

Are Altmetrics Useful for Assessing Scientific Impact? A Survey

Yusra Shakeel
Karlsruhe Institute of Technology &
Otto-von-Guericke-University
Karlsruhe & Magdeburg, Germany
yusra.shakeel@kit.edu

Rand Alchokr
Otto-von-Guericke-University
Magdeburg, Germany
rand.alchokr@ovgu.de

Jacob Krüger
Eindhoven University of Technology
Eindhoven, The Netherlands
jacob.krueger@rub.de

Thomas Leich
Harz University & METOP GmbH
Weringerode & Magdeburg, Germany
tleich@hs-harz.de

Gunter Saake
Otto-von-Guericke-University
Magdeburg, Germany
saake@ovgu.de

ABSTRACT

The rapidly expanding corpus of scientific publications poses various types of challenges for researchers, mostly concerning the selection and assessment of publications relevant to their research topic. Therefore, the scientific community is actively involved in proposing solutions for effectively retrieving promising publications. Traditional bibliometrics, such as citations, are most commonly used for evaluating the research impact of a publication, in spite of rightful criticism. More recently, the newly introduced altmetrics (e.g., Tweets) have gained popularity and are constantly being investigated to understand their usefulness and potential benefits for assessing the significance of publications. Researchers argue that altmetrics can be used to reflect the importance of a publication beyond the boundaries of traditional bibliometrics. However, it is important to be aware of the limitations and threats arising from altmetrics, too. In this paper, we present a survey analysis to understand the usefulness of altmetrics and determine their ability of being used as quality indicators for scientific research. Based on the findings, we discuss whether altmetrics can support the quality assessment during literature analyses to assist the analyst by reducing the required time and manual effort.

CCS CONCEPTS

• **Information systems** → **Social networks**; *Social recommendation*; • **General and reference** → *Empirical studies*.

KEYWORDS

Twitter, Citation Count, Altmetrics, Research Impact, Systematic Literature Review

ACM Reference Format:

Yusra Shakeel, Rand Alchokr, Jacob Krüger, Thomas Leich, and Gunter Saake. 2022. Are Altmetrics Useful for Assessing Scientific Impact? A Survey. In *International Conference on Management of Digital EcoSystems (MEDES '22)*, October 19–21, 2022, Venice, Italy.

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than ACM must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from permissions@acm.org.

MEDES '22, October 19–21, 2022, Venice, Italy

© 2022 Association for Computing Machinery.

ACM ISBN 978-1-4503-9219-8/22/10.

<https://doi.org/10.1145/3508397.3564845>

'22), October 19–21, 2022, Venice, Italy. ACM, New York, NY, USA, 4 pages.
<https://doi.org/10.1145/3508397.3564845>

1 INTRODUCTION

The massive growth of literature, irrespective of the research domain, has caused digital libraries to become a more and more important source of information for researchers. In particular, the capabilities of digital libraries in supporting analysts performing a literature review (e.g., systematic literature reviews) are gaining more attention, since the analysts aim to incorporate all publications related to a certain topic to provide an overview of the research that has been conducted [3, 8, 9, 20]. This usually involves an overwhelming amount of publications, making it challenging for an analyst to infer their relevance and quality. Even if the analyst does not follow systematic methods based on defined guidelines, they still have to perform similar steps, namely searching, selecting, and quality assessing publications.

The most reliable method for selecting a publication and assessing its quality remains reading it carefully [4, 8]. However, such a manual analysis requires considerable amounts of effort and time, especially when facing a large—and steadily increasing—number of potentially relevant publications. Recently, Hassler et al. [5] and we [21] identified that the available tooling for systematic literature reviews must be improved, particularly with respect to the selection and quality assessment of publications—which are among the most desired features of researchers. Precisely, while promising immense benefits of reducing an analyst's workload and time needed, existing tools seem to require further improvements with respect to guiding the selection and quality assessment of publications.

Through our extensive systematic literature analysis, we [21] identified four underlying concepts for techniques supporting the selection of publications, namely: visual text mining, semantic web, information retrieval, and citation analysis. However, all of these seem to be of limited capability. So, we have to investigate new methods for supporting analysts performing systematic reviews. To address this issue, the scientific community is actively involved in critically analyzing the effectiveness of bibliometrics (e.g., traditional citation counts) and the newly introduced altmetrics (e.g., Tweets) as a means of providing insights into the scientific impact of publications [1, 12, 17–19].

In this paper, we survey studies that analyze the usefulness of altmetrics, particularly in the domain of computer science, for reflecting the impact and importance of a publication. We aim to

understand if such metrics, which are often available in dedicated digital libraries, can be utilized to support an analyst in deciding what publications are more likely to be important for them. To achieve our goal, we analyze studies that investigate the pros and cons of altmetrics, which must be taken into consideration to ensure an appropriate use of such metrics. More detailed, we contribute:

- an overview of existing studies that investigate whether altmetrics can reflect on a publication's importance.
- a discussion whether using altmetrics can support an analyst in assessing the quality of publications.

We hope that our contributions guide research on altmetrics, and advance to even better criteria for assessing publications.

2 BACKGROUND

Literature analyses are important and established research methods to concatenate existing knowledge or evidence regarding a specific problem, allowing to critically analyze that knowledge and identify open gaps to plan future research. A systematic conduct is generally recommended for any literature analysis to improve transparency, allow other researchers to verify its quality, to enable replications, and to assess completeness—improving the reliability and usability overall. Thus, analysts have become increasingly conscious about the quality of the publications included within their literature analyses, and seek for methods and tools that provide quick insights into the quality of a publication without having to read every full text. Traditionally, bibliometrics, such as citation counts, journal impact factor, and author h-index, have become established metrics commonly used to reflect on a publication's impact and importance. Besides the rightful criticism of using quantitative metrics for assessing research, another major disadvantage with these metrics, especially citation counts, is the time required before they first appear, since the first occurrence may take months or even years. Therefore, alternative quantitative methods to reflect on the impact of a publication, such as altmetrics, have gained more attention to support researchers in assessing publications—primarily because they accumulate faster [25] and to some extent outside of research.

Altmetrics (introduced 2010) build on usage data of a publication and rely on various resources to accumulate interactions in the internet, namely the number of downloads, bookmarks, views, saves, and how the audience engages with a publication on social-media platforms, such as Facebook and Twitter. The most important feature of such metrics is the immediate feedback that can be accumulated in a short period of time and reflects the interest of an audience beyond academia. Although there are concerns of the research community regarding the accuracy of altmetrics, since these can be easily manipulated [2], there is still adequate evidence on their usefulness in terms of speed, diversity, ease of access, coverage of different platforms, and their association with citations [18, 24].

3 RELATED WORK

In their study, Holden et al. [6] performed a selective review to investigate the use of bibliometrics, including the impact of authors and venues using citation analysis. They provide a number of potential advantages and disadvantages of bibliometrics based on the literature they identified. One of the major advantages they highlight is the ability of bibliometrics to help researchers with managing

large datasets by reflecting on the most important publications, since citations are a relatively reliable indicator and comparatively hard to manipulate compared to other metrics, such as the number of reads. However, Holden et al. emphasize that bibliometrics are still in the process of evolution, and thus must be used carefully to minimize bias and mitigate problems related to data quality.

Recently, Thelwall [24] reported evidence in favour of and against the expanding popularity of altmetrics to evaluate research. Their major advantage is the quick feedback obtained once the publication is online that helps getting early, and also non-academic, evidence on impact. However, altmetrics potentially threaten the authenticity, since they can be easily manipulated and also lack standardization in translating the evidence into specific types of impact, for example, what do the accumulated metrics reflect? Thelwall argues that, while altmetrics can be informative and reflect various aspects of a publication, they are still not well-established, and thus inappropriate for formal evaluations.

The insights in these two studies are generalized based on the evidence identified as relevant by the authors. We aim to complement these insights based on existing studies. To this end, we summarize and critically reflect on the pros and cons of altmetrics that are discussed in nine papers.

4 METHODOLOGY

We have been actively involved in developing techniques that facilitate the selection and quality assessment of publications [3, 17, 19, 21] and the role of altmetrics as well as digital libraries for assessing publications [16, 18, 20, 22]. Based on our knowledge and experience, we identified publications that discuss the usefulness of altmetrics for assessing the impact of publications, especially with perspectives on technical and computer-science interests. In particular, we used the paper by Bornmann [2] as a reference for identifying further relevant publications based on citation links (i.e., forwards and backwards snowballing).

5 RESULTS AND DISCUSSION

In Table 1, we present the studies we identified to discuss the importance of altmetrics for assessing publications. Liu and Adie [10] reported one of the first sets of potential problems with altmetrics, mainly the lack of uniformity and standardization. Moreover, they highlight general problems with quantitative assessment methods, for example, the possibility of manipulation limiting the reliability of such metrics. As a consequence, Liu and Adie emphasize that tool developers should be careful with the information sources they consider for altmetrics, since some sources may become irrelevant in the future. Bornmann [2] published one of the first studies discussing the benefits of altmetrics compared to traditional bibliometrics, mainly including four factors:

- (1) Broadness: altmetrics can measure impact outside academia.
- (2) Diversity: altmetrics can measure the impact of a publication not only based on other publications, but rather over a greater diversity of sources.
- (3) Speed: unlike citations, altmetrics can be accumulated immediately once a publication is available online.
- (4) Openness: altmetrics are freely available to the public and can be easily accessed using Web APIs.

The authors further discuss the limitations of altmetrics regarding data quality and the commercialization of various platforms, such as Twitter. Thelwall [23] further investigates Mendeley reader counts for various research fields, such as Signal Processing and Health Information Management, to determine their importance in comparison to citations. The main disadvantages identified include the lack of users—since only a small proportion of researchers are using such platforms for Web interactions—and a high proportion of non-publishing readers that can increase bias.

Based on a comparative analysis of three important altmetrics providers, Ortega [11] concluded that there are major differences in their counting algorithms and coverage of metrics. This lack of uniformity causes doubts regarding the validity and reliability of the tools. To ensure completeness, Ortega recommends to use multiple sources or a combination of the most established metrics from different sources for analyzing research. Additionally, Holmberg et al. [7] study the use of altmetrics for capturing and measuring the societal impact of research. They highlight that altmetrics have the potential to reveal the societal influence and impact of research through a wide variety of accumulated metrics. However, for such metrics to be a reliable source of evidence on the societal impact, information regarding how the audience's knowledge and behaviour is influenced by a certain publication is valuable but not available, since such information is hard to impossible to trace.

Schultz et al. [15] focused on Leisure Science literature to investigate the usage and importance of altmetrics. They discuss that such metrics allow authors to track and monitor the type and level of the audience's engagement, for example, ResearchGate allows to see the country from where a publication is accessed. However, the study conducted by Regan and Henchion [13] showed that only around 20 % of 80 participants involved in their survey could provide an accurate description of altmetrics, illustrating that these metrics are still not well-established and add limited value. Still, Regan and Henchion agree with previous works that altmetrics can be utilized as a means of communication, but should not be considered alone to determine scientific impact.

More recently, Zahedi and Costas [25] discussed the advantages and limitations of the Mendeley readership data, which allows to easily access statistics for a data collection based on publication identifiers, for instance, via DOI, Scopus IDs, or PMID. The drawbacks highlighted are similar to the previous ones regarding non-uniformity of coverage across different tools as well as regarding the data quality. Finally, Thelwall [24] discusses similar points, but for altmetrics in general. Thelwall concludes that, even though altmetrics have the potential to reflect non-academic impact, they face major problems of manipulation, data sparsity, and translating relevant evidence for specific types of impact. Thus, the conclusion is that altmetrics can still not compete with a detailed review for assessing research quality nor can they replace robust quantitative indicators, such as citations.

Overall, our results (cf. Table 1) show that in recent years the scientific community has been actively involved in analyzing the importance of altmetrics as indicators of research impact. However, altmetrics are still under investigation, with constant development and advances in methods to accumulate and interpret them—which is especially important due to the increased popularity of exclusive social-media metrics, such as tweets [14]. The significance

and reliability of altmetrics for evaluating research is fluctuating, without any conclusive evidence in favour or against their usage. Consequently, the scientific community is and must be more and more involved in critical discussions to assess the potential benefits of and threats posed by altmetrics.

Generally, most researchers agree that altmetrics offer benefits regarding quick accumulation, ease of access, and reflecting the influence of a publication on a broader audience. Unfortunately their use as measures of research quality is still critical, and more efforts to resolve or minimize the arising issues are needed. Finally, we want to stress that altmetrics face the same problems as any quantitative metric for assessing quality, and researchers have to be careful when using them.

6 CONCLUSION

In this paper, we investigated the benefits and drawbacks of altmetrics with respect to using them as indicators of scientific impact and quality. Currently, there is not enough evidence to prove altmetrics' usefulness to measure the extent to which they can reflect on these two aspects. Thus, it is important to critically evaluate decisions that are based on altmetrics, particularly in comparison to expert evaluations. Future research should aim to pave a way to understand the relevance of altmetrics as complements or alternatives for traditional metrics, especially for literature analyses.

ACKNOWLEDGMENTS

This research has been funded by the German DFG—MatWerk, NFDI 38/1, project # 460247524 and supported by the Helmholtz Metadata Collaboration Platform & the German National Research Data Infrastructure.

REFERENCES

- [1] Dag W. Aksnes, Liv Langfeldt, and Paul Wouters. 2019. Citations, Citation Indicators, and Research Quality: An Overview of Basic Concepts and Theories. *SAGE Open* 9, 1 (2019).
- [2] Lutz Bornmann. 2014. Do Altmetrics Point to the Broader Impact of Research? An Overview of Benefits and Disadvantages of Altmetrics. *Journal of Informetrics* 8, 4 (2014).
- [3] Gabriel C. Durand, Anusha Janardhana, Marcus Pinnecke, Yusra Shakeel, Jacob Krüger, Thomas Leich, and Gunter Saake. 2018. Exploring Large Scholarly Networks with Hermes. In *International Conference on Extending Database Technology (EDBT)*. ACM.
- [4] Tore Dybå and Torgeir Dingsøyr. 2008. Strength of Evidence in Systematic Reviews in Software Engineering. In *International Symposium on Empirical Software Engineering and Measurement (ESEM)*. ACM.
- [5] Edgar Hassler, Jeffrey C. Carver, David Hale, and Ahmed Al-Zubidy. 2016. Identification of SLR Tool Needs – Results of a Community Workshop. *Information and Software Technology* 70 (2016).
- [6] Gary Holden, Gary Rosenberg, and Kathleen Barker. 2005. Tracing Thought Through Time and Space: A Selective Review of Bibliometrics in Social Work. *Social Work in Health Care* 41, 3-4 (2005).
- [7] Kim Holmberg, Sarah Bowman, Timothy Bowman, Fereshteh Didegah, and Terttu Kortelainen. 2019. What is Societal Impact and Where Do Altmetrics Fit into the Equation? *Journal of Altmetrics* 2, 1 (2019).
- [8] Barbara A. Kitchenham and Stuart Charters. 2007. *Guidelines for Performing Systematic Literature Reviews in Software Engineering*. Technical Report EBSE-2007-01. Keele University and University of Durham.
- [9] Jacob Krüger, Christian Lausberger, Ivonne von Nostitz-Wallwitz, Gunter Saake, and Thomas Leich. 2019. Search. Review. Repeat? An Empirical Study of Threats to Replicating SLR Searches. *Empirical Software Engineering* 25, 1 (2019).
- [10] Jean Liu and Euan Adie. 2013. Five Challenges in Altmetrics: A Toolmaker's Perspective. *Bulletin of the American Society for Information Science and Technology* 4 (2013).
- [11] José L. Ortega. 2018. Reliability and Accuracy of Altmeteric Providers: A Comparison among Altmeteric.Com, PlumX and Crossref Event Data. *Scientometrics* 116,

Table 1: Potential pros and cons of altmetrics as noted in the publications we surveyed.

References (Year ↑)	Pros	Cons
Liu and Adie [10] (2013)	Altmetrics may provide means to assess a more diverse range of scholarly outputs, not only limited to academia.	Quantitative values that are a subjective measure of online attention. Metrics from one data source can be measured in various ways, common standard is missing. Altmetrics can be manipulated easily, for instance, through authors engaging in self-promotion. Data quality issues demand for unique identifiers to locate publications correctly. Using data sources that may not be relevant in the future.
Bornmann [2] (2014)	Altmetrics can measure a broader impact of research, making this information easily available. Data from diverse sources is accumulated, supporting various types of outcomes. Altmetrics provide an immediate feedback, unlike citations.	Issues with data quality are an increased bias, missing supporting evidence, and a lack of measurement standardization. Different tool providers are more inclined towards commercialization rather than an informed use of altmetrics.
Thelwall [23] (2017)	Altmetrics overcome the citation lag problem.	Manipulated easily. Small proportion of researchers is active on advanced platforms, such as Mendeley or Twitter.
Ortega [11] (2017)	Coverage of altmetrics is constantly increasing over time.	Inconsistencies due to differences in counting algorithms and coverage of providers, such as Altmetric.com or PlumX.
Holmberg et al. [7] (2019)	Non-academic impact accumulated from audiences interacting on various platforms. Heterogeneity, since different metrics can reflect research impact and engagement with research differently.	Increasing knowledge of the audience through research cannot be traced back. Intention and usage of research is not clear, for example, tweets from anonymous Twitter accounts.
Schultz et al. [15] (2019)	Diverse range of outputs and contexts. Authors can track the amount and type of engagement from diverse audiences.	Lack of standardization to interpret altmetrics. Still not clear what types of attention and impact altmetrics reflect.
Regan and Henchion [13] (2019)	Researchers are able to communicate their knowledge and add to the visibility of their work.	Altmetrics do not constitute scientific impact and lack robustness, since a defined method does not exist for accumulating these metrics.
Zahedi and Costas [25] (2020)	Free access to diverse metadata and statistics, for example, reader counts from Mendeley.	Lack of access to temporal and longitudinal data, for instance, readership history. Coverage of some fields, such as humanities, is very low compared to others, such as medicine.
Thelwall [24] (2020)	Early and broader evidence on impact. Fine-grained impact context with wider output types.	Incomplete and biased coverage of impact areas. Lack of quality control and standardization.

- 3 (2018).
- [12] Jason Priem, Paul Groth, and Dario Taraborelli. 2012. The Altmetrics Collection. *PloS One* 7, 11 (2012).
- [13] Áine Regan and Maeve Henchion. 2019. Making Sense of Altmetrics: The Perceived Threats and Opportunities for Academic Identity. *Science and Public Policy* 46, 4 (2019).
- [14] Mohammad K. Saberi and Faezeh Ekhtiyari. 2019. Usage, Captures, Mentions, Social Media and Citations of LIS Highly Cited Papers: An Altmetrics Study. *Performance Measurement and Metrics* (2019).
- [15] Callie S. Schultz, Janet K. L. McKeown, and David Wynn. 2019. Altmetrics: Measuring Engagement with Contemporary Leisure Scholarship. *Leisure Sciences* 42, 1 (2019).
- [16] Yusra Shakeel, Rand Alchokr, Jacob Krüger, Thomas Leich, and Gunter Saake. 2022. Altmetrics and Citation Counts: An Empirical Analysis of the Computer Science Domain. In *Joint Conference on Digital Libraries (JCDL)*. ACM.
- [17] Yusra Shakeel, Rand Alchokr, Jacob Krüger, Thomas Leich, and Gunter Saake. 2022. Incorporating Altmetrics to Support Selection and Assessment of Publications During Literature Analyses. In *International Conference on Evaluation and Assessment in Software Engineering (EASE)*. ACM.
- [18] Yusra Shakeel, Rand Alchokr, Jacob Krüger, Gunter Saake, and Thomas Leich. 2021. Are Altmetrics Proxies or Complements to Citations for Assessing Impact in Computer Science?. In *Joint Conference on Digital Libraries (JCDL)*. IEEE.
- [19] Yusra Shakeel, Abhisar Bharti, Thomas Leich, and Gunter Saake. 2022. Weighted Altmetric Scores to Facilitate Literature Analyses. In *International Conference on Theory and Practice of Digital Libraries (TPDL)*. Springer.
- [20] Yusra Shakeel, Jacob Krüger, Ivonne von Nostitz-Wallwitz, Christian Lausberger, Gabriel C. Durand, Gunter Saake, and Thomas Leich. 2018. (Automated) Literature Analysis - Threats and Experiences. In *International Workshop on Software Engineering for Science (SE4Science)*. ACM.
- [21] Yusra Shakeel, Jacob Krüger, Ivonne Von Nostitz-Wallwitz, Gunter Saake, and Thomas Leich. 2019. Automated Selection and Quality Assessment of Primary Studies: A Systematic Literature Review. *Journal of Data and Information Quality* 12, 1 (2019).
- [22] Yusra Shakeel, Jacob Krüger, Gunter Saake, and Thomas Leich. 2018. Indicating Studies' Quality based on Open Data in Digital Libraries. In *International Conference on Business Information Systems (BIS)*. Springer.
- [23] Mike Thelwall. 2017. Are Mendeley Reader Counts Useful Impact Indicators in All Fields? *Scientometrics* 113, 3 (2017).
- [24] Mike Thelwall. 2020. The Pros and Cons of the Use of Altmetrics in Research Assessment. *Scholarly Assessment Reports* (2020).
- [25] Zohreh Zahedi and Rodrigo Costas. 2020. Do Online Readerships Offer Useful Assessment Tools? Discussion Around the Practical Applications of Mendeley Readership for Scholarly Assessment. *Scholarly Assessment Reports* 2, 1 (2020).