

Data Journalism and Fact-Checking Research: Global Bibliometric Trends and Adoption in Indonesia

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Abstract

Purpose: This study aimed to map the intellectual structure of global research on data journalism and fact-checking and analyzed its specific adoption patterns in Indonesia to understand how global trends translated into the Global South context.

Methods: Adopting a quantitative bibliometric approach, data were retrieved from the Scopus database covering the last decade. The study utilized Biblioshiny software, selected for its integrated statistical workflow and superior capability in comparative thematic mapping, to visualize and compare co-occurrence and co-citation networks between the global dataset and the Indonesian adoption dataset.

Findings: Global results revealed an exponential growth trajectory driven by the interdisciplinary convergence of journalism studies and computer science, with *Natural Language Processing* and *Pandemic* emerging as dominant motor themes. Conversely, the Indonesian dataset indicated a unique, reactive adoption pattern with a sharp acceleration in publications during 2016–2025. Unlike the global trend toward automated detection, Indonesian research prioritized *Social Media* as the central problem context and *Human* collaboration as the primary solution, reflecting a sociotechnical adaptation to local resource constraints.

Originality: This study provided new theoretical insights into journalism technology adoption in the Global South by conceptualizing the methodological divide between global computational trends and local human-centric practices. It offered a non-Western perspective on digital media evolution and suggested future empirical research on human-machine collaboration.

Keywords: Comparative Bibliometric, Data Journalism, Fact-Checking, Thematic Mapping, Global South.

Introduction

The misinformation and fake news crisis has evolved from a mere information nuisance into an existential threat to social stability, economic integrity, and the quality of democracy in the 21st century. A radical transformation in media technology structures has drastically exacerbated this situation, particularly with the dominance of digital platforms operating on algorithmic logic without traditional editorial intervention. In the contemporary social media ecosystem, the collapse of the gatekeeping function has enabled non-journalistic actors to recottach audiences on a scale equivalent to, or even exceeding, mainstream media, creating a systemic *information disorder*. Allcott & Gentzkow (2017) demonstrated that social media had become an important channel for the circulation of false political stories during the 2016 U.S. presidential election, while Bovet & Makse (2019) further demonstrated how fake news propagated through Twitter networks and influenced patterns of political information diffusion. Furthermore, Shu et al. (2020) deepened this analysis by dissecting the complex trichotomy forming the disinformation ecosystem: malicious actors producing content, social media platforms

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facilitating unimpeded dissemination, and users susceptible to psychological manipulation. This phenomenon confirms that the current information crisis is not merely a matter of content quality, but a structural issue rooted in the digital architecture itself.

The severity of this crisis becomes increasingly apparent when examining the viral and asymmetric dynamics of its spread. Monumental research by [Vosoughi et al. \(2018\)](#) and [Bovet & Makse \(2019\)](#), analyzing news dissemination on Twitter over a decade, revealed a startling fact: fake news spreads ‘farther, faster, deeper, and more broadly’ than the truth across all information categories. Their findings debunk the technocratic assumption that bots are the primary culprits; rather, humans are the principal agents of disinformation dissemination. [Vosoughi et al. \(2018\)](#) argue that fake news possesses high ‘novelty’ value and triggers strong emotional responses such as surprise, fear, or anger, which compel individuals to share it. This is compounded by Bakir and McStay’s findings regarding the ‘economy of emotions’, wherein social media algorithms are inherently designed to prioritize content that elicits such emotional reactions to maximize platform financial gain through user engagement ([Yang & Tian, 2021](#)). Consequently, the current digital environment is systematically biased toward the spread of erroneous yet emotionally captivating information, creating formidable challenges for fact-based journalism.

From a cognitive perspective, public susceptibility to disinformation is also closely linked to how individuals process information in an environment characterized by information overload. [Pennycook & Rand \(2019\)](#) challenge the popular narrative that partisan bias is the primary driver of belief in fake news. Instead, through a series of behavioral experiments, they found that lazy thinking, or a lack of analytical reasoning, is a stronger predictor. This implies that individuals often fail to verify information not because they wish to defend a specific ideology, but because they do not engage high-level cognition while browsing social media. On the other hand, psychological interventions such as those proposed by [Pennycook et al. \(2021\)](#) offer hope; providing simple accuracy nudges can significantly improve the quality of content shared by users. These complex psychological and algorithmic dynamics demand a robust institutional response. Journalism can no longer merely report the news; it must actively investigate, verify, and restructure the flow of information through a rigorous evidence-based approach, in which data journalism and fact-checking emerge as two primary pillars of defense.

Data journalism transcends conventional reporting by utilizing computational techniques to filter large datasets, uncover hidden patterns, and empirically verify public claims. Coddington’s further distinguishes this practice from mere Computer-Assisted Reporting (CAR), positioning data journalism at the epistemological intersection of social science, computer science, and visual design ([Stalph, 2018](#)). [Appelgren et al. \(2019\)](#) assert that this field is maturing in many Western nations, reflecting a global need for higher accountability. However, this adoption is not globally uniform. [de-Lima-Santos & Mesquita \(2021\)](#) caution against technological determinism, noting that in Global South countries, data journalism faces unique structural barriers such as limited access to open data and gaps in technical skills, which significantly influence how this practice is adopted as a verification tool in developing nations.

Concurrent with the rise of data, fact-checking has undergone rapid institutionalization as a distinct journalistic genre. [Graves \(2016\)](#), in his seminal work *Deciding What’s True*, documents the history of the rise of political fact-checking in the United States as a response to the fragmentation of truth. He argues that fact-checking is

not merely a new reporting technique, but a reform movement seeking to revitalize journalistic authority amidst a crisis of trust. Graves highlights an epistemological shift where journalists now dare to abandon the norm of passive objectivity ('he said, she said') in favor of the role of an adjudicator actively assessing the truth of public claims. To be effective, this practice requires clear operational definitions of what it opposes. Tandoc Jr. et al. (2019) formulated a comprehensive typology of fake news, distinguishing between satire, parody, fabrication, and photo manipulation. Tandoc Jr. et al. (2021) later updated this framework by analyzing how disinformation often mimics traditional news values to gain legitimacy. The transformation of fact-checking from sporadic manual activity into an institutionalized, technology-supported global operation marks a crucial evolution in modern information governance.

Although data journalism and fact-checking are theoretically complementary where data provides robust verification methods and fact-checking provides a corrective publication format academic literature regarding the two often proceeds in silos. A recent systematic literature review by Morini (2025) offers a sharp critique of this fragmentation. Morini found that data journalism research is split into two cultures that rarely dialogue: journalism studies focused on newsroom sociology, and visualization/computation research focused on technical tools. This separation hinders a holistic understanding of how data technology can be effectively used to combat disinformation. This is where the urgency of an integrative academic mapping lies. Donthu et al. (2021) assert that bibliometric analysis is an established and powerful method for evaluating the intellectual structure of a discipline, identifying 'invisible colleges', and tracking topic evolution over time. However, to date, there has been no large-scale bibliometric study specifically visualizing the convergence between data journalism and fact-checking as a unified response to the global information crisis.

The urgency of this mapping becomes increasingly critical when situated within the context of Indonesia, a country with unique and complex media ecology characteristics. With extremely high social media penetration yet varied levels of digital literacy, Indonesia has become fertile ground for the circulation of hoaxes that are often intertwined with issues of identity, religion, and politics. Responding to this challenge, the Indonesian media industry has undertaken significant adaptations. Nurlatifah (2021) highlight how mainstream media outlets such as Tirto.id and Kompas.com have institutionalized fact-checking as a daily routine, even developing collaborative journalism models that blend human verification with digital machine assistance. This phenomenon indicates that in Indonesia, fact-checking has evolved from a mere civil society movement into a new standard of professionalism. However, the rich dynamics of practice in the field have not yet been adequately reflected in scientific knowledge production. The lack of a comprehensive bibliometric evaluation of this Indonesian trajectory leaves a critical gap in our understanding of how local academic productions relate to global standards. Analyzing this local adoption is vital to determine whether Indonesia is developing a resilient, indigenous model of digital verification.

There is a significant knowledge gap in Indonesian academic literature. A recent bibliometric study by Syarrafah et al. (2025) attempted to map fake news research trends in Indonesia. Although making an important contribution in identifying publication trends, their study found that existing research remains highly fragmented and tends to focus solely on legal aspects or media literacy. (Syarrafah et al., 2025) noted the scarcity of research linking hoax mitigation with sophisticated methodological solutions such as data journalism or forensic network analysis. The absence of mapping that connects the

pillar of data journalism with that of fact-checking in the local context creates a void in understanding how Indonesian academia responds to global trends: are they merely replicating Western concepts, or are they developing distinct verification models tailored to local challenges?

Based on the exposition above, this study aims to address two primary novelties. *First*, this research conducts a comprehensive bibliometric mapping that integrates two domains that have traditionally been separate data journalism and fact-checking to visualize the global intellectual structure and the intersection between the two, addressing the critique of fragmentation raised. *Second*, this study offers a comparative analysis of adoption patterns in developing countries (Global South), specifically Indonesia, which has been underrepresented in Western-biased global bibliometric studies. Specifically, this research is formulated to answer three research questions: (1) What are the conceptual structure map, topic trends, and key actors in global research on data journalism and fact-checking? (2) How are the publication growth patterns, collaboration networks, and topic focuses in research affiliated with Indonesia characterized? (3) What are the significant similarities and differences between global trends and adoption patterns in Indonesia? By comparing global and local trajectories, this study is expected to provide an empirical foundation for the development of journalism curricula and media policies that are more relevant in Indonesia. This manuscript is systematically organized to include Introduction, Methods, Results, Discussion, and Conclusion sections.

Methods

This study employs a quantitative approach by applying Comparative Bibliometric Analysis to examine the scientific literature regarding data journalism and fact-checking. Bibliometric analysis, defined as a quantitative technique for analyzing publication patterns within a scientific field ([Donthu et al., 2021](#)), was selected for its capacity to objectively map research developments and uncover research gaps within a discipline. The primary units of analysis include scientific articles, authors, institutional/country affiliations, and keywords/themes. Data were systematically extracted from the Scopus database on November 27, 2025. The data collection and screening process adhered to the five main stages of bibliometric methodology: (1) defining keywords; (2) initial search results; (3) refinement of search results; (4) initial statistical compilation; and (5) data analysis ([Passas, 2024](#); [Ruiz-Real et al., 2018](#)).

To address the research objectives, the data were divided into two datasets with uniform screening criteria: the Global Set (2016-2025) and the Indonesia Adoption Set (2019-2025). The implementation of this dual-dataset framework serves as a methodological modification from conventional bibliometric studies, allowing for a direct comparative alignment of thematic trajectories. All analysis procedures were implemented using the Biblioshiny package within the R software environment. Biblioshiny was scientifically chosen over other tools, such as VOSviewer, due to its integrated *all-in-one* workflow that supports the entire bibliometric pipeline within a single reproducible framework. Unlike visualization-only software, Biblioshiny offers superior analytical depth through graphs, charts, and network maps to facilitate the interpretation of findings, which is essential for identifying motor and niche themes in this study. The conducted bibliometric analysis included: (1) descriptive analysis of annual publication trends; (2) citation analysis to identify influential articles; (3) Keyword Co-occurrence Analysis to map thematic structures; and (4) Country/Institution Collaboration Network Analysis to compare collaboration patterns and research

specializations.

Results

This study conducted a systematic search within the Scopus database to identify scientific articles discussing global trends and Indonesian adoption patterns regarding two pillars of contemporary journalism. The keywords *Data Journalism* and *Fact-Checking* were selected to represent the core of the research, aiming to ensure that the analyzed literature focuses on the interaction between these two practices within the context of the modern information ecosystem. Keyword selection was derived directly from the study's two core concepts: *Data Journalism* and *Fact-Checking*. These two phrases were entered verbatim into the Scopus Search Within (All Fields) query box, as both are established, standardized terms in the literature. No other terminology variations or additional search operators were used to ensure the results remained strictly focused on the intersection of these two concepts. To construct the Global Set, both keywords were searched simultaneously so that only articles explicitly discussing both topics were included in the dataset. Meanwhile, for the Indonesia Adoption Set, the same keywords were used but further refined using the Search Within (Affiliation Country) filter to select articles with author affiliations from Indonesia.

The publication timeframes were established differently for the two datasets, taking into account the developmental context of each topic. For the Global Set, the period of 2016-2025 was selected because this range retains strong relevance during the acceleration and maturation phase of research related to Data Journalism and Fact-Checking at the international level, particularly following the escalation of the global mis/disinformation crisis. Conversely, the Indonesia Adoption Set utilized a narrower period, specifically 2019-2025, to focus the analysis on the phase when this topic began to develop and be more clearly adopted within the Indonesian academic context. This distinction in time periods aims to maintain the consistency of the comparative analysis while simultaneously capturing more recent local dynamics.

Scopus was selected as the primary data source as it is an internationally recognized, leading, and reputable indexing database. Scopus provides access to a vast collection of high-quality articles across various disciplines, with rigorous selection criteria for indexed journals and documents. Consequently, articles sourced from Scopus are considered to be of high quality and have undergone a thorough peer-review process, thereby ensuring the accuracy and validity of the data for bibliometric analysis.

The initial search within the Scopus database was conducted on November 27, 2025. Utilizing the keyword combination of *Data Journalism* and *Fact-Checking* in the Search Within (All Fields) metadata field, the preliminary search yielded a total of 3.612 documents. This volume of documents, exceeding 3.000 in the initial retrieval, indicates that the intersection of *Data Journalism* and *Fact-Checking* represents a highly active research domain, frequently discussed across various document types, including articles, reviews, book chapters, and conference papers. These results further demonstrate that the 2016–2025 period constitutes a transformative era in which these two subjects began to be frequently addressed concurrently within the literature.

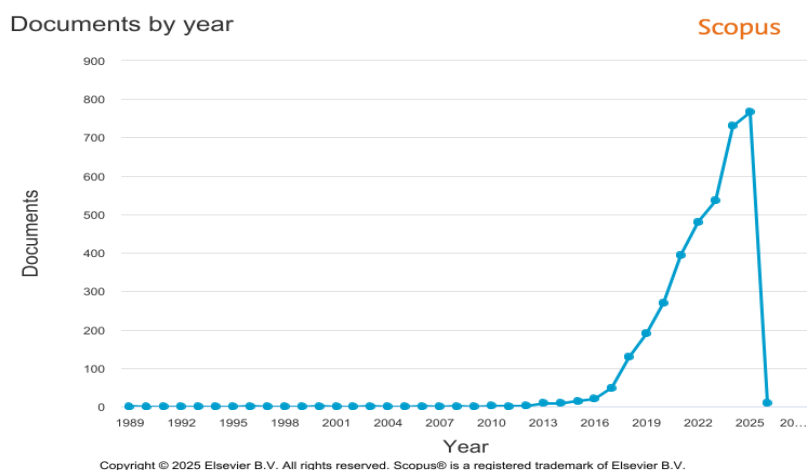


Figure 1. Keyword search result of ‘Data Journalism’ and ‘Fact-Checking’ in Scopus database (source: author's analysis)

To ensure that the bibliometric analysis focused exclusively on scientific articles representing primary research, Figure 1 present a series of rigorous filters were applied to the initial search results of 3.612 documents. These filters also served to segregate the data into two comparative sets: the Global Set and the Indonesia Adoption Set. This refinement process is summarized in Table 1. Following the application of rigorous filters restricting the document type to *Article* exclusively, alongside affiliation constraints for the Indonesia Adoption Set, the total number of documents subject to comprehensive analysis was reduced to 332 for the Global Set and 27 for the Indonesia Adoption Set. This stringent screening process yielded a focused and relevant data sample, facilitating an in-depth bibliometric analysis of performance, conceptual structures, and local adoption patterns.

Table 1. Data source set and selection

Category	Information
Research Database	Scopus
Time Range (Global Set)	2016-2025
Time Range (Indonesia Set)	2019-2025
Search/Keyword (Primary)	‘Data Journalism’ AND ‘Fact-Checking’
Document Type	‘Article’
Data Extraction	Exported with complete record (cited, bibliography, abstract & keyword, and other information) in BibTeX format
Sample Quantity (Global Set)	332
Sample Quantity (Indonesia Set)	27

Note: AND=Boolean operator used to retrieve documents containing both search terms;
BibTeX=A bibliographic data format used for integration with the Biblioshiny/R-Bibliometrix statistical environment.

Bibliometric analysis conducted on 332 articles within the Global Set (2016-2025) demonstrates that research regarding Data Journalism and Fact-Checking has undergone rapid development over the past decade. In general, the primary characteristics of this dataset depict a field of study currently in a growth phase, garnering widespread attention within the academic community. The Annual Growth Rate reached 43%, reflecting a

rapid expansion significantly higher than the typical growth rates observed in the social sciences. Furthermore, the relatively young Average Document Age of only 2.26 years indicates that the majority of publications are recent contributions, suggesting that this theme remains in an active stage of development and retains contemporary relevance. This refinement process is summarized in [Table 2](#).

Table 2. Bibliometric statistics of the global set	
Description	Result
Timespan	2016:2025
Authors	785
Author's Keywords (DE)	852
Source (Journals, Books, etc)	149
Author of Single-Authored Docs	45
Documents	332
International Co-Authorship %	26.51
Document Average Age	2.26
Annual Growth Rate	43
Co-Authors per Docs	2.93
Average Citation per Docs	23.08

Note: DE=Author Keywords (descriptors provided by the authors); Docs=Documents; %=Percentage.

Citation performance within the Global Set also exhibits a strong pattern. Articles in this dataset received an average of 23.08 citations per document, indicating that the published literature is not only voluminous but also influential. Regarding collaboration, an average of 2.93 authors per article and an international collaboration rate of 26.51% suggest that research related to Data Journalism and Fact-Checking is interdisciplinary and involves cross-border scientific networks. Collectively, these findings confirm that global research in this field is developing intensively, is highly collaborative, and possesses significant academic impact.

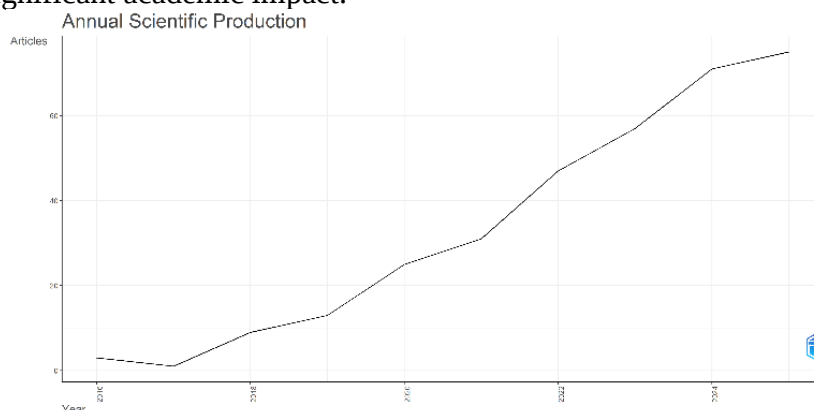


Figure 2. Growth curve of the global set journal article publications (2016-2025)
(source: author's analysis)

[Figure 2](#) presents publications that commenced slowly in 2016 (3 articles) and 2017 (1 article). However, the field entered a period of accelerated growth beginning in 2018 (9 articles), which then surged dramatically to 25 articles in 2020 and continued to rise. The most prominent trend is the steady increase observed from 2021 (31 articles) through the most recent period in 2025 (75 articles). This surge, particularly from 2023 to 2025, indicates that the intersection of Data Journalism and Fact-Checking remains in a growth phase and has not yet reached a saturation point within the academic realm. This drastic

increase reflects the sustained relevance of both journalistic practices as responses to technological advancements and the increasingly complex disinformation crisis.

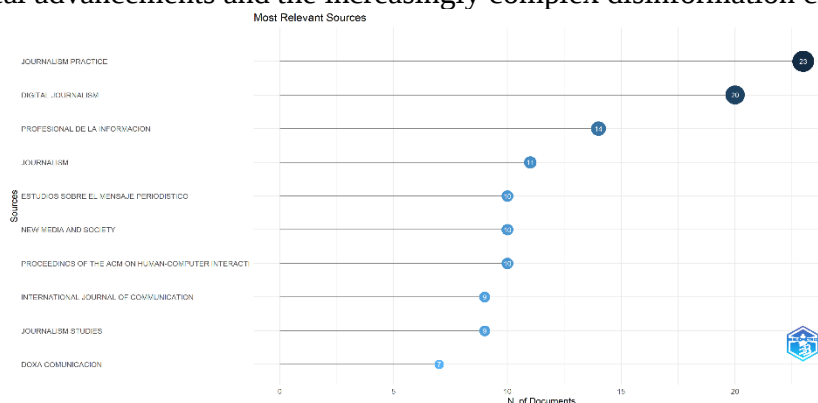


Figure 3. Most relevant source the global set (source: author's analysis)

The performance structure of the Global Set was evaluated based on the contributions of publication sources and authors. A total of 149 publication sources and 785 authors were identified within the Global Set. The journals publishing the most research on Data Journalism and Fact-Checking are dominated by communication and journalism disciplines. Figure 3 presents the 10 most relevant journals. *Journalism Practice* and *Digital Journalism* lead with the highest contributions, confirming that research on this topic is deeply rooted in Journalism Studies. The dominance of these journals aligns with the findings of Appelgren et al. (2019), who noted that data journalism has evolved into a mature sub-field within journalism studies, with an increasing focus on newsroom practices and technological adaptation. Furthermore, the inclusion of *Proceedings of the ACM on Human-Computer Interaction* highlights the interdisciplinary dimension of this research, corroborating Ekström et al. (2020) perspective on how digital journalism studies must account for the intersection of journalistic knowledge production, computational infrastructures, and human-technology interactions.

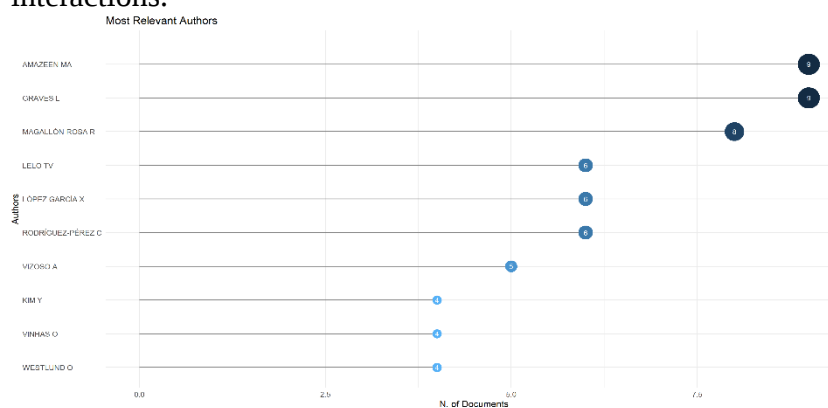


Figure 4. Most relevant authors the global set (source: author's analysis)

Figure 4 illustrates the 10 most productive authors, indicating the presence of a group of core researchers who consistently lead the academic discourse. Authors Amazeen, M.A., and Graves, L. are the most productive, contributing 9 articles each. The consistency of Graves' productivity, for instance, reflects his central role in defining and mapping the institutionalization of the global fact-checking movement, as elucidated in his seminal work (Graves, 2016). The existence of these key authors forms an 'invisible college' that steers the global research agenda toward a deeper understanding of

verification mechanisms in the digital age.

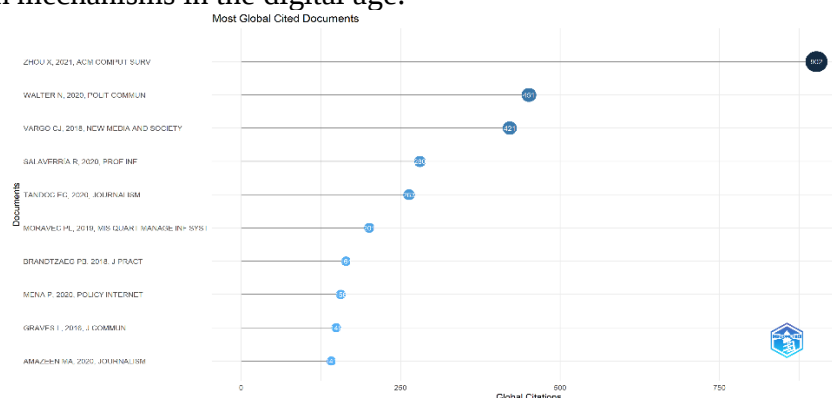


Figure 5. Most global cited documents the global set (source: author's analysis)

Figure 5 illustrates the intellectual foundation of global research (Global Set) is analyzed through the identification of articles with the highest citation counts, which serve as markers of the most influential works in the fields of Data Journalism and Fact-Checking. High citation counts reflect works that have become primary theoretical or methodological references. One significant finding is the emergence of the article by Zhou X with 902 citations, originating from the Data Science domain (*ACM Computing Surveys*). The dominance of citations for this article indicates that research development regarding Data Journalism and Fact-Checking is heavily influenced by literature situated at the intersection of data science, computing, and communication studies. This confirms that both fields are evolving as interdisciplinary domains, integrating data-driven analytical approaches with communication and journalism studies.

The most highly cited articles can be categorized into three main themes that constitute the intellectual foundation of the Global Set. The *first* theme focuses on systems and computing, where the article by Zhou X, published in *ACM Computing Surveys*, underscores that influential literature in this field relies heavily on advancements in Natural Language Processing (NLP), machine learning, and Computational Social Science. This computational approach constitutes a crucial basis for the development of misinformation detection systems, fake news classification, and the automated analysis of information dissemination patterns. The relevance of this theme is bolstered by a recent technical review by Shen et al. (2023), which demonstrates that the evolution of detection methods is increasingly dependent on deep learning models to handle the complexity of massive social media data.

The *second* theme shifts the focus toward disinformation and political communication. Articles by Walter N and Vargo CJ (published in *Political Communication* and *New Media & Society*) strengthen the understanding of the dynamics of disinformation dissemination within the digital media ecosystem. Both highlight how platform algorithms, political polarization, and user behavior contribute to the formation of public opinion and influence political processes. This literature indicates that the issue of disinformation is not merely technical but is deeply rooted in the structure of contemporary political communication. This aligns with the perspective of Posetti & Matthews (2018), who emphasize that the current 'information disorder' is a modern manifestation of the historical problem of propaganda, yet exacerbated by the unprecedented speed and scale of digital technology.

Lastly, the third theme explores journalism practices and roles, where contributions from Salaverria R, Tandoc EC, and Graves L represent core studies regarding how

journalism adapts to the demands of the digital era, particularly in the context of data journalism, editorial transparency, and fact-checking as strategic responses to misinformation. These studies affirm the importance of the role of media institutions and journalism professionals in maintaining accuracy, verification, and information credibility in the public sphere. The urgency of this role is further elucidated by (Waisbord, 2019), who argues that contemporary journalism faces serious epistemic vulnerability; therefore, the adoption of data-driven practices and rigorous verification is not merely a technical innovation, but a fundamental effort to restore the public authority of journalism amidst a crisis of truth.

These three clusters form a comprehensive intellectual foundation, ranging from misinformation detection technologies and the socio-political dynamics influencing its spread, to the institutional responses of modern journalistic practice. The combination of the three demonstrates that research regarding data journalism and fact-checking is multidimensional and evolves through collaboration between computer science, communication, and media studies. Thus, it can be concluded that the analysis of publication performance and intellectual foundations confirms that the field of Data Journalism and Fact-Checking is developing very dynamically, exhibiting exponential growth patterns, and is underpinned by solid core literature. This foundation is dominated by studies on the challenge of disinformation, the integration of data analytics in journalistic practice, and technological developments that continue to shape the contemporary information ecosystem.

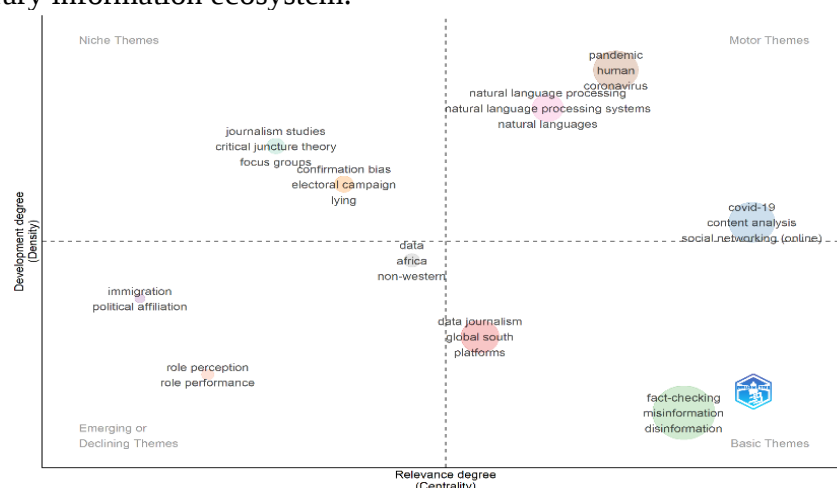


Figure 6. Thematic map the global set (source: author's analysis)

The conceptual structure of global research was analyzed using a Thematic Map generated from keyword clustering within the Global Set (2016–2025). This map (Figure 6) visualizes the relationships between themes based on two primary indicators: centrality (the degree of importance of a theme within the network) and density (the strength of a theme's internal cohesion). Based on the positioning of clusters across the four quadrants, three major theme groups shaping Data Journalism and Fact-Checking research can be identified, starting with the Motor Themes. Clusters in this quadrant exhibit high centrality and density values, indicating that these themes are both established and serve as primary drivers of research development. Within this group, the theme *Pandemic* emerged as the densest theme ($D=196.7$), signaling very high research intensity during the COVID-19 period. Meanwhile, 'natural language processing' (NLP) occupies a central and dense position ($C=4.54$; $D=109.2$), confirming that computational methods play a fundamental role in disinformation detection and the automation of fact-checking.

Beyond these driving forces, the analysis identifies Basic Themes, which are characterized by high centrality but low density. These themes serve as a general foundation connecting various subfields within the research landscape. In this category, *Covid-19* represents the theme with the highest centrality value ($C=15.8$), demonstrating that the pandemic functions as a nexus influencing nearly all research directions, whether related to information behavior, verification, or technology usage. The theme *fact-checking* is also situated in this quadrant ($C=9.8$), reaffirming its position as a core concept bridging discussions on journalism, politics, misinformation, and technology. Lastly, the quadrant for Emerging or Declining Themes contains topics with low centrality and low density values, classifying them as either newly emerging or potentially declining in relevance. Notably, 'data journalism' is located in this position ($C=1.89$; $D=61.4$). Despite being a primary keyword of this study, its position suggests that research on data journalism develops along a relatively distinct trajectory and is not always directly connected to central themes such as COVID-19 and fact-checking.

Overall, this thematic structure demonstrates that global research on Data Journalism and Fact-Checking is multidimensional. Advancements in computational technology, socio-political dynamics related to disinformation, and the transformation of modern journalistic practices constitute the three main pillars shaping the direction of literature development in the 2016-2025 period. The thematic structure reveals consistency between global social phenomena dynamics and methodological approaches within the literature. The thematic map confirms that research has evolved not only regarding technological aspects (NLP, computing) but also regarding social aspects (disinformation, campaigns, public opinion) and professional journalistic practices.

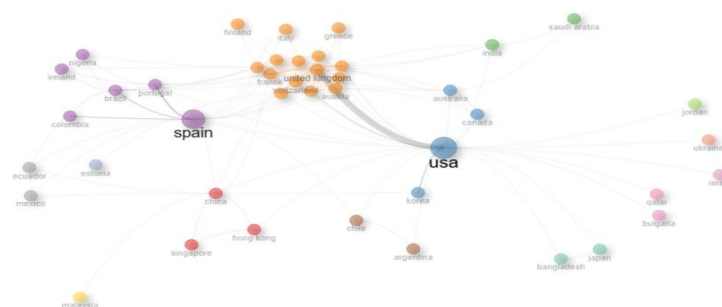


Figure 7. Collaboration network the global set (source: author's analysis)

Figure 7 illustrates a Country Co-authorship Network analysis was conducted to map research relationships between nations and identify research powerhouses in the fields of data journalism and fact-checking. The network visualization reveals the existence of five main collaboration clusters arranged based on research proximity and the intensity of cross-border cooperation. Within this network, the calculation of betweenness centrality indicates that the United States (USA) plays the most central role, with a value of 407.177. This finding confirms the USA's position as a gatekeeper connecting various distinct research clusters. While the United Kingdom (127.529) and Spain (109.533) also occupy strategic positions as significant regional hubs, particularly in facilitating research collaborations within the European and Ibero-American regions.

The network mapping further identified five specific country collaboration clusters, as illustrated in Figure 7, each possessing distinct geographic and thematic characteristics. Cluster 1, the Asia-Pacific Network, comprises China, Hong Kong, and Singapore, with

China serving as the cluster center. Collaborations in this cluster tend to focus on technology issues, data, and the dynamics of disinformation in the East and Southeast Asian regions. This is distinct from Cluster 2, the Anglophone Cluster, which involves the USA, Australia, Korea, and Canada. In this group, the USA serves as the center of global research gravity and demonstrates strong interconnectivity with European research centers. Additionally, Cluster 3, representing South Asia and the Middle East, is a smaller cluster involving India and Saudi Arabia; with India as the central country, its collaboration pattern tends to be bilateral and is not yet strongly integrated with other dominant clusters.

Furthermore, the Ibero-American Cluster (Cluster 4) comprises Spain, Brazil, Portugal, Colombia, Ireland, and Nigeria. In this arrangement, Spain acts as a regional collaboration hub connecting Spanish- and Portuguese-speaking countries, which frequently publish in productive regional journals within the literature. Finally, Cluster 5 encompasses Western and Northern Europe, involving the United Kingdom, Germany, the Netherlands, Sweden, Finland, France, Italy, and Switzerland. This cluster exhibits dense research collaboration among Western European and Nordic countries, with the UK serving as the primary bridge between Europe and North America.

The network structure reveals that global research centers remain dominated by Western nations, particularly the USA and UK, which function as primary connecting nodes between clusters. Conversely, the Ibero-American cluster demonstrates strong internal cohesion, marking the existence of a stable regional research community. Meanwhile, Asian collaboration, particularly the cluster led by China, remains relatively distinct from the Anglophone and European clusters, indicating opportunities for cross-regional collaboration in the future. Overall, the country collaboration network confirms that research related to data journalism and fact-checking evolves through uneven global interaction patterns, with a concentration in Western countries, yet continues to open space for the development of regional research communities.

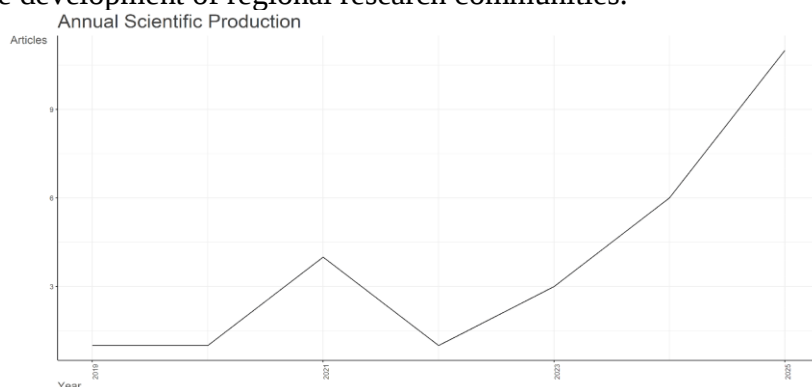


Figure 8. Annual scientific production set Indonesia (source: author's analysis)

Figure 8 illustrates the trajectory of research related to Data Journalism and Fact-Checking in Indonesia demonstrates a gradual growth pattern that subsequently experienced sharp acceleration over the last two years. Annual publication data is illustrated in the following graph. The publication trend regarding Data Journalism and Fact-Checking in Indonesia exhibited relatively slow development in the early years before eventually undergoing significant acceleration in the most recent period. The topic began to emerge in 2019 and remained at a marginal level until 2020, with only one article published in each year. The first surge occurred in 2021 when the number of publications increased to four articles, signaling the beginning of growing academic attention toward this issue in Indonesia. However, the sharpest growth occurred in 2024 and 2025. In 2024,

the publication count rose to six articles, then nearly doubled to eleven articles in 2025. This drastic increase in the last two years indicates that Data Journalism and Fact-Checking have only recently become a strong research focus in Indonesia, aligning with the escalating urgency of disinformation issues and the national need for data-driven journalistic practices.

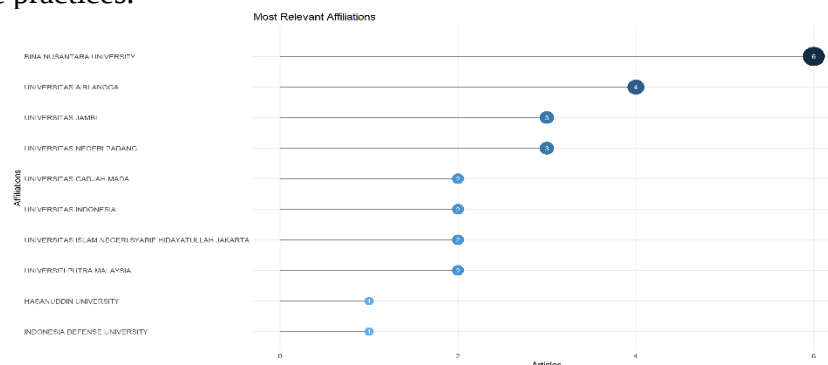


Figure 9. Most relevant affiliation set Indonesia (source: author's analysis)

Figure 9 illustrates the Indonesian institutions most actively contributing to research on Data Journalism and Fact-Checking. The dominance of both private and state universities demonstrates that research initiatives are not centralized within a single type of institution, but rather dispersed across various higher education institutions with interests in media, communication, and information technology studies. Institutionally, the *Most Relevant Sources* graph shows that Bina Nusantara University emerges as the institution with the highest number of publications, followed by Universitas Airlangga and Universitas Jambi.

The presence of Universiti Putra Malaysia on the list also reflects increasingly strong regional research collaboration patterns. This indicates that a portion of publications involving Indonesian researchers is produced through cross-border cooperation, particularly with Malaysia, which possesses a well-established research tradition in Journalism Studies within the Southeast Asian region. This phenomenon of cross-border co-authorships, as explained by Abramo et al. (2019), serves as a vital channel for knowledge flows connecting innovation systems between nations. Furthermore, (Abramo et al., 2019) emphasize that research collaboration, both domestic and international, is often correlated with the diversification of research output, as evidenced by the variety of topics beginning to be addressed by these institutions.

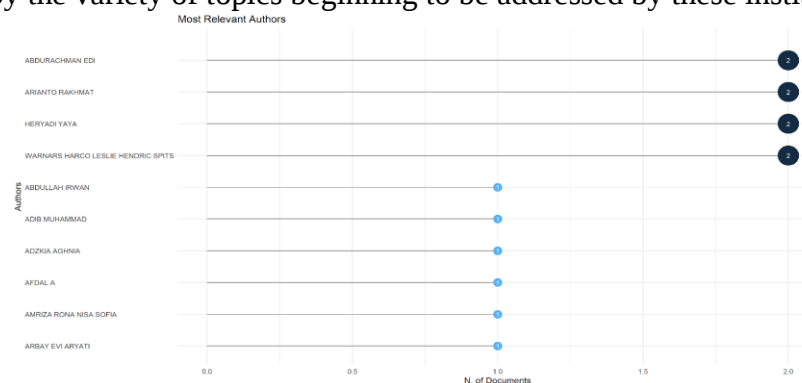


Figure 10. Most relevant authors set Indonesia (source: author's analysis)

Meanwhile, Figure 10 displays the Indonesian authors most actively contributing to research on Data Journalism and Fact-Checking. It shows that several Indonesian researchers occupy positions as the most productive contributors, each with two articles.

This pattern suggests that research productivity in Indonesia is still largely driven by individuals or small-scale collaborations. Unlike the Global Set, which possesses a group of core researchers with highly dominant publication outputs, the publication pattern of Indonesian researchers appears more evenly distributed and has not yet converged on a stable group of core authors. This author network structure aligns with the structural dynamics observed by Singh et al. (2020), where co-authorship networks in their initial stages are typically characterized by small-scale, dispersed collaborations before evolving into more densely connected core groups as the field matures.

The Thematic Map for the Indonesia Adoption Set (Figure 10) demonstrates that the conceptual structure of research in Indonesia remains dominated by issues regarding social media platforms and forms of collaborative verification. Each cluster is positioned based on its Centrality and Density values, allowing for categorization into Motor Themes, Basic Themes, Niche Themes, and Emerging/Declining Themes.



Figure 11. Thematic map set Indonesia (source: author's analysis)

The Thematic Map for the Indonesia Adoption Set (Figure 11) demonstrates that the conceptual structure of research in Indonesia remains dominated by issues regarding social media platforms and forms of collaborative verification. Each cluster is positioned based on its Centrality and Density values, allowing for categorization into Motor Themes, Basic Themes, Niche Themes, and Emerging/Declining Themes. Within this framework, the *Human* cluster ($D=93.33$) serves as a Motor Theme, representing the most mature and cohesive theme within Indonesian research. The emergence of terms such as human, machine, and journalism indicates a focus on human-machine collaboration or semi-automated fact-checking models. This development implies that Indonesia is moving toward a more systematic verification approach, although it has not yet attained the methodological depth observed in broader global research.

In contrast to the mature motor themes, the 'Social Media' cluster is identified as a Basic or Transversal Theme, possessing the highest centrality value ($C=1.78$). This position establishes it as an umbrella theme connecting nearly all Indonesian research topics. Containing terms related to misinformation and disinformation, this cluster indicates that local research is heavily problem-oriented and stems from the specific context of hoax dissemination on digital platforms. Consequently, social media constitutes the primary terrain that requires continuous mapping and comprehension within the Indonesian academic landscape. Furthermore, the analysis identifies several Niche Themes, comprising specific and relatively isolated topics. Clusters such as *Indonesia*, *Collaboration*, *Credibility*, and *Fake News Detection* are situated within this quadrant, which is characterized by low centrality. This positioning signifies that these themes remain highly specific and exhibit limited connectivity with other dominant

research structures. While these topics represent specialized areas of interest, they have not yet been integrated into the central discourse that bridges the major thematic networks of data journalism and fact-checking in Indonesia. Specifically, *Fake News Detection* displays very low centrality, indicating that research on hoax detection that is technical-computational in nature remains isolated and has not yet integrated into the research mainstream in Indonesia.

The comparative analysis between the Global Research Thematic Map (Figure 6) and the Indonesia Adoption Set (Figure 11) reveals a selective adoption pattern. This phenomenon aligns with the argument of [de-Lima-Santos & Mesquita \(2021\)](#), who posit that the adoption of journalistic innovations in the Global South is neither linear nor technologically deterministic; rather, it is heavily influenced by structural constraints and local contextual needs. Indonesian research responds to the issue of disinformation with a significantly different focus, particularly regarding methodological and practical aspects. This refinement process is summarized in Table 3.

Table 3. Key gaps found in Indonesian research adoption

Theme	Set Global	Set Indonesia	Gap/Implication
Umbrella Issue (Context)	Basic Theme: COVID-19 (High C)	Basic Theme: Social Media (Highest C)	Crisis Differentiation: Global research integrated around the Pandemic Crisis. Indonesian research is centered on the Platform as the primary context for disinformation issues.
Computational Methodology	Motor Theme: NLP (High D)	Niche Theme: Fake News Detection (Low C)	Methodological Gap: Global uses NLP as a mature, driving method. Indonesian research on technical detection is isolated and fails to integrate into the mainstream research structure.
Journalism Practice Focus	Basic Theme: Fact-Checking (High C)	Motor Theme: Human (High D)	Focus Shift: Global emphasizes Fact-Checking practices as an umbrella concept. Indonesia prioritizes the Human Role in verification, favoring semi-automated collaboration models over critical institutional studies of fact-checking.
Data Journalism	Emerging/Declining Theme	Not Present (Not a main cluster)	Practical Gap: The topic of Data Journalism (as journalistic innovation) is marginalized in Indonesia, suggesting local research prioritizes hoax mitigation over the exploration of data-driven journalism practices.

Note: Thematic mapping results were objectively generated through the Biblioshiny

statistical environment. C=Centrality (the degree of interaction of a network node with other nodes); D=Density (the internal cohesion and development of a research theme); NLP=Natural Language Processing.

The adoption pattern in Indonesia is *problem-oriented*, driven by the urgency of *Social Media* as a source of contention (Basic Theme). This confirms the findings of [Juditha \(2018\)](#), who highlighted that hoax interactions in Indonesia are deeply embedded within the dynamics of social media platforms as the primary arenas for social and political conflict. Meanwhile, solutions that have been maturely developed center on the role of the *Human* in verification collaboration (Motor Theme). This finding echoes [Zhang & Li \(2020\)](#) empirical evidence that digital verification tools complement rather than replace traditional human-driven verification routines, which in Indonesia is tangibly manifested through collaborative fact-checking practices between humans and machines, as documented by ([Nurlatifah, 2021](#)).

The primary gap lies in the low integration of computational/technical research, standing in stark contrast to global trends dominated by data mining and machine learning approaches for hoax detection ([Shu et al., 2017](#)). Furthermore, there is a notable neglect of the *Data Journalism* theme, which is fundamental in the global arena. The absence of this topic as a major theme indicates ecological barriers as described by ([Mutsvairo et al., 2019](#)), where limited access to open data, a lack of data literacy, and political pressure in developing nations often hinder the development of investigative data-driven journalism.

Discussion

The analysis of global performance indicates that the integration of Data Journalism and Fact-Checking is not merely a transient trend, but a structural evolution within communication science driven by methodological hybridity and the urgency of the information crisis. *First*, findings regarding the high level of interdisciplinary collaboration and co-citation between journalism journals (*Journalism Practice*) and computer science literature (*ACM Computing Surveys*) align with ([Usher, 2020](#)), framework regarding how the integration of big data and computational tools redefines journalistic epistemic authority. This phenomenon further strengthens the argument of ([Pooley, 2019](#)), who views communication as a ‘post-discipline,’ where disciplinary boundaries have blurred and studies must engage various frameworks, ranging from computational sociology to political science. Global research data demonstrates that Computational Social Science (CSS), as conceptualized for communication research by [Peng et al. \(2019\)](#), has become an inevitable foundation for modern journalism. This asserts that contemporary journalistic authority depends on a synergy between editorial intuition and computational logic to comprehend audience behavior and information dissemination patterns on a massive scale.

Second, the global thematic structure positioning *Pandemic* and *Fact-Checking* as central themes (Basic & Motor Themes) indicates a shift in the research agenda from the exploration of innovation toward crisis mitigation, a trend that is also validated in the latest systematic review by [Tejedor et al. \(2024\)](#) on social science literature. This agenda is driven by alarming empirical evidence, such as the seminal study by [Vosoughi et al. \(2018\)](#), which proved that fake news spreads far faster, deeper, and broader than the truth on social media. This finding, coupled with the *infodemic* phenomenon during the pandemic ([Cinelli et al., 2020](#)), has positioned fact-checking as a primary defense mechanism. This response aligns with the view of [Cazzamatta \(2025\)](#), stating that fact-checkers have transformed into vital new mediators for restoring public trust amidst a

polluted media ecosystem. *Third*, the dominance of Natural Language Processing (NLP) methods in the global research map validates the argument of [Opdahl et al. \(2023\)](#) regarding the necessity of *Trustworthy AI*. Global research is moving aggressively toward automation, where AI is utilized not to replace journalists, but to empower them in detecting manipulation patterns invisible to the human eye.

In contrast to the highly technical global trajectory, the research adoption pattern in Indonesia exhibits unique characteristics, being reactive-contextual in nature and heavily reliant on social-collaborative solutions. These findings address the knowledge gap regarding how global concepts are adopted in the Global South. The dominance of social media as a central research theme in Indonesia reflects a critical departure from technical-centric global trends, highlighting a sociopolitical response to platform-based misinformation. This reinforces the study by [Juditha \(2018\)](#), which identified social media in Indonesia as the primary arena for information conflict. Unlike Western research, which may focus on platform algorithms, Indonesian research highlights platforms as spaces of social interaction where hoaxes are produced and consumed. Consequently, research in Indonesia tends to view this issue as a problem of social behavior, rather than merely a technical issue.

Furthermore, the emergence of the *Human* cluster as a Motor Theme in Indonesia offers critical insight. While the global sphere races toward full automation, Indonesian research returns to the fundamental role of the human. This pattern aligns with the findings of ([Vosoughi et al., 2018](#)) that the spread of fake news is driven more by human factors than by bots. Since the root lies in human behavior, the solution focuses on the human element. This is reinforced [Zhang & Li \(2020\)](#), who observed in a non-Western context that emerging media technologies co-exist with traditional human practices rather than displacing them. This approach is further reinforced by the reality identified by [Haque et al. \(2018\)](#) in their study on South Asia, finding that fact-checking initiatives in developing countries face significant challenges such as resource scarcity, technological limitations, and political pressure. These conditions naturally compel local research to rely on more accessible solutions: human expertise and collaboration.

comparative analysis between the Global and Indonesian datasets reveals two critical gaps. The isolation of fake news detection in the Indonesian research landscape reveals a significant 'Computational Gap' that must be addressed to advance the discipline of communication science in Indonesia. These gaps represent the contribution of this study in filling the knowledge gap. The first gap is the Computational Gap. The analysis shows that the *Fake News Detection* cluster in Indonesia remains isolated as a Niche Theme, in contrast to its central role at the global level. [Shu et al. \(2019\)](#) emphasize that effective disinformation detection requires complex data mining approaches. This lag indicates that Indonesia has not yet adopted the Computational Social Science infrastructure recommended by [Lazer et al. \(2020\)](#). Without this, Indonesian research risks difficulty in providing scalable solutions and remains fixated on slow manual content analysis.

The *second* gap is the Practical Gap (Data Journalism Gap). The absence of the 'Data Journalism' theme as a major cluster in Indonesia is highly concerning. This phenomenon has been anticipated in literature regarding developing countries. ([Mutsvairo et al., 2019](#)), in their book *Data Journalism in the Global South*, highlight that the adoption of DJ is often hindered by a lack of open data, structural resistance in newsrooms, and a focus on more immediate crises. These structural barriers are further exacerbated by crisis conditions. As identified by [Appelgren \(2022\)](#), media leadership

during times of crisis tends to prioritize the efficiency of remote management. However, this focus often results in the neglect of informal communication and creative collaboration, both of which are essential components for fostering journalism innovations such as Data Journalism (DJ)

This finding is supported by [Heravi & Lorenz \(2020\)](#), who assert that DJ is a core competency for accountability. The absence of this theme in the Indonesian research map suggests that local academics and practitioners are too preoccupied with *extinguishing fires* (debunking hoaxes) while neglecting the importance of constructing *fire-resistant architecture* through investigative data-driven journalism practices. The need for this robust information architecture aligns with the argument of [Humprecht et al. \(2023\)](#), who emphasize that a nation's resilience to disinformation is heavily dependent on the level of public trust in news media. Without the transparency and accountability established through data-driven journalism, it will be difficult for the media to maintain its credibility as a primary public reference amidst a polarized information ecosystem. This gap must become a primary focus of future research agendas and curricula.

While this study provides a comprehensive mapping, several limitations must be acknowledged. *First*, data collection relied exclusively on the Scopus database. Although Scopus is a highly reputable database, this potentially excludes relevant publications indexed in other databases (such as Web of Science) or national journals not indexed in Scopus (SINTA), which may contain rich local discussions on this topic. *Second*, the use of English keywords 'Data Journalism' and 'Fact-Checking' in document retrieval may have caused a language bias. Research in Indonesia written in the Indonesian language without complete English metadata may not have been captured by this search strategy. *fourth*, bibliometric analysis, while powerful in mapping macro trends, has limitations in capturing the qualitative nuances of each article. The interpretation of article 'content' is based on metadata (abstracts and keywords) rather than a close reading of the full texts, leading to a potential simplification of the complexity of arguments within certain articles. Future research is suggested to employ a mixed-method approach by combining bibliometric analysis with a Systematic Literature Review to address these limitations. Prospective future studies should focus on testing Human-Machine Collaboration models in Indonesian newsrooms and exploring the implementation of data literacy curricula in communication campuses.

Conclusion

This study concludes that while the global trajectory of Data Journalism and Fact-Checking has evolved into a *hybrid epistemology* that blends editorial intuition with computational logic, adoption in Indonesia demonstrates *reactive-contextual* characteristics dominated by human-based collaborative solutions. The data reveals a significant *Computational Gap*, where the *Fake News Detection* cluster in Indonesia remains isolated as a Niche Theme, in contrast to its role as a Motor Theme at the global level supported by Computational Social Science infrastructure and Trustworthy AI. These findings confirm that structural barriers in the Global South, such as resource constraints and newsroom resistance, force a shift in focus from full automation toward collaborative verification. In practical terms, media leadership is required to move beyond crisis-era administrative efficiency by revitalizing informal creative spaces to foster accountable journalism innovation. The theoretical implications of this study emphasize that national resilience to infodemics depends not only on algorithmic sophistication but also on the construction of a transparent information architecture to restore public trust in

news media. As a prospect for future study, a mixed-methods approach is necessary to test human-machine collaboration models within local newsrooms and to explore the structural barriers to AI adoption, aiming to transform the national journalism paradigm from reactive debunking into proactive, data-driven investigative reporting.

Authors' Contributions and Responsibilities

Rully Khairul Anwar made substantial contributions to the conception and design of the study. Erai Tsabbita Pranastia took responsibility for data analysis, interpretation, and discussion of results. All authors read and approved the final manuscript.

Conflict of Interest

We certify that there is no conflict of interest with any financial, personal, or other relationships with other people or organization related to the material discussed in the manuscript.

Generative AI Statement

The authors used Google Gemini to improve language and readability during manuscript preparation. All outputs were reviewed and edited by the authors, who take full responsibility for the content of this manuscript.

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