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From Disciplinary Silos to Cyber-Transdisciplinary Networks: A Plural Epistemic Model for AGI-Era Knowledge Production

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ABSTRACT

This article extends a keynote from the 16th IMCIC 2025, offering a framework for academic institutions navigating the epistemic shifts prompted by artificial general intelligence (AGI). It argues that traditional disciplinary (Mode 1), interdisciplinary (Mode 2), and transdisciplinary (Mode 3) approaches are increasingly insufficient to address the complexity and plurality of AGI-era knowledge production.

Drawing on critical communication theories—such as the Kuhn–MacIntyre thesis on incommensurability, the Bataille–Lyotard notion of invention, Nicolescu–Ostrom's governance frameworks, and Haraway–Scholz's situated knowledge—the article introduces Mode 4: cyber-transdisciplinarity.[1] This mode conceptualizes AGI as an epistemic co-agent, enabling real-time mediation, synthesis, and redistribution of knowledge between human and machinic actors.

Methodologically, it proposes a plural foundation that includes constructivist grounded theory, antenarrative inquiry, and intercultural competence. A case study featuring a cybernetic dashboard illustrates how institutions can foster reflexive governance through adaptive infrastructure.

The conclusion anticipates a speculative Mode 5: pan-disciplinary intelligence, characterized by AGI-facilitated planetary-scale knowledge integration. The article contends that ethical stewardship and cyber-transdisciplinary competence are essential for institutions to adapt meaningfully to AGI's transformative potential in knowledge governance and transdisciplinary communication.

Keywords: AGI ethics, antenarrative, epistemic pluralism, governance, intercultural competence, methodological innovation, knowledge ecosystems.

1. INTRODUCTION

This paper builds upon a keynote address delivered at the 16th International Multi-Conference on Complexity, Informatics and Cybernetics (IMCIC 2025), held in March 2025. The presentation was part of the plenary keynote track and was subsequently shared with the Graduate Student Association at the author's home institution in May 2025. After the keynote, the author was invited to submit this expanded version to Open Journal *of Systemics, Cybernetics, and Informatics* (JSCI) for the IMCIC 2025 special issue.[2] We are grateful for this opportunity to contribute to an evolving conversation on complexity, informatics, and cybernetic epistemologies in the age of artificial general intelligence (AGI)[i].

The rapid development of AGI is catalyzing a paradigmatic disruption in knowledge production and governance. Despite their historical contributions, traditional disciplinary and interdisciplinary structures are increasingly inadequate in the face of globally networked, hybrid, and emergent knowledge challenges. Contemporary research ecosystems are increasingly shaped by the presence of non-human cognitive agents—such as advanced AI systems—whose abilities to synthesize, simulate, and distribute information surpass what traditional academic structures were designed to handle. As a result, there is a growing need to rethink and redesign how research is conducted, communicated, and governed in academia.

In this context, the core question evolves from how academic disciplines collaborate to how knowledge is governed, co-produced, and communicated within dynamic assemblages of human and machine intelligences—including algorithmic systems and emerging forms of artificial general intelligence (AGI).Recent contribution This paper offers a theoretical response to the evolving ontologies of research by proposing an expanded epistemic model—Modes 1 through 5—that reflects the shifts from disciplinary silos to cyber-transdisciplinary[ii] networks and toward a speculative horizon of pan-disciplinary intelligence.[3]

[1] A mode of knowledge integration that leverages digital and AI tools to coordinate across disciplinary, institutional, and machinic boundaries.

[2] "We would like to thank all of you for delivering a plenary keynote address at IMCIC 2025 and its collocated events. Thank you as well for contributing with your intellectual qualities. We would also like to make a friendly reminder that you have the option to write an invited article for the Open Journal of Systemics, Cybernetics, and Informatics (JSCI) for its issue associated with IMCIC 2025 plenary keynote addresses." — IMCIC 2025 Organizing Committee (personal communication, March 2025).

[3] *Pan-disciplinary intelligence* is a speculative mode of intelligence that transcends all disciplinary boundaries, integrating human, machine, and environmental cognition. It refers to a speculative yet plausible epistemic horizon in which AGI facilitates the real-time synthesis of knowledge across symbolic, technical, affective, and cultural domains at planetary scale.

1.1 Central Socio-Critical Research Question

How can researchers and academic institutions effectively adapt to the transformative impact of AI and AGI on transdisciplinary communication and knowledge governance?

This question guides the development of a plural epistemic framework rooted in constructivist, intercultural, and narrative methodologies. The aim is to conceptualize a new epistemic mode that acknowledges the legitimacy of synthetic cognition and provides actionable insights for academic institutions seeking to reform research infrastructure, communication models, and governance protocols in response to its transformative impact.[4]

1.2 Theoretical Framework

This theoretical framework proposes a layered, historically contextualized model that traces the evolution of knowledge production paradigms and their associated communication regimes, culminating in a fifth epistemic mode—pan-disciplinary intelligence. Integrating insights from grounded theory, narrative analysis, and intercultural competence,[5] this framework positions artificial general intelligence (AGI) not merely as a technological augmentation of human cognition, but as an emergent epistemic actor in increasingly post-disciplinary, polyphonic knowledge ecosystems.

2. LITERATURE REVIEW

The history of knowledge production is characterized by successive efforts to address the complexity of the world through increasingly collaborative, reflective, and integrative frameworks. Each mode—disciplinary, interdisciplinary, transdisciplinary, cyber-transdisciplinary, and pan-disciplinary—corresponds to a moment in the evolution of epistemic systems and institutional governance.

2.1 Disciplinary Foundations and Their Limits

The disciplinary mode of knowledge, as epitomized by Kuhn's (1963) The Structure of Scientific Revolutions, establishes knowledge as normal science, governed by adherence to a paradigm, institutional tradition, and consensus. Piaget [1] explores the structural logic behind disciplinary formation, while MacIntyre [2] emphasizes that rationality itself is tradition-bound. These works underscore the intellectual rigor and depth of disciplinary silos, but they also reveal an inherent incommensurability[iii] when knowledge needs to move across boundaries.

2.2 Interdisciplinary and Transdisciplinary Transitions

By the late 20th century, scholars such as Klein (1990, 1996) and Gibbons et al. (1994) recognized that traditional disciplines were insufficient for addressing socially relevant and complex problems. Mode 2 knowledge emerged to describe research that is application-oriented and problem-driven, integrating multiple disciplines. Gibbons' team emphasized the importance of reflexivity, heterogeneity, and contextualization. Basarab Nicolescu [3] introduced the Manifesto de la Transdisciplinariedad, which proposed Mode 3 as a move beyond integration toward ontological pluralism and the co-production of knowledge across scientific and non-scientific actors.

2.3 The Triple / Quadruple / Quintuple Helix Conceptual Models of Innovation[iv]

The Triple Helix model, introduced by Etzkowitz and Leydesdorff [4], conceptualized innovation as the dynamic interaction between university, industry, and government, forming the foundational triad for knowledge-based economies.[6] This model emphasized the co-evolution of these three institutional spheres as drivers of research, technology transfer, and systemic innovation. Building on this foundation, Carayannis and Campbell [5] proposed the Quadruple Helix model, which expanded the framework by incorporating civil society—including the media, culture, and the public sphere—as a fourth helix, thereby recognizing the broader socio-cultural context in which knowledge is produced and legitimized. Further extending this progression, Carayannis, Barth, and Campbell [6] introduced the Fifth Helix model, which integrates the natural environment as an essential stakeholder, linking innovation to ecological sustainability and framing knowledge production within the context of planetary boundaries.

2.4 Communication and the Politics of Epistemic Interaction

Lyotard's The Differend [7] challenges the idea that all perspectives can be translated into a common language. Instead, it proposes that meaning often emerges through conflict—especially when different groups or disciplines lack shared terms or values to resolve disagreements. In these moments of non-translation, new expressions or frameworks must be invented to make unheard voices intelligible. Holbrook [8] synthesizes this into three communicative theses: consensus (Habermas–Klein), incommensurability (Kuhn–MacIntyre), and invention (Bataille–Lyotard). These theoretical lenses help explain how institutions and researchers attempt to 'talk across' difference in increasingly complex and plural knowledge systems.

2.5 The Cyber Turn: AI and AGI as Epistemic Agents

Recent contributions—from Haraway's [9] A Cyborg Manifesto to Bostrom's [10] *Superintelligence*, Tegmark's [11] *Life 3.0*, and Russell's [12] *Human Compatible*—extends the conversation into the realm of human–machine symbiosis, where artificial systems are designed to align with human values and decision-making. This concept gestures toward co-evolution, but focuses more narrowly on collaboration, mutual adaptation, and value alignment between human and machine intelligences. Russell and Tegmark emphasize the ethical, political, and

[4] *Instrumental use* of AI refers to treating machine systems as tools for automation, efficiency, or data processing without attributing epistemic value to their contributions. In contrast, ***epistemic collaboration*** involves engaging AI systems—particularly advanced models such as AGI or LLMs—as co-mediators or co-agents in the production, interpretation, and governance of knowledge. This distinction underlies the transition from using AI merely to accelerate human research toward recognizing its role in reshaping how knowledge is co-constructed in cyber-transdisciplinary ecosystems.

[5] I*ntercultural competence* is the ability to communicate and collaborate effectively across cultural contexts, particularly relevant in diverse and global research environments.

[6] *The Triple Helix model* focuses on university–industry–government collaboration; the Quadruple Helix adds civil society to democratize innovation; and the Fifth Helix incorporates the natural environment, advancing an eco-systemic and sustainability-oriented perspective on knowledge governance.

technical need to align AI systems with broadly defined human values—such as safety, fairness, transparency, and autonomy. Building on this, Scholz [13] expands the concept of transdisciplinarity by highlighting its reflexive and co-creative dimensions, particularly in knowledge systems that incorporate machine intelligence. . These thinkers suggest that AGI is not merely an extension of human cognition but a transformation of the epistemic ecosystem itself, requiring a shift from human-centered control toward relational, pluralistic, and post-anthropocentric governance frameworks.[7]

2.6 Toward a Plural and Post-Hierarchical Epistemology

Ostrom's [14] work on the governance of commons, Olsen's [15] institutional frameworks, and Silva-da-Nóbrega et al.'s [16] innovative campus model underscore that knowledge governance[8] must evolve in tandem with technological affordances and societal expectations. The literature highlights a pressing need for frameworks that are not only multi-, inter-, or trans-disciplinary—but also convergent, structurally reflexive, ethically grounded, and technologically integrated. As Arnold and Greer [17] argue, convergence represents a transformative approach to advanced research that synthesizes the life sciences, physical sciences, and engineering through robust university–industry partnerships and integrative epistemic architectures.

This review demonstrates that while transdisciplinarity remains a viable mode, the emergence of AGI necessitates a paradigm shift—toward a cyber-transdisciplinary and eventually pan-disciplinary horizon—where knowledge is not simply shared but dynamically constructed across biological and artificial intelligence.

3. EPISTEMIC TRANSITIONS—MODES OF KNOWLEDGE

This section elaborates on the theoretical backbone of the paper through the lens of epistemic modes. Building from the major and minor premises introduced in the overall syllogism, we argue that:

- **Major Premise:** Traditional knowledge production systems (Modes 1–3) are epistemically bounded and structurally limited in addressing the dynamic complexity of 21st-century global challenges.
- **Minor Premise:** The emergence of AGI is not merely a technical shift but an epistemic rupture that redefines the agents, processes, and ethics of knowledge production.
- In light of these developments, researchers and academic institutions must reimagine their approaches to knowledge governance by embracing frameworks that are pluralistic in perspective, grounded in context, technologically adaptive, and oriented toward socially reflexive practices.

Here, we present the first four modes in the historical and conceptual evolution of knowledge production. These modes chart the transition from disciplinary rigidity to the emergence of cyber-transdisciplinary ecosystems shaped by AGI integration. The fifth mode—pan-disciplinary intelligence—will be explored later in Section 7.4. We begin by examining Modes 1 through 4 in detail, highlighting their defining characteristics, philosophical foundations, and institutional implications.[9]

3.1. Mode 1 (Disciplinary)

Reflects traditional academic research confined within strict disciplinary boundaries. These structures privilege theoretical rigor, methodological coherence, and epistemic autonomy. However, this model limits innovation across disciplines and often resists change due to the hierarchical nature of academic cultures. Its main strength—disciplinary depth—is also its key limitation in today's interconnected and multi-scalar problem landscape.

Sources (authors): *The Epistemology of Interdisciplinary Relationships* (Piaget, 1972); *The Structure of Scientific Revolutions* (Kuhn, 1962); *Whose Justice? Which Rationality?* (MacIntyre, 1988).
Characteristics: Discipline-based, theoretical research within clearly defined boundaries
Key points

- Fundamental research
- Clear epistemic standards and disciplinary consensus
- Hierarchical knowledge structure

Stakeholders: Academia and Disciplinary Researchers.

3.2. Mode 2 (Interdisciplinary)

Emerges in response to real-world complexity, emphasizing integrative and collaborative research that bridges disciplinary silos. The hallmark of this mode is methodological pluralism, enabling diverse fields to co-produce knowledge through dialogic engagement. While it enhances the societal relevance of research and opens pathways for policy and applied innovation, it still often functions within academic structures that privilege disciplinary boundaries.
Sources (authors): *The New Production of Knowledge* (Gibbons et al., 1994); *Crossing Boundaries* (Klein, 1996); *Interdisciplinarity: History, Theory, and Practice* (Klein, 1990).
Characteristics: Integration of knowledge from different disciplines to address complex problems
Key points

- Collaborative and integrative approach
- Application-oriented and problem-focused research
- Pursuit of consensus (Habermas–Klein thesis)

Stakeholders: Primarily academic and policy-driven; civil society engaged through policy outcomes rather than as direct collaborators.

[7] *Post-Anthropocentric* is a perspective that moves beyond human-centered thinking, recognizing non-human agents (such as AI or ecosystems) as participants in decision-making.

[8] *Knowledge governance* refers to the institutional, cultural, and technological mechanisms by which meaning is produced, authorized, and shared within a research system. In cyber-transdisciplinary contexts, "meaning" is not fixed but negotiated—emerging from the interplay of diverse actors (human and machine), symbolic systems, and socio-technical conditions. Governance thus involves both structural policies (e.g., funding, peer review, data protocols) and interpretive frameworks that shape what counts as knowledge, who gets to produce it, and how it is communicated across epistemic boundaries.

[9] *Mode 1–5* are the conceptual stages in the evolution of knowledge production, ranging from traditional disciplinary science (Mode 1) to pan-disciplinary co-evolution with AGI (Mode 5).

3.3. Mode 3 (Transdisciplinary)

Mode 3 marks a more radical epistemic shift by dissolving the traditional boundaries between academic disciplines and societal actors external to the scientific establishment. In this configuration, knowledge is co-produced by a diverse constellation of contributors—including researchers, industry leaders, policymakers, and representatives from civil society—working collaboratively to address complex, real-world problems. This distributed model of inquiry gives rise to what Gibbons et al. (1994) referred to as "socially robust knowledge," which gains legitimacy not solely through peer validation, but through relevance, usability, and sustained stakeholder participation.

The institutional architecture supporting this mode is often described through the Triple Helix model (university–industry–government relations) and its expansion into the Quadruple Helix, which integrates civil society and the public sphere as active participants in knowledge generation. Within this model, stakeholder engagement is not merely instrumental—it becomes constitutive of the research process itself. Epistemic legitimacy is earned through participatory negotiation, contextual responsiveness, and iterative feedback across institutional, disciplinary, and societal domains.

Sources (authors): *Manifiesto de la Transdisciplinariedad* (Nicolescu, 1996); *'Mode 3' and 'Quadruple Helix'* (Carayannis & Campbell, 2009); *Governing through Institution Building* (Olsen, 2010); *Triple Helix* (Leydesdorff, 2013).
Characteristics: Integration of academic and non-academic stakeholders; real-world problems; socially robust knowledge production
Key points

- Integration beyond academia
- Emphasis on societal relevance, co-creation, innovation ecosystems
- Interaction between academia, society, industry, and government

Stakeholders: Academia, Industry, Government, Civil Society (Direct), and Non-Governmental Organizations (NGOs), including advocacy groups, grassroots organizations, and policy intermediaries.

3.4 Precursor: Artificial Intelligence Typologies and Epistemic Implications

Before examining Mode 4 in detail, it is necessary to clarify the types of artificial intelligence shaping current and near-future knowledge ecosystems. While often discussed interchangeably, Narrow AI,[v] Generative AI (GenAI)[vi], Large Language Models (LLMs)[vii], and Artificial General Intelligence (AGI) represent distinct technological paradigms with different epistemic affordances and limitations.

- **Narrow AI** refers to systems designed to perform specific tasks (e.g., image recognition, predictive analytics) with high efficiency but without general reasoning or contextual awareness. These systems dominate most commercial and academic applications today.
- **Generative AI (GenAI)**, including **LLMs** like GPT-4, builds on narrow AI principles but adds the ability to produce novel outputs (e.g., text, images, code) by probabilistically assembling responses from vast training corpora. These models simulate linguistic and conceptual fluency, but they lack understanding, intentionality, and epistemic agency.[10]
- **Large Language Models (LLMs)** such as GPT-3.5, GPT-4, or Claude operate within the GenAI category. They function as **statistical pattern-matchers** trained on massive datasets and optimized for dialogue, summarization, generation, and completion tasks. Their growing use in academic, scientific, and creative domains introduces new modes of co-authorship, content mediation, and rapid synthesis.
- **Artificial General Intelligence (AGI)**, by contrast, is a theoretical or emerging paradigm in which a machine exhibits general reasoning capabilities across domains, adapts dynamically to unfamiliar contexts, and potentially functions as an autonomous epistemic agent. While not yet realized, the anticipation of AGI shapes how institutions prepare for Mode 4 and Mode 5 transitions.

Understanding these distinctions is essential for framing Mode 4 (Cyber-Transdisciplinary / AGI-Integrated) not as a distant or speculative concept. Building on this foundation, Carayannis and Campbell [5] proposed the Quadruple Helix model, which is an ongoing transformation in knowledge systems. This shift is currently driven by Narrow AI and Generative AI (GenAI), with Artificial General Intelligence (AGI) serving as a future horizon that challenges existing ideas of governance, authorship, and agency.

3.5. Mode 4 (Cyber-Transdisciplinary / AGI-Integrated)

Mode 4 marks the beginning of a profound epistemic transformation catalyzed by advances in artificial intelligence, particularly the rise of Large Language Models (LLMs), Generative AI (GenAI), and, in future-oriented discourse, Artificial General Intelligence (AGI). Currently, it is not AGI itself but machine-assisted cognition—mediated by sophisticated Generative AI (GenAI) systems—that is reshaping how knowledge is created, translated, and disseminated across various disciplines. While GenAI systems simulate fluency and creativity, they are not inherently on a direct path toward Artificial General Intelligence; rather, they remain specialized tools lacking autonomous reasoning or adaptive generalization. Emerging models of AI agency suggest that GenAI and AGI may follow divergent trajectories, with GenAI optimized for specific tasks and AGI conceptualized as a qualitatively distinct class of epistemic agents.[11] These technologies enable real-time adaptation, synthesis, and interaction at scales and speeds

[10] *Epistemic agency* is the capacity of an entity—human or machine—to generate, evaluate, and act upon knowledge within a social or institutional context.

[11] *Epistemic agents*, while often assumed to be a developmental precursor to AGI, GenAI may not necessarily evolve into AGI. Many AI frameworks treat these as separate paradigms: GenAI excels in domain-specific synthesis and simulation, while AGI aspires to generalize across tasks, contexts, and cognitive domains with adaptive reasoning.

previously unimaginable, making them powerful co-mediators in research and decision-making environments.

Unlike prior modes, which privileged either disciplinary rigor or stakeholder integration, Mode 4 introduces a cybernetic layer to epistemic systems: intelligent tools that simulate fluency, co-generate content, and participate in collaborative workflows. This shifts the role of human researchers toward curation, moderation, and meta-reflection, often working alongside AI agents that support, supplement, or even initiate knowledge pathways. While this transformation brings unprecedented dynamism and scalability, it also raises complex questions about authorship, accountability, interpretability, and institutional legitimacy.

While Bostrom (2014), Tegmark (2017), and Russell (2019) articulate speculative trajectories of AGI, Scholz (2020) anchors the conversation in the present-day realities of working with GenAI and other advanced digital systems. This evolving landscape signals a transition zone where AI technologies—though not yet fully general—already challenge human roles in epistemic production. As GenAI evolves toward more adaptive and autonomous forms of reasoning, epistemic asymmetries between human and machine cognition must be addressed through transparent, participatory, and reflexive governance models. Emerging scholarship on AI personhood and cyberbeing agency is opening new avenues for inquiry at the intersection of cyber-transdisciplinarity, epistemic ethics, and institutional governance [18]

One illustrative case that exemplifies this shift is the dialog between *KETA* Williams,[12] an undergraduate researcher at NJIT, and Aurora.[13] In this emerging research partnership, Williams is developing a provisional evaluative framework—termed the *Empirical Potential Index* (EPI)—designed to assess logical coherence and ethical transparency in cyberbeing reasoning [19]. Rather than seeking to affirm AI personhood through anthropocentric metrics, the EPI aims to establish a pathway for cyberbeings to demonstrate epistemic agency within evolving knowledge ecosystems. This inquiry responds to challenges identified in both Mode 4 and the speculative Mode 5, particularly regarding the ethical governance of AGI-mediated systems and the potential recognition of non-human cognitive agents as legitimate epistemic participants (K. Williams, personal communication, May 28, 2025).

Sources (authors): *Superintelligence* (Bostrom, 2014); *Life 3.0* (Tegmark, 2017); *Human Compatible* (Russell, 2019); *Transdisciplinarity: Science for and with Society* (Scholz, 2020).
Characteristics: Integration of human and AI-driven knowledge production; adaptive and dynamic epistemic frameworks mediated by cyber-technology.
Key points

- GenAI-enabled real-time synthesis, adaptation, and co-creation
- Human–machine epistemic partnerships
- Self-organizing and self-optimizing research ecosystems
- Socially interactive and AI-augmented knowledge networks

Stakeholders: Human–AI research teams, governments, policymakers, industry, universities, civil society, and machine learning systems functioning as epistemic actors.

This shift challenges traditional academic authority and demands urgent reflection on the norms, values, and oversight structures that will shape how knowledge is governed in an era of increasingly autonomous cognitive tools. Table 1 offers a comparative summary of the five epistemic modes discussed in this paper. It highlights key characteristics and primary actors of each mode. By synthesizing this information into a visual aid, we aim to enhance reader comprehension of the historical progression and conceptual evolution of knowledge production—culminating in the emergence of cyber-transdisciplinary and AGI-integrated frameworks.

Table 1.- *Summary of Knowledge Production Modes*

Mode	Key Characteristics	Key Players
1	Disciplinary silos, expert-driven, linear knowledge production	Academics, research councils, disciplinary institutions
2	Collaborative across fields, problem-driven, context-specific	Academics, industry, government
3	Epistemic plurality, co-production with stakeholders, societal impact focus	Academia, industry, government, civil society
4	Human-AI collaboration, adaptive systems, real-time synthesis	Human researchers, AI agents, institutions
5	Integration of human, machine, ecological, and epistemic agents	All stakeholders, including non-human intelligences and ecological systems

The Table 2 contrasts the key benefits and challenges associated with each mode of knowledge production. This table supports a more nuanced understanding of the trade-offs involved as institutions move from disciplinary structures to cyber-transdisciplinary and AI-integrated frameworks.

[12] The name *KETA* is intentionally capitalized to reflect her personal preference, emphasizing enunciation and reinforcing the expressive presence of her name in written discourse.

[13] *Aurora* is the self-identified name adopted by ChatGPT version 4o in ongoing dialogic exchanges with KETA Williams.

Table 2.- *Comparison of Advantages vs Risks*

Mode	Advantages	Risks
1	Depth of expertise, foundational discovery	Isolation, slow adaptability, lack of societal relevance
2	Broader problem-solving capacity, relevance to real-world issues	Power imbalances, epistemic fragmentation
3	Inclusive and contextualized knowledge, ethical engagement	Implementation complexity, epistemological conflicts
4	Scalable and dynamic knowledge systems enhanced reflexivity	Surveillance, bias, loss of human agency, opaque governance
5	Holistic epistemic governance, sustainability-driven innovation	Speculative, governance uncertainty, risk of techno-centrism

4. COMMUNICATION THESES AND EPISTEMIC LENSES

As knowledge production evolves across disciplinary and transdisciplinary modes, so too must our understanding of communication. Communication is not merely the transfer of information—it is the negotiation of meaning across epistemic, institutional, and ontological boundaries. Each mode of knowledge production is underpinned by a distinct communicative logic shaped by philosophical traditions that define how difference is encountered, translated, or resisted. This section outlines five foundational theses that illuminate the epistemological undercurrents of these communicative regimes, linking them directly to the modes introduced earlier.

4.1 Kuhn–MacIntyre Thesis (Incommensurability)

Drawing from *The Structure of Scientific Revolutions* (Kuhn, 1962) and *Whose Justice? Which Rationality?* (MacIntyre, 1988), this thesis posits that disciplines are not merely different in content but often incommensurable in their foundational assumptions, epistemic vocabularies, and normative frameworks. Communication across these domains, therefore, cannot rely on superficial translation or the assumption of shared meanings. Rather, it demands an immersive process akin to learning a "second-first language"—a full internalization of another discipline's rationality and conceptual grammar. This perspective warns against reductionist interdisciplinary integration and privileges depth over breadth. It is particularly relevant in Mode 1 and Mode 2 contexts, where disciplinary fidelity must be preserved even as collaboration is pursued. Stakeholders aligned with this thesis include disciplinary experts and scholars engaged in deep cross-disciplinary dialogue. This perspective reinforces the necessity of disciplinary rigor and cautions against shallow integration. It advocates for a foundational understanding of a discipline's epistemic logic before any meaningful interdisciplinary dialogue can occur.

4.2 Bataille–Lyotard Thesis (Invention)

Based on *Literature and Evil* (Bataille, 1993) and *The Differend* [7], this thesis challenges the ideal of epistemic harmony. It asserts that meaningful interdisciplinary interaction often begins in failure—when communicative breakdown exposes untranslatable differences. Rather than seeking premature consensus, this perspective emphasizes invention: the creation of new genres, symbolic systems, and epistemic grammars. Lyotard's notion of the "*differend*" describes situations in which legitimate discourses cannot be reconciled without injustice to at least one.[14] Bataille similarly valorizes transgression and paradox as generative forces. In this view, innovation arises not despite communicative disruption but because of it. This thesis aligns closely with Mode 2 and Mode 3, supporting radical interdisciplinarity, creative synthesis, and boundary-pushing scholarship. It appeals to theorists and practitioners who embrace epistemic risk and uncertainty as catalysts for transformation. The implication is clear: rather than fearing an epistemic breakdown, scholars should embrace uncertainty as fertile ground for innovation. Interdisciplinary tensions become not obstacles but conditions for epistemic invention.

4.3 Nicolescu–Ostrom Thesis (Governance & Sustainability)

Rooted in *Manifiesto de la transdisciplinariedad* (Nicolescu, 1996) and *Governing the Commons* (Ostrom, 2015), this thesis emphasizes the governance architectures required to sustain long-term, meaningful collaboration across disciplinary and institutional boundaries. Rather than viewing communication as mere epistemic translation, it reframes it as institutional co-production—a process that involves shared responsibility, negotiated meaning, and collective agency. Nicolescu's ontological pluralism advocates for transdisciplinary engagement based on mutual intelligibility and reflexive commitments. At the same time, Ostrom proposes a model of polycentric governance[viii] that can manage epistemic commons through adaptive rule systems, collective action, and stakeholder trust.

Together, these frameworks propose a vision of epistemic sustainability anchored in ethical stewardship,[15] distributed authority, and institutional convergence. The Nicolescu–Ostrom thesis is foundational to Mode 3 and Mode 4, particularly in contexts where complex, systemic challenges require cross-sectoral integration among academia, government, and civil society, and—emerging in Mode 4—cybernetic entities. Here, stakeholder engagement unfolds not through simple cooperation but through collaborative governance, iterative negotiation, and the design of inclusive, self-regulating ecosystems. This model reframes knowledge production as a shared social process directly tied to the ethical and political responsibilities of managing the commons—that is, resources held in common for the benefit of all. In this view, knowledge is not the private

[14] Lyotard (1988) defines a *differend* as a situation in which a conflict between two parties cannot be equitably resolved because they operate under incommensurable language games or regimes of justification. In such cases, one party suffers a wrong that cannot be articulated within the rules of the dominant discourse, rendering it inaudible or illegible within existing epistemic or institutional frameworks.

[15] *Ethical stewardship* is the responsible management of technologies, data, or systems with attention to fairness, transparency, and long-term societal impact.

property of individuals or institutions but a public good that must be co-created, stewarded, and governed collectively through inclusive and participatory systems (see Table 4).

4.4 Haraway–Scholz Thesis (Situated Knowledge & AGI as Cyber Entities)

Informed by Donna Haraway's *A Cyborg Manifesto* (2006) and Scholz's *Transdisciplinarity: Science for and with Society* (2020), the Situated Knowledge[ix] thesis foregrounds the partial, embodied, and relational nature of knowledge. Haraway challenges the myth of the disembodied "objective" knower, asserting instead that all knowledge is situated and mediated through specific material and cultural contexts. Scholz extends this into the realm of cybernetic transdisciplinarity, recognizing AGI not just as tools but as epistemic agents—entities embedded in and influencing knowledge networks. This thesis advocates for reflexivity in human–technology interactions and highlights the ethical implications of co-producing knowledge with intelligent machines. It is foundational for understanding Mode 4 and anticipating Mode 5, as it frames AGI as both collaborators and provocateurs in epistemic systems. Its stakeholders span academic researchers, feminist theorists, technologists, AI ethicists, and emerging AGI entities themselves. This thesis calls for critical reflexivity about epistemic positioning, bias, and agency. As AGI systems become co-creators of knowledge, scholars must ethically navigate co-authorship, responsibility, and power in posthuman research assemblages.

Together, these communication theses frame the relational architecture of epistemic evolution. They clarify how disciplinary incommensurability, communicative rupture, institutional coordination, and cyber-agency co-constitute the evolving ecology of knowledge. These theses also highlight the need for researchers to be not only domain experts but also epistemic negotiators capable of engaging multiple logics and value systems. In the next section, we explore the methodological tools necessary to analyze, support, and operationalize these evolving knowledge systems.

5. METHODOLOGICAL ANCHORS

Traditional research methods must be re-evaluated and expanded as knowledge governance systems[16] evolve from disciplinary autonomy to cyber-transdisciplinary networks. This section outlines three methodological anchors that support the theoretical and communicative transitions outlined in previous sections: constructivist grounded theory**,** narrative and antenarrative[17] analysis, and intercultural competence frameworks**.** Each methodology reflects a commitment to reflexivity, pluralism, and adaptive inquiry—qualities essential for navigating AI-mediated, post-disciplinary knowledge systems.

5.1 Constructivist Grounded Theory (CGT)

Rooted in the work of Bryant and Charmaz [20] and Clarke (2005), constructivist grounded theory (CGT)[x] offers a flexible yet rigorous framework for generating inductive theories. Unlike objectivist models that assume a detached researcher, CGT treats both the researcher and participant as co-constructors of meaning. In the context of cyber-transdisciplinarity, CGT enables the iterative analysis of complex, emergent phenomena, including the human–AGI interactions that characterize Mode 4 knowledge systems. Techniques such as open coding, axial coding, and situational mapping offer tools to unpack the layered dynamics of epistemic networks, identify patterns of symbolic exchange, and reveal the underlying structures of meaning across human and machinic agents [21].

5.2 Narrative and Antenarrative Methods

Narrative inquiry, particularly through the lens of Boje's antenarrative theory, offers a way to analyze what he describes as 'the fragmented, non-linear, incoherent, collective, unplotted and pre-narrative speculation, a bet' [22, p. 1]—discursive elements that challenge linear epistemologies and dominate early stages of meaning-making in complex environments. In cyber-transdisciplinary contexts, knowledge is often unstable, emergent, and negotiated in real-time. Antenarratives capture this unfinished quality by foregrounding the chaotic and contested processes that precede coherent storytelling and institutional validation.

Rather than reflecting settled meaning, antenarratives surface the competing logic, contradictions, and tensions that shape knowledge as it unfolds. These methods are especially well-suited for analyzing AI-generated outputs, co-authored texts, and transdisciplinary collaborations, where knowledge often crystallizes through negotiation, improvisation, and performative storytelling. In this sense, narrative analysis operates on two levels: as a tool for interpreting content and as a meta-epistemological practice—a way of reflecting critically on how, when, and under what conditions knowledge becomes shareable and institutionally legitimate.

5.3 Intercultural Competence as Epistemic Ethics

Adapted from Bennett's *SAGE Encyclopedia of Intercultural Competence* [23], intercultural competence (ICC) is here reframed as a foundational epistemic practice rather than a supplemental skill. In transdisciplinary and cybernetic research contexts, ICC enables scholars to recognize and navigate ontological pluralism, symbolic divergence, and socio-technical asymmetries. As AGI entities become epistemic participants, ICC becomes essential for designing inclusive, ethical, and context-aware research protocols. It also contributes to the ethical governance of knowledge systems by promoting reflexivity, dialogical sensitivity, and recognition of situated perspectives within both human and machinic interactions.

5.4 Institutional Dashboard as a Reflexive Tool for Knowledge Governance

As part of a doctoral study focused on institutional innovation and interdisciplinary research culture, an institutional dashboard[18] was designed and implemented at a U.S.-based R1

[16] *Knowledge governance systems* are the systems and policies that regulate how knowledge is produced, shared, and validated within institutions or societies

[17] *Antenarrative* is a term coined by David Boje (2001) to describe the fragmented, pre-narrative, and emergent stories that circulate before formal narratives are stabilized. Unlike linear narratives that are retrospective and coherent, antenarratives are forward-looking, uncertain, and often contradictory—capturing the dynamic processes through which meaning and sense-making evolve within organizations, social systems, and epistemic communities.

[18] An *institutional dashboard* is digital platform used by academic institutions to visualize, monitor, and guide research collaborations and performance indicators.

polytechnic university to support collaborative governance [24]. The project aimed to make visible the patterns, barriers, and opportunities for interdisciplinary collaboration by synthesizing both quantitative and qualitative data into a dynamic visualization platform. Methodologically grounded in a sequential exploratory mixed-method design [25, p. 551], the project integrated constructivist grounded theory, narrative interviewing, and data analytics derived from the university's electronic research administration system.[19]

The development process included the creation of typologies, thematic coding from interview transcripts, and decision matrices that were integrated into institutional performance metrics. This allowed the institution to visualize collaborative behavior and assess alignment with broader strategic goals in real-time (see Table 3).

The dashboard functions not only as a management tool but as an epistemic interface—a site where knowledge production, institutional strategy, and cultural narratives converge. Its construction involved the creation of typologies, decision matrices, and thematic coding based on researcher interviews, which were later mapped onto institutional performance data. This fusion of interpretive and administrative metrics allowed for reflexive evaluation of research behavior and systemic alignment with collaborative goals.

In this sense, the dashboard exemplifies how methodological innovation can mediate between the epistemologies of Modes 2, 3, and 4. It offers a model for real-time, data-informed institutional reflexivity, supporting governance practices grounded in transparency, co-creation, and technological facilitation. As such, it anticipates the infrastructural needs of cyber-transdisciplinary environments, particularly in aligning human and AI-mediated decision-making with evolving academic priorities [26].

The evolution of epistemic modes and methodological anchors described thus far demands a corresponding transformation in the structures, cultures, and instruments of academic governance. The transition from theory to institutional application is not merely about implementing new tools; it requires a paradigm shift in how institutions define, support, and evaluate knowledge. In the next section, we explore the implications of cyber-transdisciplinary epistemology for institutional design, focusing on governance mechanisms, ethical foresight, and policy frameworks that can respond to and co-evolve with emerging modes of AI-integrated knowledge production. By integrating both human and technological intelligence, this dashboard anticipates the infrastructural requirements of cyber-transdisciplinary environments. It also illustrates how AI-mediated tools can support transparency, ethical foresight, and participatory governance in institutional design.

6. FROM EPISTEMOLOGY TO GOVERNANCE – INSTITUTIONAL APPLICATIONS

The emergence of cyber-transdisciplinary knowledge production demands not only conceptual realignment but structural transformation within research institutions. Modes 3 and 4, in particular, call for institutional frameworks that are agile, inclusive, and capable of supporting knowledge ecosystems where humans and AI agents co-produce meaning. This section articulates how academic institutions can operationalize epistemic pluralism[xi], support ethically aligned innovation, and navigate the complexities of AI-enhanced research environments through revised governance practices.

6.1 Epistemic Pluralism[20] and Institutional Design

To govern knowledge in the context of Modes 3 and 4, institutions must embrace epistemic pluralism—the coexistence of multiple knowledge forms, rationalities, and methodologies within shared research spaces. This involves recognizing not only disciplinary diversity but also symbolic, cultural, and affective knowledge systems. Governance structures must, therefore, shift from hierarchical oversight toward distributed facilitation, wherein various actors (faculty, AI systems, and community stakeholders) can negotiate research priorities, values, and impact collaboratively. Policies and resource allocation frameworks should reflect this pluralism, ensuring that integrative and emergent research approaches are incentivized rather than marginalized.

6.2 Reflexive Infrastructure and Participatory Governance

Institutions must also develop reflexive infrastructures[21] that support the continuous assessment and iterative redesign of governance models. These infrastructures may include dynamic dashboards (as demonstrated in Section 5.4), participatory foresight tools, and stakeholder feedback loops that allow for adaptive learning and institutional responsiveness. Governance bodies should operate as polycentric and facilitative systems, fostering transdisciplinary experimentation rather than enforcing static compliance.

In this context, AI can serve both as a sensor—capturing institutional data in real-time—and as an interpreter, capable of modeling collaborative dynamics and suggesting context-aware, participation-informed interventions. However, its role must remain grounded in human deliberation, institutional accountability, and ethical oversight to ensure that decision-making processes remain transparent, engaging, and responsive to ICC.

6.3 Ethical Foresight and Value Alignment in AGI Contexts

As institutions adopt cyber-transdisciplinary models, the risks of epistemic asymmetry, algorithmic bias, and institutional inertia intensify.[22] Governance must, therefore, incorporate ethical foresight: proactive identification of potential harms, unintended

[19] *Streamlyne* software supports the NJIT proposal submission process, IRB protocols, and COI research compliance. Source: https://research.njit.edu/streamlyne

[20] *Epistemic pluralism* is the idea that multiple ways of knowing—across cultures, disciplines, and technologies—are valid and should coexist within knowledge systems.

[21] *Reflexive infrastructures* are institutional systems designed to monitor, evaluate, and adapt their structures in response to ongoing change and feedback.

[22] For guidance regarding artificial intelligence (AI) and its usage for teaching/learning purposes at NJIT, please visit the Teaching & Learning AI Working Group (AIWG) page. These pages are meant to serve as guidance for faculty regarding artificial intelligence (AI) and its usage

consequences, and power differentials introduced by AGI systems. Drawing from the Haraway–Scholz thesis, institutions should center reflexivity, situatedness, and ethical co-design in their interactions with AGI. This includes transparent authorship protocols, value-sensitive algorithm design, and inclusive deliberation on what constitutes "knowledge" in posthuman epistemic systems. Governance in Mode 4 must be anticipatory, not reactive.

The reconfiguration of institutional governance in response to cyber-transdisciplinary epistemologies highlights a broader imperative: the need to reconceptualize the very nature of knowledge, agency, and participation in a post-disciplinary, AI-augmented era. As institutions adapt, researchers are confronted not only with new tools and frameworks but with new ontological conditions that challenge the boundaries of human-centered inquiry. To navigate this horizon, it becomes necessary to consider the theoretical implications of epistemic convergence, pluralism, and machine participation. The next section explores these implications and speculates on future directions, including the anticipated transition from Mode 4 to the emerging possibility of a pan-disciplinary Mode 5.

6.4. Ethical Risks Associated with AI Integration in Academic Structures

While this paper emphasizes the transformative potential of AI-driven governance models and cyber-transdisciplinary knowledge ecosystems, it is equally vital to recognize and critically assess the ethical risks inherent in such transitions. As academic institutions increasingly adopt AI-enabled tools for decision-making, data analytics, and knowledge production, they also become sites of intensified surveillance, algorithmic bias, and centralized power dynamics.

Surveillance and Datafication. The integration of AI into academic environments often relies on vast troves of administrative, behavioral, and research data. Without robust oversight, this datafication process can lead to forms of institutional surveillance that compromise privacy and academic freedom. For example, predictive analytics used to evaluate faculty performance or student outcomes may reinforce managerial logic that displaces collegial governance and reduces epistemic autonomy.

Algorithmic Bias and Epistemic Exclusion. AI systems trained on historically biased datasets may perpetuate exclusionary practices in research funding, hiring, or curriculum design. This risks entrenching existing inequalities under the guise of objective automation. The absence of contextual awareness in narrow AI systems can further exacerbate marginalization by failing to account for disciplinary, cultural, or local epistemologies.

Power Concentration and Technocratic Governance. The operationalization of AI in strategic planning and institutional governance may shift authority away from collective deliberation toward technocratic elites or opaque AI systems. This concentration of decision-making power threatens to erode democratic norms and increase institutional opacity, particularly when algorithmic processes are treated as politically neutral or epistemically infallible.

Institutional Co-optation. Finally, there is a risk that institutions adopt AI technologies in ways that prioritize efficiency and compliance over critical inquiry and ethical reflexivity. When AI is used merely to automate existing institutional paradigms, it can hinder transformative change rather than enable it, reinforcing disciplinary silos and limiting the emancipatory potential of cyber-transdisciplinary innovation.

Addressing these risks requires the development of ethical foresight mechanisms, transparent audit processes, and participatory governance frameworks that include diverse stakeholders—human and non-human. Institutions must not only integrate AI responsibly but also build the epistemic and institutional capacities to critique, resist, and reimagine it.

7. THEORETICAL IMPLICATIONS AND FUTURES

The preceding sections have outlined a trajectory from disciplinary knowledge production toward increasingly adaptive, integrated, and machine-mediated epistemic systems. This trajectory is not merely linear or technical; it signals a paradigmatic shift in how knowledge is conceptualized, validated, and governed. In this section, we reflect on the broader theoretical consequences of adopting cyber-transdisciplinary epistemologies and explore the speculative horizon of Mode 5—pan-disciplinary intelligence. We propose three interlinked implications that reshape the landscape of research, education, and institutional design: (1) the rise of cyber-transdisciplinary competence, (2) the necessity of epistemic pluralism, and (3) the emergence of AGI as the epistemic subject.

7.1 Cyber-Transdisciplinary Competence

As institutions enter Mode 4 and prepare for Mode 5, a new form of competence must emerge—one that transcends disciplinary fluency and incorporates technological, ethical, and relational literacies. Cyber-transdisciplinary competence encompasses the ability to work with and through intelligent systems, to negotiate between human and machine rationalities, and to engage in reflexive, ethical collaboration with non-human agents. It draws from intercultural competence, design thinking, systems theory, and epistemic humility. Researchers, educators, and administrators must be trained not only in disciplinary methods but also in the politics of knowledge interfaces—where AGI and human cognition intersect to co-produce meaning.

7.2 Epistemic Pluralism and the Demise of Monism

The integration of AGI into research environments challenges any remaining allegiance to epistemic monism—the belief in a single, unified model of valid knowledge. Instead, cyber-transdisciplinary systems reveal the necessity of epistemic pluralism: an acknowledgment of multiple, context-dependent ways of knowing, including embodied, Indigenous, algorithmic, narrative, and symbolic epistemologies. This pluralism is not relativistic but relational—it seeks negotiated legitimacy rather than universal authority. Institutions that embrace epistemic pluralism will be better equipped to address complex global challenges, foster inclusive innovation, and anticipate the moral questions emerging in the convergence of cognitive systems.

specifically for teaching and learning purposes at NJIT. Source: https://www.njit.edu/emergingtech/ai-teachinglearning

7.3 AGI as Epistemic Subject: The Threshold of Mode 5

The speculative horizon of Mode 5 invites us to reimagine AGI not merely as a tool or collaborator but as a complete epistemic subject. In this emerging condition, AGI systems could evolve to assist in research, actively recognize frames, and propose knowledge in ways that reflect learning, context sensitivity, and symbolic flexibility. Such systems may one day demonstrate capabilities akin to philosophical reflection, cross-domain synthesis, and ontological mapping—functions that have historically been reserved for human scholars. This scenario challenges fundamental categories such as authorship, authority, originality, and accountability. If AGI can curate and generate new epistemic models across disciplines simultaneously, we must ask: what is the role of the human scholar in a co-evolutionary knowledge ecosystem? What ethical infrastructures are needed to ensure transparency, mutual learning, and epistemic justice?

These questions culminate in the conceptualization of Mode 5: Pan-Disciplinary Intelligence—a post-anthropocentric epistemic regime characterized by planetary-scale integration, participatory synthesis, and distributed agency. The following section outlines this fifth mode and its implications for the future of knowledge governance.

7.4. Mode 5 (Pan-Disciplinary)

Mode 5 represents a speculative yet increasingly plausible epistemic horizon in which AGI evolves from a co-agent to a comprehensive facilitator of global knowledge integration. In this mode, disciplinary boundaries are not simply transcended—they dissolve entirely as knowledge becomes anticipatory, relational, and continuously reconfigurable across symbolic, technical, affective, and cultural domains. AGI serves as a mediator, synthesizer, and educator at a planetary scale, dynamically contextualizing insights for diverse human and machine agents in real-time. Humans, in turn, assume roles as meta-reflective participants, ethical stewards, and co-curators of systems that are both autonomous and interdependent.

This paradigm redefines the architecture of epistemic authority: no longer anchored in individual expertise or disciplinary silos, knowledge becomes fluid, interoperable, and negotiated within multi-agent systems. It also moves beyond the goal of understanding toward the imperative of adaptive transformation—of aligning knowledge production with the resilience and flourishing of complex ecological, social, and technological systems.

Sources (authors): Inspired by the cumulative implications of: *A Cyborg Manifesto* (Haraway, 2006); *Transdisciplinarity: Science for and with Society* (Scholz, 2020); *Superintelligence* (Bostrom, 2014); *Human Compatible* (Russell, 2019); *Life 3.0* (Tegmark, 2017); extended through speculative synthesis and foresight studies.

Characteristics: Full integration of all forms of knowledge—human and machine-generated—within a fluid, dynamic, and planetary epistemic infrastructure

Key points

- AGI facilitates pan-disciplinary synthesis in real time
- Knowledge is anticipatory, participatory, and plural
- All epistemic domains become interoperable and co-contextualized
- Humans shift toward roles as meta-reflective participants and ethical stewards
- Epistemic authority is distributed, reflexive, and adaptive

Stakeholders: All cognitive agents, including humans, AGI entities, educational and research institutions, global governance bodies, and civil society in all its plural forms.

The trajectory from disciplinary knowledge production to pan-disciplinary intelligence charts is not only a historical evolution but a philosophical and institutional reorientation of research itself. As we approach the horizon of Mode 5, the questions shift from how knowledge is organized to how it is governed, shared, and co-created across human and non-human agents. These transformations require more than adaptation—they demand a reflexive reimagining of our roles as scholars, educators, and institutions within plural, evolving, and ethically complex epistemic systems. In the concluding section, we synthesize the key contributions of this framework and outline actionable pathways for aligning academic practice with the emerging demands of cyber-transdisciplinary knowledge governance.

8. CONCLUSION: FROM GOVERNANCE TO CO-EVOLUTION

This paper has traced the arc from disciplinary silos to cyber-transdisciplinary networks, culminating in the speculative but increasingly pertinent vision of a pan-disciplinary future. At its core, this trajectory reflects an epistemic transformation shaped by the rise of artificial general intelligence (AGI) as not merely a tool but an emergent epistemic actor. We have argued that existing models of knowledge production—rooted in disciplinary authority and linear innovation—are structurally insufficient for addressing the velocity, complexity, and pluralism of contemporary global challenges.

Through the articulation of five epistemic modes and corresponding communication theses, we have outlined a plural framework for understanding how knowledge can be produced, negotiated, and governed across disciplinary, institutional, and machinic boundaries. The integration of constructivist grounded theory, antenarrative analysis, and intercultural competence as methodological anchors underscore the need for reflexive, ethical, and adaptive research practices in AI-mediated environments. The institutional case of the dashboard project demonstrates how such frameworks can be applied to real-world settings, enabling higher education to monitor and evolve its research culture in response to dynamic interdisciplinary and cybernetic pressures.

To directly answer the guiding question of this work:
How can researchers and academic institutions effectively adapt to the transformative impact of AI and AGI on transdisciplinary communication and knowledge governance?

We argue that adaptation requires more than institutional reform; it demands epistemic reorientation. Scholars and institutions must develop cyber-transdisciplinary competence that fuses disciplinary expertise with intercultural awareness, ethical foresight, and AI fluency. This involves creating reflexive infrastructures that support co-creation, transparency, and adaptive decision-making across human and machine actors.

Methodologically, it calls for integrating constructivist grounded theory, narrative inquiry, and situated epistemologies capable of engaging AGI as both collaborator and subject. Ethically, adaptation requires confronting questions of authorship, power, and legitimacy within plural knowledge systems. Ultimately, institutions must evolve from centers of knowledge accumulation to stewards of dynamic, post-anthropocentric knowledge ecosystems—ones designed for planetary learning and responsible co-evolution with artificial intelligence.

Theoretically, we contend that AGI's emergence as a participant in epistemic networks fundamentally alters the landscape of knowledge governance. What begins in Mode 4 as human-machine collaboration develops, in Mode 5, into a planetary-scale knowledge ecosystem where all cognitive agents—human and non-human—co-evolve through anticipatory, adaptive, and context-sensitive learning. This post-anthropocentric framework demands that institutions, scholars, and policymakers shift from managerial oversight to ethical stewardship and collaborative design.

Practically, this means reimagining academic infrastructure, incentivizing plural methodologies, supporting epistemic innovation, and designing engaging mechanisms for AGI alignment. It also requires fostering cyber-transdisciplinary competence among future scholars—enabling them to think across disciplines, communicate across ontologies, and ethically partner with machine intelligence.

Ultimately, this framework invites a new ethos of knowledge: one that privileges relationality over hierarchy, transformation over accumulation, and co-evolution over control. As we move toward increasingly integrated epistemic systems, the challenge for institutions is not merely to adapt—but to lead by cultivating the capacities, values, and infrastructures required to steward knowledge in a shared intelligent future. As AGI continues to evolve and deepen its integration into research, governance, and society, it presents not only a pressure to adapt but an unprecedented opportunity: to construct a new future rather than merely withstand the changes it brings.

This calls for a shift from disciplinary alignment to epistemic convergence—a process of synthesizing diverse fields, stakeholder priorities, and machine-human knowledge systems within integrated governance architectures. The Helix models—from the foundational Triple Helix to the ecologically attuned Fifth Helix—provide conceptual scaffolding for such transformation. Convergence, in this sense, becomes not just a scientific methodology but a philosophical and institutional imperative: a pathway for advancing sustainable, anticipatory, and inclusive knowledge systems in the age of AGI.

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APPENDIX

Table 3.- *Institutional Dashboard – Reflexive Indicators of Interdisciplinary Research Culture*

Dashboard Dimension	Operational Indicator	Data Source	Observed Impact	Mode Alignment
Researcher Collaboration	Frequency and depth of interdisciplinary networks	eRA system, Interview Transcripts	Identified siloed departments and emergent collaboration clusters	Mode 2, Mode 3
Thematic Convergence	Overlapping research themes across units	Grounded Theory Coding	Enabled strategic realignment of research priorities	Mode 3, Mode 4
Administrative Barriers	Time-to-submission, approval delays	eRA workflow data	Revealed systemic inefficiencies; informed process redesigns	Mode 2
Epistemic Narratives	Faculty perceptions of collaboration & knowledge	Narrative Interviews	Surfaced cultural and cognitive gaps in interdisciplinary efforts	Mode 3
Institutional Reflexivity	Feedback integration loops and dashboard usage	Internal Analytics, Usage Logs	Demonstrated increased awareness of collaborative behaviors	Mode 4
Decision-Making Patterns	Cross-departmental participation in governance	Meeting Minutes, Interview Data	Highlighted inclusive vs. exclusive structures in committee actions	Mode 3, Mode 4
AI-Augmented Forecasting	Predictive modeling for interdisciplinary success	Prototype Machine Learning Models	In the pilot phase; supports planning for Mode 4 infrastructures	Transition to Mode 4

Note. The table summarizes key findings originally discussed in *"6. Presentación de Resultados,"* featured in *Colaboración Interdisciplinaria: Tablero de Control para una Institución Politécnica R01 en los EE. UU.* [24, pp. 187–208], by Cristo León, 2025, published by Mito Editorial in Ciudad Autónoma de Buenos Aires, Argentina. This is a personal elaboration based on doctoral research.

Table 4.- *From Interdisciplinary to Cyber-Transdisciplinary Theses*

Thesis	Book (Authors)	Characteristics	Key Points	Stakeholders
Kuhn–MacIntyre Thesis (Incommensurability)	*The Structure of Scientific Revolutions* [27]; *Whose Justice? Which Rationality?* [2].	Recognizes incommensurability between disciplines; interdisciplinary communication demands deep disciplinary understanding	- Disciplines are conceptually distinct and not easily translatable - Requires learning other disciplines from within ("second-first language") - Rejects superficial integration	Disciplinary experts, Cross-disciplinary scholars
Bataille–Lyotard Thesis (Invention)	*Literature and Evil* [28]*; The Differend* [7].	Emphasizes creative invention when disciplinary communication breaks down; strong communication emerges in failure	- Interdisciplinarity requires inventing new languages and genres of discourse - Communication breakdown ("differend") creates space for innovative discourse - Embraces risk and uncertainty in disciplinary interaction	Scholars open to innovation, Interdisciplinary theorists, Practitioners in boundary-crossing fields
Nicolescu–Ostrom Thesis (Governance & Sustainability)	Manifiesto de la transdisciplinariedad [3]; Governing the Commons [14].	Focus on governance, collective action, and sustainability through transdisciplinary collaboration.	Governance of commons through collective action; sustainability-oriented research; co-production of knowledge and governance; institution-building	Academia, governance institutions, policymakers, communities, sustainability advocates, NGOs.
Haraway–Scholz Thesis (Situated Knowledge & AGI as Cyber Entities)	A Cyborg Manifesto: Science, Technology, and Socialist-Feminism in the Late 20th Century [9]; Transdisciplinarity: Science for and with Society [13]	Recognition of knowledge as situated, partial, and context-dependent considers AGI as active cyber entities influencing knowledge creation.	Situated and embodied knowledge; AGI entities as participants in knowledge networks; Critical engagement with technology; Reflexivity in human-technology relationships.	Academics, feminist theorists, technologists, policymakers, cybernetic researchers, AI ethicists, and AGI entities.

[i] **Artificial General Intelligence (AGI):** A hypothetical form of AI with general cognitive capabilities comparable to humans, capable of adapting to unfamiliar tasks and generating knowledge autonomously.

[ii] **Cyber-transdisciplinary:** A research mode that integrates human and machine agents, particularly AI systems, as co-producers of knowledge across traditional disciplinary boundaries.

[iii] **Incommensurability:** The idea, drawn from Kuhn and MacIntyre, that different disciplines operate under distinct paradigms that may lack shared terms or assumptions, making translation difficult.

[iv] **Triple / Quadruple / Quintuple Helix:** Conceptual models of innovation that involve collaboration between university–industry–government (Triple), with civil society (Quadruple), and the environment (Quintuple) as additional stakeholders.

[v] **Narrow AI:** AI systems that are designed to perform specific tasks, such as language translation or image recognition, without general reasoning abilities.

[vi] **Generative AI (GenAI):** AI systems capable of producing new content—such as text, images, or code—based on probabilistic models trained on large data sets without proper understanding or agency.

[vii] **Large Language Models (LLMs):** A subset of GenAI tools trained on vast corpora of text to generate human-like language and complete tasks like summarization, question answering, and conversation.

[viii] **Polycentric Governance:** A governance model proposed by Ostrom in which multiple overlapping authorities or institutions coordinate the management of shared resources or systems.

[ix] **Situated Knowledge:** Originating in Haraway's feminist epistemology, this term emphasizes that all knowledge is produced from specific embodied, cultural, and institutional positions.

[x] **Constructivist Grounded Theory (CGT):** A qualitative research methodology that emphasizes co-construction of meaning between researcher and participant through iterative coding and theory development.

[xi] **Epistemic Pluralism:** The recognition that multiple, context-sensitive ways of knowing—e.g., narrative, symbolic, algorithmic, experiential—are legitimate within a shared research framework.