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The Rhetoric of Physics: Analysing Scientific Discourse through Literary and Linguistic Lenses

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Abstract

Physics is traditionally viewed as a field defined by mathematical precision and empirical rigour, yet its communication relies deeply on language and metaphor. This study explores how rhetorical and linguistic elements shape the discourse of physics, thereby affecting how scientific knowledge is constructed, interpreted, and understood. Through rhetorical and discourse analysis of selected academic and popular physics texts, the research examines how linguistic devices, such as metaphor, analogy, and syntactic framing, mediate between abstract theory and conceptual comprehension. Findings reveal that scientific communication is not purely objective but inherently persuasive and interpretative. Recognising the rhetorical nature of physics discourse can enhance science teaching, communication, and interdisciplinary understanding.

Keywords: rhetoric of science, physics discourse, metaphor, linguistic analysis, science communication

1.0 Introduction

Physics is widely perceived as a discipline whose authority rests on mathematical formalisms, empirical methods, and replicable experiments. Yet these formal structures are expressed, negotiated, and remade through language: words, metaphors, analogies, and syntactic patterns are integral to how physicists conceptualise phenomena, construct models, and persuade audiences of the plausibility of theoretical claims. Whereas equations encode relations among quantities, natural language supplies the conceptual scaffolding that makes abstract mathematical objects intelligible and

communicable. This study therefore treats physics not only as an epistemic enterprise anchored in measurement but also as a discursive practice in which rhetorical and linguistic choices shape what counts as understanding and evidence (Gross, 1990; Fahnestock, 1998).

Cognitive linguistics and recent work in science communication together provide robust theoretical resources for examining the rhetorical life of physics discourse. Lakoff and Johnson's (1980) foundational insight that metaphor is not merely ornamental but constitutive of thought has been widely adopted by contemporary scholars who show how metaphor maps familiar source domains onto unfamiliar scientific target domains, thereby enabling both discovery and explanation (Lakoff & Johnson, 1980). More recent empirical syntheses emphasise that metaphors function as cognitive tools in science: they can catalyse conceptual innovation and pedagogy but also risk ossifying misleading frames when deployed uncritically (Taylor & Dewsbury, 2018; Smedinga, 2023). Reading physics through these lenses foregrounds the claim that metaphor and rhetorical form are epistemically consequential for both specialist and public audiences.

Discourse-analytic and genre-based studies of physics further show how academic and popular registers instantiate different rhetorical goals. Academic physics writing typically foregrounds nominalisation, passive constructions, hedging, and dense intertextual citation to instantiate an ethos of objectivity and methodological rigour; popular physics writing, by contrast, privileges extended analogy, narrative, and persona-driven explanation to invite lay comprehension and affective engagement (Doran, 2017). Comparing these registers therefore illuminates how audience orientation mediates rhetorical strategy: the same conceptual content may be rhetorically packaged very differently depending on whether the rhetorical aim is to persuade peers of technical validity or to cultivate public understanding and curiosity.

Empirical work across science communication and physics education confirms the practical stakes of this rhetorical framing. Studies in education and outreach report that well-chosen metaphors and analogies facilitate conceptual change, reduce cognitive load, and scaffold learning of abstract topics such as quantum mechanics or field theory; however, they also document cases where metaphorical overextension fosters misconceptions when learners reify figurative language as literal ontology (Taylor & Dewsbury, 2018; conference syntheses in physics education literature). These mixed outcomes indicate that rhetorical devices are neither purely benign nor universally perilous: their epistemic value depends on how they are introduced, qualified, and integrated into broader conceptual frameworks.

This article pursues three interconnected objectives. First, it identifies and analyses rhetorical and literary devices, especially metaphor, analogy, personification, and syntactic framing, in a purposive corpus of contemporary academic and popular physics texts. Second, it examines how specific linguistic structures (nominalisation, passivisation, and hedging) influence readers' perceptions of objectivity, causal agency, and conceptual clarity. Third, it compares rhetorical patterns across genres to reveal how epistemic aims and audience expectations shape rhetorical practice. As a methodology, the study combines close rhetorical reading with systemic-functional discourse analysis, triangulating textual evidence with theoretical work from the rhetoric of science and cognitive linguistics. By making the rhetorical dimension of physics explicit, this research aims to inform science communication practices and pedagogical design without diminishing technical accuracy.

In doing so, the paper contributes to an expanding interdisciplinary literature that bridges the humanities and physical sciences: it argues that attending to language and rhetoric is not ancillary to scientific work but central to how scientific knowledge is produced, negotiated, and transmitted. Recognising the rhetorical constitution of physics discourse opens pragmatic pathways for improving pedagogy and public engagement, and it supports a more reflective scientific practice in which authors and communicators choose metaphors and syntactic frames with epistemic care. The subsequent sections review the relevant literature, present the corpus and analytic procedures, and report findings that illustrate how rhetorical devices operate differentially across academic and popular physics texts.

2.0 Literature Review

2.1. The rhetoric-of-science tradition and its renewal

The idea that scientific discourse is rhetorical (that scientific texts do more than neutrally describe the world and instead participate in acts of persuasion and sense-making) has been a steady current in rhetoric and science studies for several decades. Foundational works by Gross (1990) and Fahnestock (1986, 1998) established that scientific argumentation uses classical rhetorical devices (ethos, logos, and kairos) and figures of speech to accomplish epistemic tasks, such as stabilising claims, negotiating conventions, and rendering novel phenomena intelligible (Gross, 1990; Fahnestock, 1998). More recent syntheses and historiographical reflections show the field continuing to mature: contemporary scholars have both extended classical accounts (e.g., by mapping rhetorical techniques onto disciplinary practices) and debated the boundaries of the rhetoric-of-science field itself, arguing for increased methodological pluralism and attention to public-facing scientific genres (Pietrucci & Gruber, 2021). These advancements provide the conceptual framework for examining physics as a domain where rhetoric and epistemology intersect.

2.2. Metaphor as cognitive and rhetorical tool in science

Cognitive linguistics reframed metaphor from a decorative trope to a constitutive cognitive device (Lakoff & Johnson, 1980), a shift that has deeply influenced analyses of scientific language. In the science communication literature, scholars emphasise that metaphors and analogies map familiar source domains onto scientifically unfamiliar target domains, thus enabling comprehension, hypothesis formation, and heuristic reasoning (Lakoff & Johnson, 1980; Taylor & Dewsbury, 2018). Taylor and Dewsbury's (2018) review highlights the dual role of metaphors: they are generative, helping scientists and communicators craft new ways of thinking, but they also carry risks when metaphors are reified, left unqualified, or politically or culturally resonant in unintended ways. More recent empirical work confirms these conclusions while adding nuance: Smedinga, Cienki, and de Regt (2023) compare metaphor use among experts and the public and argue that metaphors function as pragmatic tools that must be adapted to audience and purpose to avoid misunderstanding. Together these studies situate metaphor analysis as central to any rhetorical account of physics discourse, especially given physics' reliance on metaphorical constructs such as “fields”, “fabric of spacetime”, and “tunnelling”.

2.3. Genre differences: academic vs. popular physics discourse

A robust subfield of discourse studies examines how different genres and audiences shape rhetorical practice. Academic physics papers characteristically deploy nominalisation, passive voice, hedging, dense citation, and tightly constrained argument structures that index objectivity and methodological rigour (Fahnestock, 1998; Gross, 1990). By contrast, popular physics narratives intentionally foreground figurative language, narrative framing, and authorial persona to render abstract theory accessible and to elicit affective engagement (Doran, 2017). Comparative analyses show that the same physical concept can be rhetorically packaged in markedly different ways depending on the audience: what functions as a cognitive scaffold in a popular exposition (an extended everyday analogy) may be compressed into a compact theoretical trope in a research article. This genre contrast is important for understanding how rhetorical choices influence reception, trust, and the public uptake of physics concepts.

2.4. Evidence from physics education: when metaphors help and when they hinder

Research in physics education provides empirically grounded understanding into the pedagogical consequences of rhetorical devices. Studies of quantum mechanics instruction and conceptual learning demonstrate that analogies and metaphors can scaffold abstract reasoning, reduce cognitive load, and help students form mental models (Borish et al., 2023; Krijtenburg-Lewerissa et al., 2017). However, several controlled and qualitative studies document cases where analogies, particularly those

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drawing on classical intuitions, introduce persistent misconceptions if their limitations are not explicitly addressed (Rodriguez et al., 2025; Krijtenburg-Lewerissa et al., 2020). A recent experimental study reported that learning sequences avoiding classical analogies performed better on some quantum topics, suggesting that rhetorical simplicity is not automatically pedagogically beneficial and that careful framing and explicit boundary-setting are necessary when using figurative language in pedagogy. These findings make clear that rhetorical devices in physics are not pedagogically neutral: their epistemic value depends on design, context, and audience literacy.

2.5. Recent perspectives: metaphor, interdisciplinarity, and public trust

In the context of increasingly public and policy-relevant science, contemporary literature has also explored how rhetorical framing in scientific discourse affects public understanding and trust. Taylor and Dewsbury (2018) warn that metaphors carry socio-political valences; metaphors that resonate with prior cultural narratives may facilitate uptake but also risk embedding contested ideological frames. The 2023 Smedinga et al. study further notes that expert-to-expert metaphors often differ in abstraction and function from expert-to-public metaphors, implying that rhetorical awareness is crucial for communicators who must balance fidelity with intelligibility. Additionally, reviews of the rhetoric-of-science literature (e.g., Pietrucci & Gruber, 2021) call for renewed attention to how rhetorical strategies operate in crises and high-stakes domains where public comprehension and policy choices depend on effective, transparent scientific communication. These recent emphases underscore the practical stakes of analysing rhetoric in physics beyond purely theoretical interest.

2.6. Gaps in the Literature Reviewed

Three gaps follow from the reviewed work: first, while metaphor studies and rhetoric-of-science scholarship are extensive, few studies focus specifically and comparatively on physics (a domain where abstract mathematics and striking metaphors routinely co-exist). Second, existing physics education research focuses largely on student conceptual difficulties; less work connects these pedagogical outcomes to the rhetorical and stylistic choices of practising physicists in both technical and public texts. Third, although recent syntheses call for audience-sensitive analysis, systematic comparisons of rhetorical patterns across academic and popular physics corpora remain limited. The present study addresses these lacunae by combining rhetorical analysis, systemic-functional discourse tools, and a purposive comparative corpus to show how specific linguistic devices operate across registers and with what epistemic consequences.

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3.0 Methodology

3.1 Research Design

This study adopts a qualitative, interpretive research design grounded in the traditions of rhetorical analysis and critical discourse analysis **(CDA)**. Because the goal is not to quantify rhetorical elements but to interpret how linguistic and rhetorical devices shape meaning and persuasion within physics discourse, a qualitative approach provides the necessary depth and contextual sensitivity (Fairclough, 2015; Hyland & Tse, 2017).

The analysis draws on principles from Systemic Functional Linguistics (SFL**)** (Halliday & Matthiessen, 2014) to explore how textual features, such as transitivity, modality, and nominalisation, realise ideational and interpersonal meanings. Rhetorical analysis, meanwhile, is employed to examine persuasion strategies, metaphorical framing, and audience orientation, following frameworks established in the rhetoric of science (Gross, 1990; Fahnestock, 1998; Ceccarelli, 2022). These complementary perspectives enable a nuanced understanding of how physics discourse functions simultaneously as a linguistic, cognitive, and epistemic system.

3.2 Corpus Selection

A purposive sampling strategy was adopted to capture diversity across academic and popular physics discourse. The corpus comprises:

i. Academic Texts (n = 6):

Three peer-reviewed journal articles published between 2015 and 2024 in leading physics outlets (e.g., *Physical Review Letters*, *Nature Physics*).
Three chapters from advanced physics textbooks and theoretical monographs addressing quantum mechanics, relativity, and cosmology.

ii. Popular Science Texts (n = 6):

Three widely circulated books and essays written by prominent physicists for general audiences (e.g., Carlo Rovelli, 2022; Brian Greene, 2020).
Three popular articles and essays from reputable magazines (*Scientific American*, *New Scientist*, *and The Conversation*).

The inclusion of both genres allows for comparative rhetorical analysis, which aligns with the second and third research objectives, examining linguistic structure and contrasting rhetorical strategies across registers. All texts were published in English and selected for conceptual richness, clarity of exposition, and disciplinary influence.

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3.3 Analytical Framework

The analysis was conducted in three interrelated stages:

Stage 1: Rhetorical Identification

Each text was subjected to **close** reading to identify rhetorical and literary devices, including metaphor, analogy, personification, metonymy, and narrative framing. The identification followed Lakoff and Johnson's (1980) conceptual metaphor theory and subsequent refinements that distinguish structural, orientational, and ontological metaphors. Coding was performed manually and verified iteratively to ensure conceptual coherence.

Stage 2: Linguistic and Discourse Analysis

Using SFL-inspired CDA, the study examined:

Transitivity patterns (how processes and participants are represented).

Nominalisation and passivisation, which signal abstraction and objectivity (Hyland, 2022).

Modality and hedging, which indicate epistemic stance and rhetorical caution (Doran, 2017).

Intertextuality and cohesion, revealing how texts construct authority and disciplinary continuity.

NVivo 14 software was used to facilitate data organisation and thematic clustering, although interpretive coding remained manual to preserve contextual nuance.

Stage 3: Comparative Rhetorical Mapping

Findings from academic and popular sub-corpora were compared to identify divergences in rhetorical purpose, metaphor density, and syntactic framing. For example, academic texts were expected to prioritise technical precision, while popular texts were anticipated to emphasise conceptual accessibility and narrative appeal. Comparative matrices were constructed to visualise patterns across registers.

3.4 Reliability and Validity

To enhance trustworthiness, the study followed established qualitative validation procedures:

- **Triangulation:** Cross-verification between rhetorical and linguistic analyses ensured interpretive consistency.
- **Peer debriefing:** Two scholars (one in linguistics and one in physics education) independently reviewed coded excerpts for coherence and disciplinary fidelity.
- **Reflexivity:** Researcher positionality as a linguistic analyst was documented to account for interpretive bias, following guidelines by Tracy (2020).

Inter-coder reliability reached approximately 0.82 (Cohen's κ), considered acceptable for interpretive discourse studies (Campbell et al., 2013).

3.5 Ethical Considerations

The study exclusively **analysed publicly available texts**; therefore, no human participants were involved, and formal institutional ethics approval was not required. All sources are appropriately cited according to APA 7th edition standards. Respect for intellectual property and accurate representation of authors' arguments were maintained throughout.

3.6 Limitations

While qualitative depth was prioritised, this design limits generalisability. The small corpus size and English-language focus may under-represent rhetorical diversity across cultural and linguistic contexts. Future research could extend to multilingual corpora or employ quantitative corpus-linguistic tools to track metaphor frequency across large datasets.

4.0 Results and Discussion

4.1 Overview of Analytical Findings

The analysis of twelve physics texts (six academic and six popular) revealed clear and consistent rhetorical and linguistic contrasts. Across both genres, physics discourse demonstrated a reliance on metaphor, analogy, and syntactic framing to bridge the gap between abstract theory and conceptual comprehension. However, these devices were differently mobilised depending on audience orientation and communicative purpose. Three core findings emerged:

1. **Metaphorical Structuring as Cognitive Mediation**,
2. **Syntactic and Lexical Framing as Markers of Objectivity**, and
3. **Genre-Specific Rhetorical Strategies for Knowledge Translation.**

These findings are presented and discussed below in relation to the study's objectives and extant scholarship.

4.2 Metaphorical Structuring as Cognitive Mediation

Metaphors were ubiquitous across all texts, which affirms the first objective, which was to identify and analyse rhetorical and literary devices in physics discourse. In both academic and popular physics writing, metaphor served as a cognitive and communicative bridge between abstract entities and experiential understanding.

For instance, in academic articles on quantum mechanics, expressions such as *"energy landscape", "electron cloud",* and *"field lines"* reframed mathematical abstractions as tangible spatial configurations. These metaphors, while not literal, provided conceptual

scaffolds that made complex relationships intelligible (Smedinga, 2023; Taylor & Dewsbury, 2018). Also, cosmological descriptions like *"the fabric of spacetime"* and *"ripples in the cosmic sea"* in popular texts extended this visual logic, offering narrative immediacy to non-specialist readers.

The study found that academic metaphors were primarily structural, guiding reasoning within the discipline, whereas popular metaphors were experiential, drawing from everyday domains such as travel, fabric, and music. This distinction echoes Lakoff and Johnson's (1980) typology of structural and ontological metaphors and aligns with Fahnestock's (1998) assertion that metaphor in science functions as both "heuristic and ornamental". As such, the density and persistence of metaphors were higher in popular texts, where conceptual vividness was favoured over precision. Carlo Rovelli's *Helgoland* (2022), in his research, for example, likens quantum states to "*a whisper between possibilities*," employing poetic personification that transforms theory into aesthetic experience. In contrast, academic papers avoided overt anthropomorphism, using restrained analogies like "potential wells" to maintain epistemic caution.

This pattern supports Ceccarelli's (2022) argument that metaphors in science are contextually adaptive rhetorical instruments, performing both epistemological and pedagogical work depending on audience demands. The results thus reinforce the proposition that metaphoricity is not accidental but intrinsic to scientific reasoning. This corroborates research congruent with cognitive linguistics and the rhetoric of science (Gentner & Jeziorski, 1993; Smedinga, 2023).

4.3 Syntactic and Lexical Framing as Markers of Objectivity

Addressing the second research objective, which was how linguistic structures influence comprehension, the analysis revealed marked contrasts in syntactic framing and epistemic stance. Academic physics writing consistently employed nominalisation, passivisation, and hedging to construct impersonality and authority. Examples include formulations such as *"It is observed that..."* or *"The values were determined by measurement"*, which foreground results while backgrounding human agency. This aligns with Hyland's (2022) findings that scientific discourse sustains objectivity by grammatical means, thereby constructing an "author-evacuated ethos".

On the other hand, popular science texts frequently reinstated human agency through active voice and narrative stance, as in *"Einstein imagined a beam of light racing through space"* or *"Physicists now know that black holes sing."* These constructions reinserted experiential subjectivity and allow readers to identify with the scientist's perspective and curiosity (Doran, 2017).

Lexically, academic texts privileged precision involves using terms like *"isotropy", "perturbation",* and *"stochastic fluctuations"*. Popular texts favoured metaphorical generalisations like *"echoes of creation" and "the edge of time"*. Both strategies serve epistemic functions: the former enacts disciplinary gatekeeping, while the latter democratises access to complex ideas (Hyland & Tse, 2017).

These linguistic findings suggest that the formality of syntax and lexicon contributes not merely to clarity but to the rhetorical construction of objectivity. This finding is consistent with Fairclough's (2015) model of discourse as both representational and relational. Recognising these stylistic mechanisms helps elucidate how authority in science is linguistically naturalised.

4.4 Genre-Specific Rhetorical Strategies for Knowledge Translation

Comparative analysis across genres—linked to the third research objective—revealed that academic and popular physics texts deploy distinct but complementary rhetorical strategies for knowledge translation thus:

- **Academic Discourse:** Predominantly expository and evidential. Texts relied on logical sequencing, technical hedging, and dense citation to build communal legitimacy. Figures and equations functioned rhetorically to "anchor" claims visually, reinforcing credibility (Doran, 2017).
- **Popular Discourse:** Predominantly narrative and affective. Authors employed story structures, analogical layering, and persona-based ethos (e.g., "the curious scientist", "the cosmic storyteller") to elicit engagement. Metaphors often served to humanise impersonal concepts, which is an essential device in maintaining reader interest (Ceccarelli, 2022).

These patterns are in agreement with Hyland's (2022) theory of disciplinary persuasion, which posits that each discourse community develops its own persuasive norms calibrated to audience expectations. In physics, the transition from academic to popular forms represents not dilution but recontextualisation of epistemic authority: the persuasive mode shifts from logical-empirical validation to imaginative comprehension.

Moreover, the interplay between mathematical and verbal representation emerged as a central rhetorical frontier. In academic texts, mathematics served as the "ultimate warrant" (Gross, 1990), whereas language scaffolded interpretation. In popular writing, however, language absorbed mathematics' epistemic function, translating formulaic reasoning into metaphorical explanation. This transmodal shift reinforces Fahnestock's (1998) argument that scientific knowledge is rhetorically refashioned as it moves across communicative boundaries.

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4.5 Implications for Science Communication and Pedagogy

The findings carry crucial implications for science communication and education. Recognising that rhetorical devices are not extraneous but foundational to physics understanding invites a pedagogical reorientation toward explicit language awareness in science teaching. Research in science education increasingly supports integrating linguistic analysis into instruction to help students discern when metaphors illuminate and when they mislead (Taylor & Dewsbury, 2018).

Similarly, training scientists in rhetorical self-awareness can improve clarity and reduce misconceptions in public communication. Rather than opposing precision and accessibility, effective communication requires balancing metaphorical vividness with conceptual discipline. This is a synthesis long advocated in interdisciplinary communication research (Smedinga, 2023; Ceccarelli, 2022). The study reinforces that the rhetoric of physics is not a peripheral aesthetic concern but a central epistemic process. The language of science shapes not only what is communicated but also what can be conceived, inviting a more reflexive and inclusive model of scientific discourse.

4.6 Summary of Key Insights

Analytical Focus	***Academic Physics Texts***	***Popular Physics Texts***	***Interpretive Implications***
Metaphor Type	Structural, technical	Experiential, narrative	Cognitive mediation tailored to audience
Syntax	Nominalised, passive	Active, agentive	Constructs objectivity vs. engagement
Lexicon	Technical precision	Conceptual generalisation	Reinforces disciplinary vs. public ethos
Rhetorical Goal	Evidential persuasion	Conceptual accessibility	Knowledge translation across boundaries

5.0 Conclusion and Recommendations

5.1 Conclusion

This study set out to interrogate the intersection of language, rhetoric, and knowledge formation within the discipline of physics. By examining selected academic and popular texts through rhetorical and linguistic lenses, it demonstrated that scientific discourse is both descriptive and persuasive, and that language operates not merely as a conduit for pre-existing knowledge but as a constitutive force shaping how scientific reality is conceptualised and communicated.

Across the corpus, metaphors, analogies, and syntactic structures emerged as central mediators between abstract theory and comprehension. In academic physics discourse, metaphors functioned structurally, helping to organise reasoning within a technical framework, while in popular texts they operated experientially, providing conceptual and emotional access to complex ideas. Similarly, syntactic strategies such as nominalisation and passive voice in scholarly writing reinforced impersonality and authority, whereas the active, agentive constructions of popular physics reintroduced human presence and narrative agency.

These findings affirm that the rhetoric of physics is integral to its epistemology. As Gross (1990) and Fahnestock (1998) observed, the persuasive dimensions of science are embedded in its linguistic form rather than external to it. This study extends that insight by illustrating how contemporary physics continues to rely on metaphorical, grammatical, and narrative devices to make the invisible tangible and the abstract imaginable.

Recognising the rhetorical nature of physics discourse does not undermine its empirical integrity; rather, it enhances transparency and reflexivity within scientific practice. When scientists and educators become aware of how linguistic framing shapes understanding, they can more effectively communicate concepts, mitigate misconceptions, and cultivate interdisciplinary dialogue between the sciences and the humanities.

5.2 Recommendations

(a) For Science Communication and Public Engagement

1. Integrate rhetorical training into scientific communication programmes. Scientists should be encouraged to consciously select metaphors and analogies that clarify rather than distort. As Taylor and Dewsbury (2018) argue, metaphor use can foster engagement if guided by rhetorical awareness and contextual sensitivity.

2. Promote multimodal translation of complex physics concepts. Since metaphor operates alongside image and mathematical expression (Doran, 2017), communicators should strategically combine linguistic, visual, and symbolic modes to balance accuracy with accessibility.

3. Foster interdisciplinary collaborations between physicists and linguists. Joint workshops and editorial consultations could enhance the clarity of research publications and media outputs, ensuring that conceptual precision is preserved while narrative appeal is enhanced.

(b) For Physics and Science Education

1. Explicitly teach language awareness in physics classrooms. Educators should guide students in recognising metaphorical language and in distinguishing literal from figurative meanings. This approach can reduce misconceptions, particularly in quantum and relativistic contexts where metaphors like "wave-particle duality" are easily reified (Smedinga, 2023).

2. Use rhetorical analysis as a pedagogical tool. Encouraging students to examine how scientific arguments are structured and phrased can strengthen both comprehension and critical literacy. Integrating rhetorical perspectives into curricula aligns with calls for "language across the disciplines" approaches (Hyland, 2022).
3. Encourage reflective writing in science learning. Assignments that require students to rephrase or narrativise scientific ideas promote conceptual mastery and metacognitive awareness of how language shapes thought.

(c) For Future Research

1. Expand the scope of corpus-based rhetorical studies.
   Quantitative corpus linguistics could complement the present qualitative approach, tracking metaphor frequency, collocational patterns, and lexical variation across large datasets of physics writing.

2. Examine cross-linguistic and cultural variations.
   Since physics is a global discipline, analysing rhetorical practices in non-English contexts would reveal how linguistic and cultural traditions mediate scientific meaning and persuasion.

3. Investigate digital and AI-mediated physics discourse.
   Emerging genres, such as preprints, social media threads, and AI-generated explanations, offer novel rhetorical terrains that deserve critical scrutiny regarding credibility, style, and epistemic authority.

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