustness of measures did not yet meet the standards of traditional scientometric tools and the interpretability of altmetrics indicators requires more context analysis than those of scholarly communication.

7. Conclusion

- Some (conceptual, methodological, and other) Scientometrics 2.0 assumptions are not yet validated and tested.
  - On the conceptual part, metrics developers, indicator designers and users should
    - guarantee replicability and robustness,
    - guarantee commensurability,
    - pay attention to the interpretation of metrics, and
    - avoid arbitrariness in designing measures.
  - On the methodological part, indicator designers and users should avoid
    - over-sophistication (cf. composite, all-in-one indicators),
    - simplification that ignores essential data aspects and characteristics,
    - arbitrariness in the selection of variables and their weighting, and
    - error-proneness.
- At this moment, we find that the currently used altmetric metrics to measure the broader impact of research still fall short of the enormous expectations and the sometimes nonreflective enthusiasm in their use.

Thank you very much.

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