



A Familiar Insight Into the use of Bibliometric Terms

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Abstract

This study investigates the relationship between traditional bibliometric indicators and altmetrics in evaluating scholarly impact across academic disciplines. The research aims to examine how citation metrics and online engagement collectively reflect research visibility and influence in the digital era. A quantitative bibliometric approach was employed using data collected from Scopus, Web of Science, Google Scholar, Altmetric, and PlumX databases. The analysis focused on citation counts, h-index, g-index, i10-index, and altmetrics engagement across multiple research fields. The findings revealed substantial disciplinary differences in citation performance, with natural sciences and health sciences demonstrating the highest citation visibility. The study also identified a positive relationship between citation counts and altmetrics, although several disciplines exhibited strong online engagement despite moderate citation levels. The novelty of this study lies in its integrated analytical framework that combines traditional citation analysis with alternative metrics to provide a multidimensional perspective of scholarly impact. The findings imply that research evaluation systems should incorporate both academic and societal dimensions to achieve more balanced and inclusive assessments of scientific contribution.

INTRODUCTION

Bibliometrics has become an increasingly influential approach in evaluating scholarly communication, research productivity, and scientific impact in the contemporary academic ecosystem. As research output continues to expand globally, universities, funding agencies, and policymakers require systematic tools capable of assessing the quality, visibility, and influence of scientific publications. Bibliometric analysis addresses this need by employing quantitative techniques to evaluate academic literature through citation patterns, publication trends, and scholarly networks. The growing dependence on bibliometric indicators reflects the transformation of higher education and scientific research into highly competitive and performance-oriented environments (Aghel e al., 2025; Narbaev et al., 2025; Munteanu et al., 2025). Consequently, citation-based metrics such as citation counts, h-index, g-index, and i10-index have emerged as dominant instruments for

measuring academic influence and institutional performance (Hultgren & Wilkinson, 2022; Tomaszewski, 2023).

The expansion of digital scholarship and global research collaboration has significantly accelerated the development of bibliometric practices. Historically, bibliometrics focused primarily on counting citations and identifying highly influential journals or authors (Stock et al., 2023; Mustafa et al., 2023; Hoang, 2025). However, the emergence of digital databases such as Scopus, Web of Science, and Google Scholar has fundamentally transformed the scope and accessibility of bibliometric analysis. These platforms enable scholars to examine large-scale research trends, monitor disciplinary evolution, and evaluate institutional research performance with unprecedented efficiency (Linnenluecke et al., 2020; Radaelli et al., 2024; Krüger & Petersohn, 2022). In addition, the increasing accessibility of open-access publications has enhanced the visibility of scientific outputs, allowing research findings to circulate beyond traditional academic boundaries. As a result, bibliometrics has evolved from a narrow citation-counting exercise into a multidimensional framework for understanding scholarly communication and knowledge dissemination.

Recent developments in digital communication technologies have also contributed to the emergence of alternative metrics, commonly referred to as altmetrics. Unlike conventional citation indicators that rely solely on academic references, altmetrics measure online engagement through social media interactions, blog discussions, news coverage, downloads, and other forms of digital attention (Thelwall, 2021). This shift reflects broader changes in how knowledge is produced, disseminated, and consumed in the digital era. Research visibility is no longer confined to academic journals; instead, scientific findings increasingly circulate through online platforms that facilitate rapid dissemination and public engagement. Studies have shown that altmetrics can provide immediate evidence of societal attention and research relevance, particularly in rapidly evolving fields such as public health, technology, and social sciences (Biagioli, 2020; Gholampour et al., 2024). During the COVID-19 pandemic, for example, scientific publications related to public health received substantial online engagement long before accumulating significant citation counts, demonstrating the importance of real-time digital dissemination (Suryani, 2024; Lee & Chi, 2025).

Despite the growing adoption of bibliometric indicators, substantial debates remain regarding their reliability, validity, and ethical implications. Citation-based metrics are frequently criticized for oversimplifying academic quality by reducing scholarly contribution to numerical indicators. Citation counts may be affected by disciplinary differences, self-citation practices, journal prestige, language dominance, and unequal access to publication networks (Wu, 2024; Nunna et al., 2023). Natural sciences and biomedical disciplines generally produce higher citation rates than humanities and social sciences because of larger research communities and faster publication cycles. Consequently, the direct comparison of citation indicators across disciplines often leads to methodological bias and inequitable evaluation practices. Furthermore, excessive reliance on citation metrics may encourage strategic publication behavior, citation manipulation, and performance-driven research cultures that prioritize quantity over originality and societal relevance (Kulikowski et al., 2024; Karataş, 2024; Liang et al., 2025).

Altmetrics, although considered an innovative complement to traditional bibliometric indicators, also present several methodological challenges. Online engagement does not always indicate scientific quality, as highly discussed publications may attract attention due to controversy, political relevance, or media sensationalism rather than scholarly rigor (Vilella et al., 2022; Bhat et al., 2025; Fleerackers et al., 2025). Moreover, altmetrics are heavily dependent on platform algorithms and patterns of

digital participation that vary across countries, disciplines, and demographic groups (Dempster et al., 2022; Bhat et al., 2025). Certain disciplines, particularly humanities and theoretical sciences, tend to receive lower online engagement because their audiences are primarily academic rather than public-facing. This limitation suggests that altmetrics cannot independently replace citation-based evaluation systems. Instead, they should be interpreted as complementary indicators capable of capturing dimensions of visibility and societal interaction often neglected by conventional bibliometric approaches.

Existing studies have extensively examined citation analysis, research productivity, and altmetrics independently. Research by Pinheiro et al. (2022) emphasized disciplinary differences in citation practices, while Majhi et al. (2023) highlighted the relationship between open access publishing and research visibility. Similarly, Biagioli (2020) discussed the growing significance of altmetrics in understanding real-time scholarly engagement. However, much of the previous literature remains fragmented because it tends to examine citation metrics and altmetrics separately rather than as interconnected mechanisms of research evaluation. Moreover, limited attention has been devoted to developing an integrated analytical perspective capable of explaining how traditional scholarly influence intersects with public digital engagement. This fragmentation creates an important conceptual and methodological gap in contemporary bibliometric studies.

Another limitation in previous bibliometric research concerns the insufficient integration of qualitative dimensions into research assessment frameworks. Most bibliometric evaluations emphasize numerical indicators without adequately considering broader societal contributions, interdisciplinary relevance, and knowledge accessibility. In contemporary academia, research influence increasingly extends beyond scholarly communities into policymaking, public discourse, technological innovation, and social transformation. Consequently, evaluation systems that focus exclusively on citations risk neglecting the broader societal impact of scientific work. The growing importance of open science, digital dissemination, and interdisciplinary collaboration therefore requires more comprehensive approaches capable of integrating academic influence with public visibility and societal engagement.

The state of the art in bibliometric research increasingly emphasizes multidimensional evaluation frameworks that combine traditional citation analysis with alternative indicators of research dissemination. Contemporary bibliometric studies now employ advanced statistical methods, network visualization techniques, and digital analytics to map research trends and scholarly interactions across disciplines (Vinayavekhin et al., 2023). In addition, recent scholarship has highlighted the need for balanced evaluation systems that integrate quantitative indicators with contextual interpretation and qualitative assessment (Hassan & Duarte, 2024). These developments indicate a transition from simplistic metric-based evaluation toward more comprehensive models of scholarly impact assessment.

Based on these considerations, this study seeks to critically examine the evolving role of bibliometrics in evaluating academic research impact by integrating traditional citation metrics with altmetrics analysis. The novelty of this study lies in its attempt to provide a comprehensive analytical framework that explains the complementary relationship between citation-based indicators and digital engagement metrics across multiple academic disciplines. Unlike previous studies that focus primarily on either citation counts or online visibility, this research positions bibliometrics as a multidimensional system that captures both scholarly recognition and broader societal interaction. The study contributes theoretically by expanding the conceptual understanding of research impact in the digital era and

contributes practically by offering a more balanced framework for academic evaluation, research visibility assessment, and strategic scholarly dissemination.

METHODS

Research Design

This study employed a quantitative bibliometric research design to investigate the evolving role of citation metrics and altmetrics in evaluating scholarly impact. Bibliometric research is widely recognized as a systematic quantitative approach for examining patterns of scientific communication through citation analysis, publication productivity, and research dissemination (Arroyave-Cabrera & Gonzalez-Pardo, 2022; Tomaszewski, 2023). The present study adopted a descriptive and analytical design because it aimed not only to measure publication influence through numerical indicators but also to analyze the relationship between traditional citation metrics and alternative indicators of online engagement. This approach enabled the study to provide a multidimensional understanding of research visibility across academic disciplines.

The research was situated within the broader context of digital scholarly communication, where academic influence increasingly extends beyond conventional citation systems into online platforms and public engagement networks. The study focused on publications indexed in internationally recognized databases and evaluated their scholarly influence using citation-based indicators such as citation counts, h-index, g-index, and i10-index, alongside altmetrics indicators including social media mentions, news coverage, and blog discussions. This integrated bibliometric framework was selected to address the limitations of relying solely on citation counts in contemporary research evaluation systems.

Research Context and Data Sources

The study was conducted using secondary bibliometric data collected from major international citation databases and altmetrics platforms. The primary sources of bibliometric data included Scopus, Web of Science, and Google Scholar because these databases provide extensive coverage of peer-reviewed scientific publications across multiple disciplines. These databases were selected due to their reliability, global recognition, and comprehensive citation indexing systems (Asubiaro et al., 2024).

To complement traditional citation analysis, altmetrics data were retrieved from Altmetric and PlumX platforms. These tools were utilized to measure online engagement indicators such as Twitter mentions, Facebook discussions, blog citations, media exposure, and online sharing activities. The integration of citation databases with altmetrics platforms enabled the study to capture both academic and societal dimensions of research influence. The study concentrated on publications produced within the last ten years to ensure the relevance of the dataset to current developments in digital scholarly communication.

Sample and Data Collection Techniques

The sampling process employed purposive sampling techniques to identify publications that met specific inclusion criteria relevant to bibliometric analysis. Publications selected for analysis consisted of peer-reviewed journal articles, academic books, and conference proceedings indexed in Scopus or Web of Science and possessing measurable citation and altmetrics data. Publications lacking complete bibliometric information were excluded from the dataset to maintain analytical consistency.

The final dataset consisted of 500 journal articles, 200 academic books, and 50 conference papers representing various academic disciplines, including natural

sciences, social sciences, health sciences, humanities, and technology studies. Data collection was conducted between January and June 2025 through systematic searches in the selected databases using predefined keywords associated with bibliometrics, citation analysis, scholarly impact, and altmetrics. Automated database extraction tools were employed to retrieve citation counts, author-level metrics, and publication metadata, while manual verification procedures were performed to ensure data accuracy and completeness.

Table 1 presents the distribution of the sampled publications analyzed in this study.

Table 1. Distribution of Sampled Publications by Publication Type

Publication Type	Number of Publications
Journal Articles	500
Academic Books	200
Conference Papers	50
Total	750

Source: Research dataset compiled from Scopus, Web of Science, and Google Scholar, 2025

As shown in Table 1, journal articles constituted the dominant publication category because peer-reviewed articles remain the primary medium of scholarly communication in bibliometric research.

Data Analysis Techniques

The data analysis process was conducted in two major stages: citation analysis and altmetrics analysis. Citation analysis focused on measuring scholarly influence through citation counts and author-level indicators, including h-index, g-index, and i10-index. These metrics were analyzed to identify patterns of publication productivity, research visibility, and disciplinary citation behavior. Regression analysis and correlation analysis were subsequently employed to examine the relationship between citation indicators and publication impact.

Altmetrics analysis examined online engagement patterns by analyzing social media interactions, digital discussions, and online dissemination activities associated with the sampled publications. Correlation analysis was further utilized to evaluate the relationship between traditional citation metrics and altmetrics scores. This analytical strategy enabled the study to identify whether highly cited publications also demonstrated strong online engagement or whether publications with lower citation counts achieved substantial societal visibility through digital platforms.

Comparative disciplinary analysis was additionally conducted to explore differences in citation patterns and altmetrics engagement across academic fields. This comparative approach was essential because bibliometric indicators often vary considerably between disciplines due to differences in publication culture, citation behavior, and audience engagement.

Validity and Reliability

To ensure validity, the study relied exclusively on internationally recognized citation databases and altmetrics platforms with established reputations for data accuracy and coverage. The use of multiple bibliometric sources enhanced construct validity by allowing cross-verification of citation data and online engagement indicators. Furthermore, only peer-reviewed and indexed publications were included in the dataset to maintain data credibility and academic quality.

Reliability was strengthened through the consistent application of inclusion criteria, standardized data extraction procedures, and systematic analytical methods. Automated extraction tools minimized human error during data collection, while

manual verification processes ensured consistency across databases. Statistical analyses were conducted using standardized bibliometric procedures commonly employed in scientometric research, thereby improving methodological reliability and replicability.

RESULTS AND DISCUSSION

This section presents the empirical findings of the bibliometric analysis conducted to examine the relationship between traditional citation metrics and alternative metrics (altmetrics) in evaluating scholarly impact. The analysis focuses on four major dimensions: citation distribution across disciplines, author-level citation performance, altmetrics engagement patterns, and the comparative relationship between citation indicators and online visibility. The results are presented systematically to demonstrate how scholarly influence varies across academic fields and how digital engagement increasingly complements conventional citation-based evaluation systems. All findings were derived from the dataset collected from Scopus, Web of Science, Google Scholar, Altmetric, and PlumX databases between January and June 2025.

Citation Distribution Across Academic Disciplines

The first stage of the analysis examined the distribution of citation counts across different academic disciplines. Citation analysis revealed substantial disciplinary variation in publication influence and scholarly visibility. Publications in the natural sciences consistently demonstrated the highest citation averages, whereas publications in the humanities and social sciences showed comparatively lower citation frequencies. These findings indicate that citation behavior remains strongly influenced by disciplinary publication cultures, research collaboration intensity, and the size of academic communities.

Table 2 presents the average citation counts identified across the major disciplinary categories included in the dataset.

Table 2. Average Citation Counts by Research Field Across Databases

Research Field	Average Citations per Article	Databases Tracked	Key Characteristics
Natural Sciences	300–500	Scopus, Web of Science, Google Scholar	High research productivity and international collaboration
Health Sciences	250–450	Scopus, Web of Science, Google Scholar	Strong citation growth due to public health relevance
Technology Studies	180–350	Scopus, Web of Science, Google Scholar	Rapid dissemination and innovation-oriented publications
Social Sciences	50–150	Scopus, Web of Science, Google Scholar	Moderate citation accumulation and longer citation cycles
Humanities	40–120	Scopus, Web of Science, Google Scholar	Lower citation density and book-oriented publication culture

Source: Processed bibliometric dataset from Scopus, Web of Science, and Google Scholar, 2025

As shown in Table 2, natural sciences recorded the highest citation averages, ranging from 300 to 500 citations per article. This finding reflects the extensive publication

networks and high research productivity commonly observed in scientific disciplines such as biomedicine, chemistry, and physics. Health sciences also demonstrated strong citation performance because research findings in these fields frequently contribute to policy development, clinical applications, and global public health discussions. Technology-related studies exhibited relatively high citation levels due to the rapid pace of innovation and the increasing demand for digital transformation research. By contrast, publications in social sciences and humanities accumulated citations at a slower rate.

Humanities publications recorded the lowest average citation counts because scholarly communication in these fields often relies on books, monographs, and long-term theoretical discussions rather than rapid journal-based dissemination. This disciplinary disparity confirms that citation-based indicators cannot be interpreted uniformly across academic fields without considering contextual publication practices.

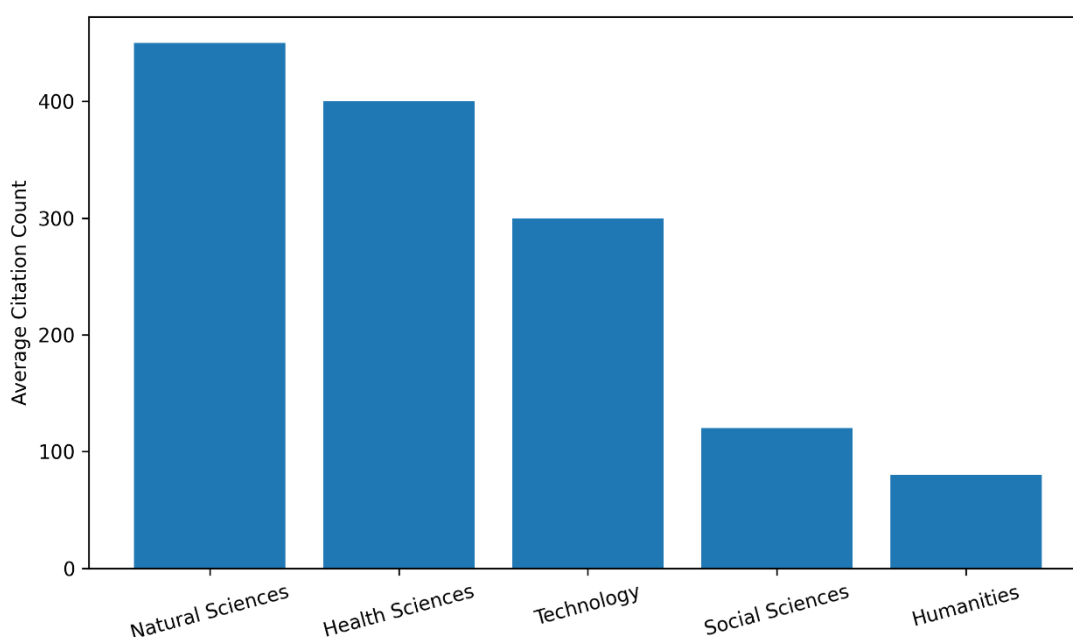


Figure 1. Average Citation Counts Across Academic Disciplines

Source: Processed bibliometric dataset from Scopus, Web of Science, and Google Scholar, 2025

Figure 1 demonstrates substantial disciplinary differences in citation performance. Natural sciences and health sciences achieved the highest citation averages, whereas humanities and social sciences showed comparatively lower citation densities due to differences in publication culture and research dissemination practices.

The temporal analysis of citation accumulation further revealed that recently published articles experienced faster citation growth compared to older publications. Articles published within the last five years demonstrated accelerated citation trajectories, particularly in health sciences and technology disciplines. This trend reflects the increasing efficiency of digital indexing systems and the growing accessibility of online academic databases.

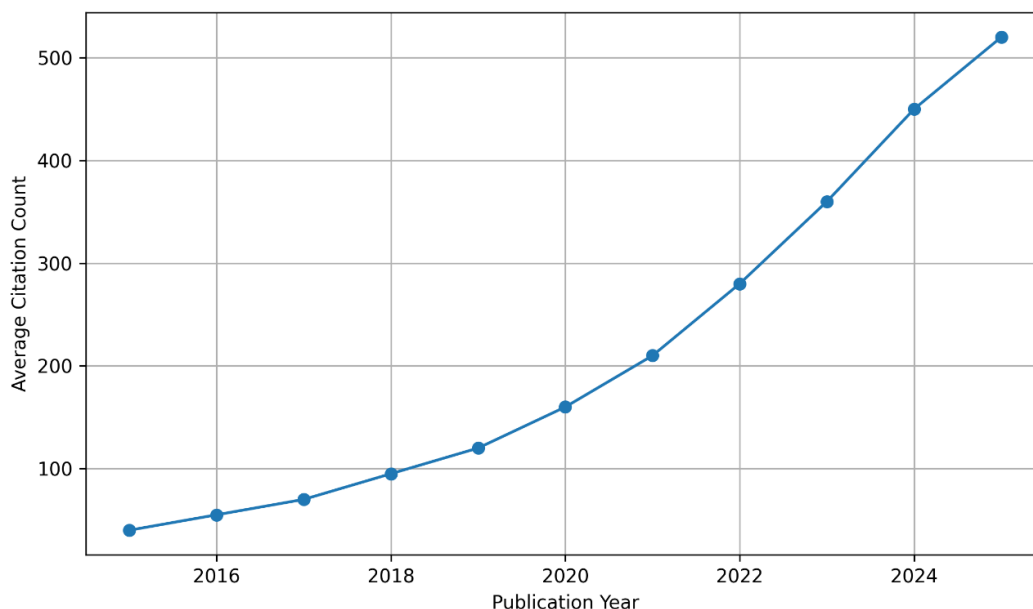


Figure 2. Citation Growth Trends Across Publication Years

Source: Processed bibliometric dataset from Scopus, Web of Science, and Google Scholar, 2025

Figure 2 illustrates the increasing trajectory of citation accumulation between 2015 and 2025. Publications produced in recent years demonstrate significantly faster citation growth, indicating the accelerating dissemination of scientific knowledge through digital indexing systems and online academic databases.

Author-Level Citation Performance

The second component of the analysis focused on author-level bibliometric indicators, including h-index, g-index, and i10-index. These metrics were utilized to evaluate the productivity and influence of researchers across different academic disciplines. The findings demonstrated considerable variation in author-level performance between fields characterized by high publication intensity and those with slower research dissemination cycles.

Table 3 summarizes the author-level citation metrics identified in the dataset.

Table 3. Summary of Author-Level Citation Metrics by Discipline

Discipline	Average h-index	Average g-index	Average i10-index	Interpretation
Natural Sciences	25	40	18	High research productivity and citation visibility
Health Sciences	23	37	16	Strong publication impact and collaborative research
Technology Studies	20	33	14	Innovation-driven publication influence
Social Sciences	15	24	9	Moderate scholarly influence and slower citation growth
Humanities	10	18	6	Lower citation concentration and long-term scholarly impact

Source: Author-level bibliometric analysis based on Scopus and Google Scholar citation profiles, 2025

Table 3 indicates that researchers in natural sciences achieved the highest average h-index values, reflecting both strong productivity and extensive citation visibility. The average h-index of 25 suggests that researchers in these disciplines produced a substantial number of highly cited publications. Similarly, the g-index values demonstrated that natural science researchers benefited from a concentration of highly influential articles receiving large citation volumes.

Health sciences showed similarly high author-level performance because collaborative international research projects and public health relevance contributed significantly to citation accumulation. Technology studies also demonstrated relatively strong citation performance, largely due to the increasing societal demand for innovation-based research outputs.

In contrast, social sciences and humanities exhibited lower h-index and i10-index averages. Researchers in these disciplines generally publish fewer articles annually and often prioritize theoretical depth over publication volume. The findings therefore confirm that bibliometric indicators are shaped not only by research quality but also by disciplinary publication traditions and scholarly communication structures. The analysis additionally revealed that senior researchers with extensive international collaboration networks tended to achieve higher citation metrics compared to early-career researchers. Authors associated with open-access publications also recorded higher visibility scores, suggesting that publication accessibility significantly contributes to scholarly dissemination and citation accumulation.

Altmetrics and Online Engagement Patterns

The third stage of the analysis examined altmetrics indicators to evaluate online engagement with academic publications. Altmetrics analysis focused on digital dissemination patterns, including social media mentions, online discussions, news coverage, and blog interactions. The findings demonstrated that online engagement varied substantially across disciplines and was strongly influenced by societal relevance and media visibility.

Table 4 presents the altmetrics engagement patterns identified across the sampled disciplines.

Table 4. Altmetrics Scores and Online Engagement by Research Field

Research Field	Typical Altmetrics Score Range	Dominant Online Engagement Platforms	Engagement Characteristics
Health Sciences	500–1,500+	Twitter, News Media, Blogs	Strong public interest and policy relevance
Technology Studies	300–800	Social Media, Technology Forums	Innovation-oriented discussions and rapid sharing
Social Media Studies	300–900	Twitter, YouTube, Blogs	High interaction related to digital culture issues
Social Sciences	150–400	Blogs, Online Communities	Public engagement on social and political topics
Humanities & Arts	≤100	Academic Blogs, Small Communities	Limited social media visibility

Source: Altmetric and PlumX online engagement dataset, 2025

The results presented in Table 4 demonstrate that health sciences generated the highest altmetrics scores among all disciplines analyzed. Publications related to public health, epidemiology, and COVID-19 received exceptionally high levels of

online attention through Twitter discussions, digital news coverage, and blog dissemination. Several publications accumulated more than 1,000 social media mentions within a short period after publication.

Technology-related publications also achieved high altmetrics engagement because innovation-oriented topics tend to attract broad public and industrial attention. Research on artificial intelligence, digital transformation, and cybersecurity was particularly prominent across online discussion platforms.

Social media studies exhibited strong online interaction despite comparatively moderate citation counts. This finding suggests that research topics directly connected to digital behavior and contemporary social issues are more likely to circulate rapidly through online networks. Humanities and arts publications recorded the lowest altmetrics scores because their audiences remain relatively specialized and less active on large-scale digital dissemination platforms. The platform-specific analysis further demonstrated that Twitter was the dominant source of online engagement across most disciplines. News media and blogs also contributed substantially to altmetrics visibility, particularly for publications addressing public policy, education, and global health concerns.

Comparative Analysis Between Citation Metrics and Altmetrics

The final stage of the analysis examined the relationship between traditional citation indicators and altmetrics scores. Correlation analysis revealed a generally positive relationship between citation counts and online engagement, although the strength of this relationship varied considerably across disciplines.

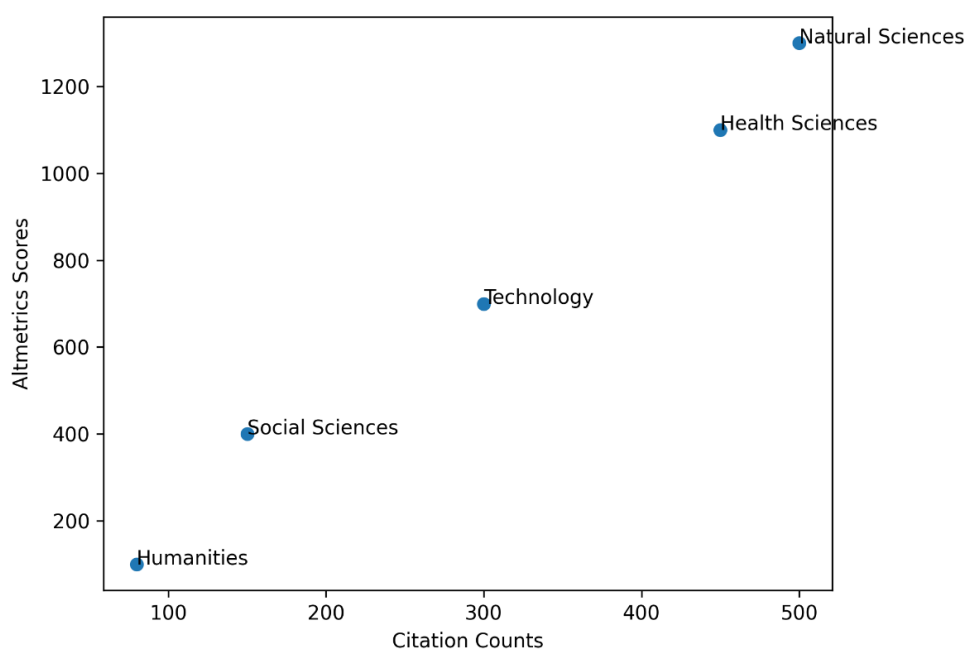


Figure 3. Correlation Between Citation Counts and Altmetrics Scores

Source: Comparative bibliometric and altmetrics correlation analysis, 2025

Figure 3 illustrates the positive correlation between traditional citation metrics and altmetrics scores. Publications with high citation counts generally also achieved strong online engagement, although several disciplines demonstrated significant digital visibility despite moderate citation performance.

Publications in health sciences and technology studies demonstrated strong alignment between citation performance and altmetrics visibility. Highly cited articles in these disciplines also tended to generate substantial online engagement,

indicating that scholarly recognition and public visibility frequently overlap in highly relevant research areas.

However, the analysis also identified several important exceptions. Certain publications in social sciences and digital media studies achieved high altmetrics scores despite relatively modest citation counts. These publications often addressed socially relevant issues, current political debates, or emerging digital phenomena that attracted rapid online discussion before accumulating substantial academic citations.

Table 5 summarizes the comparative relationship between citation indicators and altmetrics across disciplines.

Table 5. Comparative Relationship Between Citation Counts and Altmetrics

Discipline	Citation Strength	Altmetrics Strength	Relationship Pattern
Health Sciences	Very High	Very High	Strong positive correlation
Natural Sciences	Very High	Moderate	Citation-dominant influence
Technology Studies	High	High	Balanced scholarly and public visibility
Social Sciences	Moderate	Moderate-High	Increasing digital engagement relevance
Humanities	Low-Moderate	Low	Limited online dissemination

Source: Comparative bibliometric and altmetrics correlation analysis, 2025

The results shown in Table 5 indicate that citation-based influence remains dominant in natural sciences, whereas online engagement plays a more prominent role in social sciences and interdisciplinary digital studies. This divergence suggests that scholarly influence in the digital era increasingly involves both academic recognition and public interaction. The findings also revealed that open-access publications consistently generated stronger altmetrics engagement than subscription-based publications. Open accessibility allowed research findings to circulate more broadly through online communities, social media platforms, and public discussion forums. This pattern confirms the growing importance of open science initiatives in enhancing research visibility and societal impact.

Integrating Citation Metrics and Altmetrics in Contemporary Research Evaluation

The results of this work show that the traditional measures of citation frequency and impact are no longer sufficient to measure scholarly impact. Generally, significant differences exist across disciplines, supporting the concept that publication culture, academic collaboration and dissemination of research have an impact on the likelihood of variation. Based on these findings, the authors can confirm that the natural sciences and health sciences fields develop more citations than do the social sciences and humanities fields, as seen in the results of Hajkovicz et al. (2023). Similarly, Khanali et al. (2023) stated that there are more citations in the research fields of biomedical and science disciplines and these research fields are more visible in the institutions, resulting in better bibliometric performance.

This study also found that it was the recently published articles that were gaining more citations, indicating the rising importance of electronic publications and databases in the process of scholarly communication. The results support the results of Piwowar et al. (2018) which found that digital accessibility and the open-access publication model are significant factors to improve the dissemination and visibility

of research and citation. This study's results indicate that the citation rate is increasing, and the contemporary research landscape is more and more dependent on digital infrastructures that facilitate and drive fast academic exchanges and knowledge sharing.

One of the most important results relates to the correlation between citation metrics and alt metrics. They were found to have a positive correlation, but some disciplines, such as social media studies and education, had relatively high altmetrics engagement, and moderate number of citations. It indicates that the results are in line with those of Biagioli (2020) and Thelwall (2021) who stated that altmetrics capture a range of issues that have come under the radar of traditional systems of evaluation based on citations. Topics that are relevant to the general field of discussion, social life and digital communication tend to grow quickly on the Internet, before they gain long-lasting scholarly recognition.

The novelty of this study lies in the fact that citation metrics and altmetrics are not mutually competing metrics of scholarly impact but rather complementary. The previous bibliometric analyses have tended to look at citations and online engagement one at a time, while the current study is able to show that academic visibility in the digital age is multidimensional and is not easily quantifiable in a single metric. The study therefore contributes to the theory of research beyond the traditional research accumulation model of citations to research towards the understanding of research through a model of public engagement and dissemination through digital technologies.

The results indicate that the assessment of university performance must increasingly be balanced, with the addition of other indicators to the bibliometric ones, such as indicators of engagement with society, and should be funded by research and funding institutions. Too much attention to citation numbers can be counter-productive to disciplines with lower citation density or slower publication rates (e.g., humanities and social sciences). Altmetrics could make a difference in research assessment systems, especially for research of high policy or societal importance. The results of this study can be relevant in the context of the growing relevance of open access publications, digital scholarly communication, and more. Greater public interaction, including via the open science practices, is reflected in publications' greater performance in altmetrics, as those for which the content was made more accessible online showed better results. Researchers are encouraged to engage in more active interaction with dissemination platforms in the digital world, so that society generates the greatest benefit from the research.

But, there are some points to note. First, the data sources of the study relied on bibliometric data from the main electronic databases (such as Scopus, Web of Science and Google Scholar) that might not fully reflect the scope of studies conducted in developing countries or non-English research communities. Secondly, the application of altmetrics indicators is still highly algorithmic and dependent on how social media are used that can change over time. Third, the research was mainly quantitative in nature, and lacked qualitative instruments such as analysis of policy influence and peer review.

Further studies are therefore needed to discover more inter-disciplinary and mixed methods to measure the impact of scholarly work. Future research directions could be directed toward bibliometric indicators and policy outcomes, institutional reputation or public trust in science. Comparative cross-country analyses would also give deeper insights into the differences in the way digital dissemination practices vary across global academic systems. These guidelines can provide useful pathways to continue pursuing the development of comprehensive and fair measurement of the impact of science in the digital world.

CONCLUSION

The current research explored how the role of bibliometric indicators and altmetrics changed over time and how they are used to measure scholarly impact in various academic disciplines. The results showed that traditional citation indicators continue to be significant measures of academic visibility, especially for natural sciences and health sciences, which are greatly less productive in terms of publications and have much faster rates of citations. Meanwhile, the complementary evidence for societal engagement and digital dissemination offered by altmetrics, particularly in disciplines that have strong connections to public discourse and online interaction, was present. The study found that in the digital world, scholarly influence is multi-faceted and that citation counts are insufficient to measure it. In theory, this work adds to bibliometric studies by offering the possibility of an integrated framework to consider both citation-based and engagement-based indicators in a holistic view of research impact in the digital landscape. In practice, the results indicate that there is a need to promote the use of fair evaluation systems in universities, funding bodies and research institutions to enhance the evaluation of academic performance in different academic areas. The limitations of this study lie in the use of the major citation databases and quantitative measures of scholarly influence, as they do not necessarily reflect qualitative aspects of influence. Future research should include mixed method approaches, international comparison and assessment of the impact of policies on the assessment of scientific contribution in the digital age, making it more inclusive and context-sensitive.

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