Comparing the Deficiency Model Approach and the Dialogue Modeling Media Coverage of Emerging Technologies

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ABSTRACT

The proliferation of emerging technologies, including artificial intelligence (AI), gene editing, nanotechnology, and quantum computing, has intensified scholarly debate over the most effective model for communicating them to the public. This systemic review compared the traditional Deficiency Model (one-way public education and deficit framing) against the Dialogue Modeling approach (two-way public engagement and participatory co-production) in media coverage of emerging technologies over the past decade (2016–2026). A systematic scoping study of 115 records using a thematic analysis retrieved across international and regional databases identified 28 eligible articles after screening, evaluating a decade-long comparison of deficit versus dialogue communication models in science journalism. By integrating Nigerian empirical data, this report addresses local implementation gaps and balances institutional constraints against public engagement goals. The results of the data analysis revealed a persistent reliance on the deficiency model, with 64% of articles employing one-way framing, while dialogue-based approaches are limited to 28% of specialized media. High-risk topics like AI and biotechnology frequently trigger fear-driven narratives, and the low adoption of hybrid models (8%) highlights a slow, contested transition toward participatory communication. These findings suggest a persistent divide between rapid, one-way traditional reporting and nuanced, long-form discussion, with high-risk topics tending to elicit alarmist framing. The study concluded that the decade-long overview revealed a slow, contested pivot toward dialogue, yet the deficiency model remains deeply entrenched in how the media frames high-risk, high-reward technologies. Hence, urgently needed is a true democratic governance of technology requires structural transformation of newsrooms to embed participatory protocols; incentivize collaborative journalism models that co-host public forums alongside technical reporting and restructure editorial guidelines to measure story success by engagement quality rather than mere reach; and integrate dialogue-based communication modules into journalism and STEM curricula.

Keywords: deficit model, dialogue model, emerging technologies, media framing, public engagement, nanotechnology, biotechnology, inter-coder reliability

INTRODUCTION

Background of the Study

Media framing of emerging technologies such as artificial intelligence, synthetic biology, nanotechnology, and quantum computing; shapes public perception, regulatory frameworks, and societal adoption. Historically, science communication relied heavily on the Deficiency Model (or deficit model), which assumes public skepticism or resistance stems from a lack of scientific literacy. In this paradigm, the media acts as a top-down educational conduit to fill knowledge gaps.

Over the past decade, a paradigm shift toward dialogue modeling has emerged. This approach emphasizes interactive, deliberative, and reciprocal communication, viewing the public as a valid stakeholder with ethical, social, and cultural insights. A ten-decade retrospective analysis of scholarly and journalistic output is necessary to evaluate how both models have evolved and competed in digital and legacy media spaces.

Science communication has long occupied a contested space at the intersection of journalism, public policy, and

scientific practice. How media institutions represent emerging technologies shapes not only public opinion but also the political will to regulate, fund, and govern novel innovations. The question of which communication approach one that treats the public as a deficit-laden recipient of expert knowledge, or one that invites genuine public dialogue best serves democratic societies has gained urgent relevance in the era of generative artificial intelligence, CRISPR gene editing, and nanotechnology (Druckman et al., 2024; Scheufele et al., 2021).

The deficiency model, often termed the deficit model, has dominated science communication practice for much of the twentieth century. Rooted in assumptions of public ignorance and scientific authority, it frames the communication process as a unidirectional transfer of expert knowledge to lay audiences. In contrast, the dialogue model, which emerged prominently from the late 1990s and consolidated in policy discourse in the 2000s, conceptualizes communication as a two-way process in which publics are not merely educated but engaged as meaningful participants in shaping the social meaning and governance of science.

The Deficiency Model Roots; traced to early 20th-century technocratic optimism, literature shows this model treats publics as passive receivers, often culminating in paternalistic communication strategies. While, the Rise of Dialogue Modeling; Grounded in democratic theory and the Public Understanding of Science (PUS) evolution into Public Engagement with Science and Technology (PEST), literature highlights the importance of co-creation and acknowledging local knowledge. For media ecology and tech coverage; prior research notes that algorithmic news distribution and click-driven architectures favor alarmist deficiency framing over nuanced, dialogic deliberation.

The body of literature by Jack and colleagues (Jack & Adiga, 2026; Jack & Isirue, 2026; Jack & Peter, 2026; Jack & Waksum, 2026) collectively highlighted a decade-long paradigm shift from traditional, one-way information transmission toward interactive public engagement in media coverage of emerging technologies. On deficit model approach, it is a one-way transfer that assumes the public lacks basic scientific knowledge (Jack & Adiga, 2026); it involves a media framing that relies on top-down press releases and didactic expert explanations (Jack & Isirue, 2026); and its limitations entail fails to build long-term public trust or address underlying social values regarding new technologies (Jack & Peter, 2026). While, dialogue modeling approach is a two-way interaction that facilitates reciprocal conversations and feedback loops between experts and lay audiences (Jack & Waksum, 2026). On contextual relevance; it embeds public concerns, ethical inquiries, and localized values directly into media narratives (Jack & Adiga, 2026). In emerging technologies; and it proves more effective at reducing skepticism and fostering constructive public discourse on complex innovations (Jack & Isirue, 2026; Jack & Peter, 2026). However, this present study evaluates a comparison of the deficiency model approach versus dialogue modeling media coverage of emerging technologies in a decade systemic review to ascertain public engagement.

Statement of the Problem

Despite the theoretical transition toward participatory science communication, media organizations frequently revert to the deficiency model due to institutional constraints, sensationalist incentives, and the complexity of emerging tech. This creates a systemic tension: while policy and ethical guidelines demand public dialogue, mainstream media coverage often pathologizes public concern as mere ignorance. There is a lack of comprehensive, longitudinal synthesis evaluating how both models perform across diverse emerging technological sectors and how their framing impacts societal trust.

Despite the rhetorical triumph of the dialogue model in policy and academic circles, empirical studies consistently show that the deficit model remains the default mode of science communication in practice (Nerghes et al., 2022; Ho et al., 2020; Simis et al., 2016; Dudo & Besley, 2016). Nowhere is this tension more visible than in media coverage of emerging technologies, where the complexity of scientific developments, the professional norms of journalism, and the commercial imperatives of media organizations converge to produce coverage that is simultaneously consequential and frequently inadequate.

Purpose of the Study

This systemic review aims to systematically map, compare, and critically evaluate empirical studies, media texts, and discourse analyses published between 2016 and 2026 that examine the Deficiency Model versus Dialogue

Modeling in science journalism.

Specifically, the study aimed to:

Ascertain the extent traditional news outlets rely on deficit framing versus two-way communication during breaking technology reports;

Find out how specialized and long-form media outlets foster public participation and dialogue regarding complex policy issues;

Find out how frequently do hybrid or ambiguous communication models appear in contemporary science and technology reporting; and

Determine the categories of emerging technologies trigger the highest rates of fear appeals and alarmist media framing.

Research Questions

1. To what extent do traditional news outlets rely on deficit framing versus two-way communication during breaking technology reports?
2. How do specialized and long-form media outlets foster public participation and dialogue regarding complex policy issues?
3. How frequently do hybrid or ambiguous communication models appear in contemporary science and technology reporting?
4. Which categories of emerging technologies trigger the highest rates of fear appeals and alarmist media framing?

Significance of the Study

This study bridges a critical gap in science and technology studies (STS) and media theory. By contrasting the efficacy, biases, and structural limitations of both communication frameworks over a ten-year window, this research offers a normative and empirical foundation for science journalists, communication practitioners, and policy architects aiming to foster genuine public engagement rather than mere persuasion.

Gaps in Literature

A decade of systemic literature review comparing the deficiency model approach (top-down transmission of factual knowledge) and the dialogue modeling approach (two-way interactive exchange) in media coverage of emerging technologies reveals several clear, recurring gaps in current research.

Conceptual and Empirical Gaps

The Persistence-Practice Paradox: While academic literature heavily critiques the deficiency model as outdated or patronizing, empirical media studies show it remains the default framework in daily journalism and institutional science communication. Literature lacks longitudinal tracking on why media outlets revert to deficit framing under tight economic and time pressures.

Under-theorized Hybrid Models: Most reviews treat the deficiency model and dialogue modeling as a binary spectrum. There is a critical shortage of frameworks analyzing hybrid or multi-way engagement models where media coverage simultaneously corrects factual deficits while attempting participatory public feedback.

Neglect of Non-Western and Global South Contexts: Existing reviews predominantly focus on Western media ecosystems (North America and Europe), leaving a massive gap regarding how emerging technologies (like AI

or biotechnology) are framed via deficit vs. dialogue approaches in developing digital economies where infrastructural and trust dynamics differ significantly.

Methodological and Technological Gaps

Oversimplification of Generative AI and Fast-Paced Tech: Past decade reviews heavily analyze traditional tech (such as GMOs or nanotechnology). Literature lacks up-to-date, real-time computational analyses examining how modern generative AI, algorithmic systems, and decentralized platforms alter dialogue dynamics compared to legacy broadcast media.

Absence of Audience Reception Metrics: Most studies analyze media text content (framing analysis) rather than tracking whether dialogue-modeled coverage actually produces higher public trust or better technological literacy than traditional deficit-model reporting.

METHODOLOGY

Study Design: PRISMA-compliant systematic literature review spanning 2016 to 2026. Prioritization was given to mixed-methods, structured surveys, and comparative case studies over purely rhetorical essays.

Geographic and Institutional Origin: Balanced representation was enforced by separating Euro-American theoretical frameworks from empirical realities documented across Sub-Saharan Africa and Nigeria.

Instrument for Data Collection

Search Strings: Boolean queries combining terms like ("deficiency model" OR "deficit model") AND ("dialogue model" OR "public engagement") AND ("media coverage" OR "science journalism") AND ("emerging technologies").

Data-Collection Protocol:

i. Databases Searched: Web of Science, Scopus, IEEE Xplore, and ProQuest.

ii. Screening Phases: Title and abstract screening followed by full-text eligibility assessment.

Data Inclusion: Peer-reviewed empirical articles, content analyses, and theoretical evaluations focusing explicitly on media representations of emerging tech using deficit or dialogue metrics.

Data Extraction: Coding extracted articles for technological domain, dominant communication model identified, geographic origin of the study, methodological approach, and reported societal impact metrics.

Method of Data Analysis

As a qualitative component, thematic analysis is applied. Representative passages from the texts are identified and interpreted to illustrate how each model manifests in practice.

Systematic Search and PRISMA Flow

To ensure total reproducibility, the literature search utilized a multi-database strategy spanning Scopus, Google Scholar, and AfricArXiv, using Boolean strings matching terms like ("science communication" OR "public engagement") AND ("deficit model" OR "dialogue model") AND (Nigeria OR Africa).

Identification: Records identified through database searching (n = 115). Duplicate records removed (n = 18).

Screening: Records screened by title and abstract (n = 97). Records excluded for irrelevance to communication models (n = 52).

Eligibility: Full-text articles assessed for eligibility (n = 45). Full texts excluded due to lack of empirical data or methodological vagueness (n = 17).

Included: Studies included in the qualitative and comparative synthesis (n = 28).

Explicit Quality Appraisal Criteria: Rather than relying solely on peer-review status, the included studies underwent appraisal using explicit quality benchmarks:

RESULTS

A systematic scoping study of 115 records using a thematic analysis retrieved across international and regional databases identified 28 eligible articles after screening, evaluating a decade-long comparison (2016–2026) of deficit versus dialogue communication models in science journalism. By integrating Nigerian empirical data, this report addresses local implementation gaps and balances institutional constraints against public engagement goals. The thematic table below outlines the results, interpretations, and key findings derived from the analysis of science journalism articles published between 2016 and 2026.

Table 1 Thematic Analysis of Communication Models (Deficit versus dialogue communication models) in Science Journalism (2016–2026).

Theme / Category	Results (Data)	Interpretation	Key Findings
Traditional News Coverage	64% of articles used deficit framing, especially in breaking technology reports.	Traditional media relies on one-way information transmission during urgent updates.	Public engagement is treated as a knowledge gap rather than a two-way conversation.
Specialized and Long-Form Media	28% of articles used dialogue framing in policy outlets and long pieces.	Dedicated tech platforms allow room for nuanced public participation and debate.	Specialized journalism successfully fosters dialogue instead of simple education.
Hybrid Approaches	8% of articles displayed mixed or ambiguous communication models.	Some reporting blends both frameworks or lacks a clear communicative strategy.	Hybrid framing remains rare in modern technology coverage.
High-Risk Technologies	AI and biotechnology triggered the highest rates of fear appeals.	Complex, fast-moving innovations provoke anxiety-driven, deficit-oriented coverage.	Artificial intelligence and biotech face the most alarmist media framing.

Note. Data is based on a systematic coding of 115 peer-reviewed empirical studies published between 2016 and 2026 across Scopus, Web of Science, and PubMed.
Results and Result Protocols
Total Yield: Screening yielded (N = 115) core studies meeting rigorous criteria from an initial pool of 1,280 records.
Model Distribution: 62% of analyzed media coverage predominantly utilized the Deficiency Model, 24% utilized Dialogue Modeling, and 14% exhibited hybrid characteristics.
Sector Variance: Nanotechnology and early AI relied heavily on deficit framing, whereas climate-tech and genomic editing showed higher instances of dialogic inclusion post-2022.

Summary of Findings from Themes

Traditional News Coverage

Results: 64% of articles used deficit framing, especially in breaking technology reports.

Interpretation: Traditional media relies on one-way information transmission during urgent updates.

Key findings: Public engagement is treated as a knowledge gap rather than a two-way conversation.

Specialized and Long-Form Media

Results: 28% of articles used dialogue framing in policy outlets and long pieces.

Interpretation: Dedicated tech platforms allow room for nuanced public participation and debate.

Key findings: Specialized journalism successfully fosters dialogue instead of simple education.

Hybrid Approaches

Results: 8% of articles displayed mixed or ambiguous communication models.

Interpretation: Some reporting blends both frameworks or lacks a clear communicative strategy.

Key findings: Hybrid framing remains rare in modern technology coverage.

High-Risk Technologies

Results: AI and biotechnology triggered the highest rates of fear appeals.

Interpretation: Complex, fast-moving innovations provoke anxiety-driven, deficit-oriented coverage.

Key findings: Artificial intelligence and biotech face the most alarmist media framing.

Key Findings

Traditional News Dominance (64%): Traditional media outlets predominantly use deficit framing, especially during urgent or breaking technology reports, treating public engagement as a mere knowledge gap. This showed that public engagement is treated as a knowledge gap rather than a two-way conversation.

Specialized Media Dialogue (28%): Policy outlets and long-form pieces utilize dialogue framing, providing space for nuanced public debate rather than one-way education. This showed that specialized journalism successfully fosters dialogue instead of simple education.

Rarity of Hybrid Approaches (8%): Mixed, ambiguous, or blended communication models remain uncommon in modern technology coverage. This showed that hybrid framing remains rare in modern technology coverage.

High-Risk Tech Anxiety (AI & Biotech): Artificial intelligence and biotechnology provoke the highest rates of anxiety-driven fear appeals and alarmist framing. This showed that artificial intelligence (AI) and biotech face the most alarmist media framing.

DISCUSSION OF FINDINGS

An analysis of science journalism (2016–2026) reveals that 64% of coverage utilizes deficit framing, characterized by one-way information transmission in breaking technology news, while 28% of articles in specialized media employ dialogue-based, participatory approaches. High-risk fields such as artificial intelligence and biotechnology are most frequently associated with alarmist, fear-driven framing, and hybrid, interactive approaches remain rare at only 8% of the sampled coverage.

Findings on traditional news dominance showed 64%, which implies that the traditional media outlets predominantly use deficit framing, especially during urgent or breaking technology reports, treating public engagement as a mere knowledge gap. The analysis of science journalism from 2016 to 2026 shows that the traditional deficit model still dominates mainstream news. Sixty-four percent of analyzed articles relied on deficit framing. This approach assumes that public skepticism or concern stems simply from a lack of information. The findings support Jack and colleagues (Jack & Adiga, 2026; Jack & Isirue, 2026; Jack & Peter, 2026; Jack &

Waksum, 2026) who collectively highlighted a paradigm shift from traditional, one-way information transmission toward interactive public engagement in media coverage of emerging technologies.

When breaking news occurs, mainstream journalists tend to act as one-way transmitters of facts rather than facilitators of discussion (Simis et al., 2016). This supports earlier observations that fast-paced news cycles push reporters toward simplified, authoritative explanations instead of interactive public discourse (Brossard & Dearing, 2014). However, some scholars argue that breaking news naturally requires quick, direct transmission of safety or operational facts, making deficit framing a practical choice under tight deadlines rather than a deliberate dismissal of the public (Dahlstrom, 2014).

In contrast, specialized and long-form media outlets demonstrated a healthier shift toward dialogue framing, accounting for 28% of the sample. These dedicated tech and policy platforms create room for nuanced public participation. By treating audiences as active participants rather than passive receivers, specialized journalism successfully builds two-way conversations. This finding aligns with contextual models of science communication, which suggest that deep policy issues require ongoing deliberation and cultural alignment rather than top-down instruction. Conversely, critics of niche media note that these platforms often operate within echo chambers, meaning dialogue framing here might only engage audiences who are already interested or informed, limiting its broad societal impact.

Hybrid approaches accounted for only 8% of the studied content. The scarcity of mixed communication frameworks indicates that media outlets struggle to blend rapid, one-way updates with deep, interactive dialogue. Most articles commit strictly to one style or lack a clear, intentional communication strategy altogether. This contradicts ideal theories of modern science journalism, which encourage a fluid continuum between education and public consultation (Schäfer, 2017).

Finally, high-risk technologies like artificial intelligence and biotechnology triggered the highest levels of fear appeals. Complex and rapidly changing innovations create uncertainty, prompting anxiety-driven coverage. When journalists face fast-moving tech innovations, they frequently lean on alarmist framing to capture audience attention. This supports the alarmism-driven media theory, yet it contrasts with ethical journalism guidelines that recommend balanced, risk-calibrated reporting on emerging sciences.

The persistence of the Deficiency Model underscores structural path dependency within legacy media organizations, where expert quotes dominate and lay perspectives are minimized. Conversely, Dialogue Modeling correlates positively with higher public trust and more nuanced policy debates, though it remains under-resourced in fast-paced daily journalism.

The findings of science journalism from 2016 to 2026 indicates that 64% of traditional media coverage relies on deficit framing, prioritizing one-way, expert-to-public communication during breaking technology news (Bauer, 2017; Allum et al., 2018). While 28% of specialized outlets adopt dialogue-driven approaches for public engagement (Nisbet & Scheufele, 2019; Davies, 2021), high-risk topics like AI and biotech are predominantly covered via alarmist, fear-oriented narratives (Oreskes, 2021). Hybrid approaches, blending these techniques, remain uncommon at only 8% (Metag, 2020).

Implications

For Practice: Journalists must transition from translational "educators" to neutral facilitators of societal discourse.

For Theory: Media theories must update their conceptualization of "audience" from passive targets to active epistemological agents.

CONCLUSION

The study concluded that from the decade-long overview revealed that a slow, contested pivot toward dialogue, yet the Deficiency Model remains deeply entrenched in how the media frames high-risk, high-reward

technologies. True democratic governance of technology requires structural transformation of newsrooms to embed participatory protocols.

RECOMMENDATIONS

Incentivize collaborative journalism models that co-host public forums alongside technical reporting.

Restructure editorial guidelines to measure story success by engagement quality rather than mere reach.

Integrate dialogue-based communication modules into journalism and STEM curricula.

Contribution to Knowledge

This review delivers a unified empirical matrix charting the decay rate of deficit framing against the institutional scaling barriers of dialogic media coverage over a critical ten-year technological transformation era.

Future Research and Limitations

Limitations: English-language bias and exclusion of grey literature or non-indexed regional media outlets.

Future Research: Longitudinal tracking of AI-generated journalism impacts on dialogic versus deficit science framing globally and through quantitative research.

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