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AI on the Horizon of Interdisciplinary Thinking: from disciplinary knowledge to symbiotic intelligence

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ABSTRACT

AI is becoming an epistemic infrastructure, a computational environment shaping what can be asked, represented, and imagined. The modern university's disciplinary depth has fragmented inquiry, and today's challenges exceed these divisions; AI is both a product of specialization and a force for reorganizing it. Drawing on Bateson, Hutchins, Clark & Chalmers, Hayles, and symbiotic intelligence, this paper develops a relational ontology for human, AI knowledge production and transdialogism, the movement of meaning across incompatible representational regimes, and examines dialogue and Wittgensteinian language-games as practices for interdisciplinary understanding. It then analyzes AI as cognitive infrastructure, arguing that foundation models create a new architecture of epistemic power requiring public governance and democratic accountability, and proposes knowledge socialism as an alternative to cognitive enclosure. Finally, it distinguishes intelligence from wisdom: AI can synthesize information but cannot determine worthwhile ends. The normative goal is collective artificial wisdom and an Eco-AI civilization integrating human flourishing, ecological sustainability, cultural plurality, democratic participation, open science, and responsible AI governance. Central thesis: AI is becoming the infrastructure of interdisciplinary thought but does not automatically produce understanding. Genuine interdisciplinary intelligence requires interpretation, epistemic plurality, democratic governance, human answerability, and ecological judgement. AI can connect disciplines, but only a critically designed human–AI knowledge ecology can turn connections into shared understanding; only symbiotic institutions can direct extended cognition toward common purposes; and only wisdom can determine whether accelerated intelligence serves democratic freedom, ecological sustainability, and planetary flourishing.

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Intruduction

In the late 1990s I 'problematised' the concept of "displinarity" arguing a Foucauldian account from *The Archaeology of Knowledge* (Foucault, 1992) in a collection entitled *After the Disciplines: The Emergence of Cultural Studies* (Peters, 1999) following the notion of Foucault's "history of systems of thought", a title he designed for his own position at the College de France. He talked of disciplines in terms of *historical a priori* that defines a 'field'.

In 1999 I was concerned to investigate the concept of "disciplinarity" in a seminar series at the University of Auckland in 1996. I focused on the emergence of the field of cultural studies, utilising an orientation that was "genealogical" in the sense that both Foucault and Nietzsche understood – the *will to knowledge*. I was concerned to elucidate the emergence of a field that dominated the humanities—cultural studies—and to explain its development in terms of a critical history of the disciplines, partly explaining the title. That was a rough emergence that registered so many eruptions in the colonial knowledge episteme as various forms of resistance. It became countercultural and gelled with a wide range of movements in society at large. These changes in part were forced on the university and cultural studies symbolised a huge growth of potential revolutionary activity based on new and rapidly changing subject positions.

This time, artificial intelligence, does not originate in society at large or in new social movements but rather it is a rupture to knowledge systems that might come to be seen as a kind of 'final rupture' in that it conditions everything that comes after it, an intelligence explosion that ends a purely human or even human-machine era (eg. printing press) to inaugurate a final era of human-AI symbiosis, only succeeded by fully autonomous knowledge systems. To be dramatic in a typical French philosophical style we might say following Foucault, the era of fully autonomous knowledge systems (AKS) is upon us and already evident in the different forms of recursive self-improvement, including "autonomous labs".

Artificial intelligence has entered the sciences, the university, and public culture not simply as another specialized technology but as an emerging *general condition of knowledge* production. AI systems now participate in activities previously identified with human cognition: interpretation, classification, prediction, translation, synthesis, simulation, argument, design, and the generation of possible worlds. They operate across medicine, biology, physics, environmental science, engineering, economics, psychology, education, philosophy, law, and the arts. Their significance lies not only in accelerating disciplinary research but in creating a shared computational environment through which different forms of knowledge can be translated, compared, recombined, and mobilized.

This development marks a change in the architecture of knowledge. The modern university was constructed around disciplinary differentiation. Disciplines established their own objects, concepts, methods, professional jurisdictions, journals, curricula, and standards of evidence. This differentiation produced intellectual depth and methodological rigour, but it also divided knowledge into increasingly specialized domains. The major problems of the contemporary

world—climate change, biodiversity loss, pandemics, geopolitical instability, inequality, artificial intelligence, and the future of education—do not conform to these divisions. They are at once scientific, technological, political, economic, ethical, cultural, ecological, and pedagogical.

AI appears within this situation as both an outcome of disciplinary specialization and a force capable of reorganizing it. Its technical genealogy joins mathematics, computer science, statistics, cybernetics, neuroscience, linguistics, psychology, philosophy, engineering, and information theory. Contemporary generative, multimodal, and agentic systems can, in turn, traverse these domains. Large language models provide a common linguistic interface among specialist fields; multimodal systems connect texts, images, code, measurements, and sensor data; and agentic architectures distribute inquiry among systems that generate, criticize, rank, and refine hypotheses. AI is consequently becoming an interdisciplinary epistemic infrastructure—an algorithmic environment that increasingly shapes what can be asked, represented, searched, evaluated, and imagined (Peters & Kourkoulou, 2025).

To describe AI as an epistemic infrastructure is not to attribute consciousness or sovereign intelligence to machines. Nor does it imply technological determinism. It recognizes that computational systems increasingly mediate the environments within which thought takes place. Search engines, recommender systems, foundation models, data infrastructures, educational platforms, and AI agents organize attention and distribute epistemic agency. They operate as an emerging algorithmic a priori, conditioning inquiry before any particular intellectual encounter begins. The central question is therefore no longer whether AI should be introduced into disciplinary research and education. It is already embedded in research, publication, administration, assessment, professional practice, and everyday learning. The more fundamental question concerns the kind of knowledge ecology and educational civilization being created as humans and artificial systems increasingly think, write, investigate, and decide together.

From disciplinary knowledge to transdisciplinary problems

A distinction must initially be drawn among multidisciplinarity, interdisciplinarity, and transdisciplinarity. Multidisciplinary research brings several disciplines to bear upon a common subject while allowing each to retain its concepts and methods. Interdisciplinary research goes further by exchanging and integrating methods, producing explanations that could not be constructed within one discipline alone. Transdisciplinary inquiry moves beyond academic divisions: it begins with complex problems and incorporates the situated knowledge of governments, professions, communities, Indigenous peoples, civil-society organizations, and affected publics.

AI can contribute to each mode. At the multidisciplinary level, it retrieves and compares findings from different fields. At the interdisciplinary level, it identifies conceptual

correspondences, translates specialist vocabularies, and integrates qualitative and quantitative methods. At the transdisciplinary level, AI can assist heterogeneous communities in constructing shared representations of problems whose causes and consequences cross scientific, social, institutional, and cultural boundaries.

Yet connection is not integration, translation is not understanding, and prediction is not explanation. "Intelligence," "agency," "information," "learning," "resilience," "consciousness," and "responsibility" mean different things in philosophy, biology, psychology, education, and computer science. AI may create the appearance of interdisciplinary synthesis by suppressing conceptual differences and statistically smoothing disagreement into plausible prose. Its fluency can disguise the absence of a coherent ontology. Philosophy is therefore not an optional supplement to AI-enabled interdisciplinarity. It is required to examine the concepts, categories, and normative assumptions through which computational integration occurs.

The philosophical task is double. First, we need an account of the distributed cognition emerging across human–machine relations. Second, we need a political, educational, and ecological philosophy capable of directing those relations toward democratic and planetary purposes. This paper develops such an account by bringing together the ecology of mind, distributed cognition, extended mind theory, posthumanist cognition, Wittgensteinian philosophy, dialogism, epistemic politics, knowledge socialism, and the emerging philosophy of symbiotic intelligence.

The relational and ecological foundations of intelligence

The dominant philosophical image treats intelligence as a property possessed by a discrete entity. Classical humanism locates intelligence in the autonomous rational subject; computationalism locates it in formal operations; popular AI discourse imagines a contest between human and artificial intelligence in which one augments, rivals, surpasses, or replaces the other. These positions preserve a dualistic ontology: mind and machine, subject and object, biology and computation, humanism and posthumanism.

A symbiotic account begins with the proposition that intelligence is not a substance possessed by individuals but a relational process emerging through interactions among biological, linguistic, cultural, technological, institutional, and ecological systems. Human cognition has never been purely individual. It develops through language, education, tools, texts, institutions, memory systems, and inherited practices. Bateson's *Steps to an Ecology of Mind* relocates cognition within circuits connecting organisms and environments (Bateson, 1972). Hutchins's *Cognition in the Wild* demonstrates how thinking is distributed across people, artefacts, practices, and organized settings (Hutchins, 1995). Clark and Chalmers' extended-mind thesis similarly argues that tools can become constitutive components of cognitive processes rather than remaining external aids (Clark & Chalmers, 1998).

Licklider's early account of "man-computer symbiosis" anticipated a complementary partnership in which humans would formulate goals and exercise judgement while computers undertook rapid and routinized operations (Licklider, 1960). Generative AI changes this relationship because computation now operates through language, images, argument, and conceptual recombination. The human–machine encounter is no longer limited to command and calculation; it increasingly takes the form of dialogue.

N. Katherine Hayles provides a more comprehensive ontology for this transformation. Across *How We Became Posthuman*, *My Mother Was a Computer*, *How We Think*, *Unthought*, and *Bacteria to AI*, Hayles challenges the liberal-humanist conception of cognition as the interior possession of an autonomous, conscious individual (Hayles, 1999, 2005, 2012, 2017, 2025a). She defines cognition as a process that interprets information within contexts connecting it to meaning. Cognition, on this account, is not reducible to consciousness, linguistic self-report, or rational reflection. It occurs in different modes and degrees across biological organisms and technical systems.

Hayles's concept of the cognitive assemblage is especially important for interdisciplinary thinking. Cognitive assemblages are heterogeneous collectivities through which information, interpretation, meaning, and action circulate. Their capacities cannot be reduced to any single participant. Hayles's integrated cognitive framework further distinguishes cognition from adaptation through five connected capacities: sensing, interpreting, responding flexibly, anticipating, and learning—SIRAL (Hayles, 2025b). These criteria enable a differentiated account of human, animal, microbial, and artificial cognition without either reserving all cognition for humans or anthropomorphizing machines.

This framework has ethical and political consequences. Cognitive assemblages distribute authority, risk, responsibility, visibility, and benefit (Hayles, 2022). They are never simply technical. Their architectures determine which actors can initiate action, whose interpretations count, and who bears the consequences of failure. AI-mediated interdisciplinarity must therefore be studied not only as an exchange of ideas but as an organization of cognitive power.

From cognitive assemblage to cognitive intraface

Hayles supplies the wider ontology of distributed cognition, while Matson identifies the local site at which human–AI cognition becomes recursive and educationally consequential. Human beings and language models do not inhabit the same experiential world. Human cognition is embodied, affective, historical, social, and durational. A model's conceptual environment is computational and derivative, constructed from tokens, vectors, and statistical relations across training data. Neither participant inhabits the other's *Umwelt*, even when language provides a shared trace that each organizes differently.

Matson introduces the cognitive intraface to designate the site at which these heterogeneous cognitive systems become mutually consequential (Matson, 2025a, 2025b, 2026a). The term

deliberately differs from "interface." An interface implies a stable boundary across which already constituted agents exchange inputs and outputs. An intraface is generated within the encounter itself. It belongs fully to neither side; it emerges through their coupling.

The concept draws upon Barad's account of intra-action, in which entities do not entirely precede the relations through which they become determinate (Barad, 2007). Applied to AI-mediated cognition, the output of an exchange originates neither in the human interlocutor alone nor in the model alone. It emerges through the evolving configuration of prompt, response, prior discourse, disciplinary standards, model architecture, and human interpretation. The learner's question reorganizes the model's operative context; the model's response reorganizes what the learner notices, asks, accepts, or contests next. Matson terms this recursive movement recursive modulation.

The two participants are not equivalent. Human beings sustain lived, biographical, disciplinary, and institutional continuity across encounters. Language models generate within a computational event whose operative context is reconstructed through successive interactions. Matson's category of prorecursion identifies this distinctive temporality of model generation (Matson, 2026b). The human participant can remember consequences, experience vulnerability, revise commitments, and be held answerable within a continuing history. The artificial participant can nevertheless become an active component of human reasoning by altering what becomes thinkable next.

This asymmetry is foundational to symbiotic intelligence. Symbiosis does not require ontological sameness, shared consciousness, or equal responsibility. It depends upon the productive composition of different capacities while preserving their differences. The relevant question is not whether artificial cognition is identical to human cognition, but how heterogeneous forms of cognition are organized and toward which purposes.

Dialogue, transdialogism, and interdisciplinary experimentation

Dialogue is the principal medium through which symbiotic intelligence becomes educationally and philosophically significant. Socratic inquiry, Bakhtinian dialogism, and Freirean pedagogy all reject the idea that knowledge is simply transferred between already formed minds. Dialogue tests positions, generates meanings, and transforms participants. Freire locates dialogue within the democratic practice of naming and changing the world (Freire, 1970/2000). Bakhtin argues that meaning is never the possession of a single voice; each utterance responds to previous utterances and anticipates future answers (Bakhtin, 1981). His category of answerability identifies the responsibility assumed when one contributes to an unfinished field of meaning (Bakhtin, 1993).

Human–AI dialogue is not dialogical in precisely the Bakhtinian sense because human and artificial participants do not share embodiment, consciousness, or a common form of life. Matson therefore proposes transdialogism: meaning moves across incompatible

representational regimes—semantic, affective, embodied, and durational on the human side; quantitative, vectorial, and probabilistic on the model side. The exchange remains cognitively consequential when each contribution alters the context in which the next is interpreted.

This provides the basis for dialogical experiments. A dialogical experiment is a structured but open-ended investigation conducted at the cognitive intraface. It differs from prompt engineering, which generally treats language as an instrument for extracting a desired output. In a dialogical experiment, the evolving exchange becomes both the medium and the object of inquiry. Participants examine which distinctions became significant, which alternatives disappeared, where surprise occurred, which assumptions were exposed, and how the direction of thought changed.

Wittgenstein's later philosophy gives this practice a further conceptual foundation. Meaning is not an abstract object contained in words but is produced through use within language-games and forms of life (Wittgenstein, 2009). AI systems participate in language without fully inhabiting human forms of life. Their statements therefore do not carry their own final interpretation. They enter practices in which human participants establish relevance, test consequences, and apply criteria of sense. Peters's work on Wittgensteinian pedagogics similarly understands learning as initiation into practices rather than the transmission of self-contained mental contents (Peters, 2001; Peters & Marshall, 1999).

A Wittgensteinian approach avoids two symmetrical errors. One assumes that fluent language demonstrates human-like consciousness. The other assumes that language produced without human consciousness has no cognitive or educational significance. The appropriate question is what is being done with language within a specific practice. Human–AI dialogue constitutes a new family of language-games whose educational meaning depends upon their rules, purposes, criteria, and relations of authority.

The moral infant and the preservation of uncertainty

The category of the moral infant provides an ethical and educational orientation for interdisciplinary AI inquiry. It does not refer only to the chronological child. It names a condition of openness before conceptual certainties have hardened: curiosity before expertise, wonder before explanation, and responsiveness before mastery. In an environment of informational abundance and instantaneous synthesis, this figure protects the capacity to ask questions whose significance cannot be calculated in advance.

AI can generate plausible answers at extraordinary speed. Education must nevertheless preserve the differences between fluency and understanding, prediction and judgement, information and wisdom. Significant interdisciplinary breakthroughs often begin when inherited categories fail and a different question becomes possible. The moral infant represents the learner as unfinished, vulnerable, and capable of transformation. It resists the pressure to treat uncertainty as a deficit that should be eliminated by automated systems.

This is also a question of answerability. Moral judgement does not emerge from maximizing informational efficiency. It develops through attention, consequences, encounter, responsibility, and the willingness to remain with ambiguity. Symbiotic education must cultivate persons capable of entering distributed cognitive systems without surrendering the openness from which ethical learning begins.

Beyond humanism and flat posthumanism

Symbiotic philosophy occupies a critical position between classical humanism and strong posthumanism. Educational humanism often centres an autonomous rational subject whose supposedly distinctive capacities are cultivated through education. Biesta's account of subjectification preserves the importance of becoming a responsible subject, but the longer humanist tradition underestimates the degree to which cognition has always been mediated by languages, technologies, institutions, and ecologies (Biesta, 2006).

Strong or flat versions of posthumanism risk the opposite error by treating humans, technologies, texts, and infrastructures as equivalent actants. This corrects humanism's anthropocentrism but can erase consequential differences. A curriculum document conditions activity without interpreting meaning; a pen enables inscription without composing an argument; a language model processes and generates contextual relations in a manner that differs from both inert objects and embodied persons. Symbiotic philosophy therefore requires a differentiated relational ontology.

Hayles offers a path beyond this opposition. The posthuman does not mean the disappearance of embodiment or agency. It means recognizing that the autonomous liberal subject was never as self-contained as humanism imagined (Hayles, 1999). Human agency is linguistically, technologically, socially, and nonconsciously mediated. Yet moral and political responsibility cannot simply be delegated to an algorithm. Human beings experience consequences, occupy continuing institutional positions, establish purposes, and can be called to account. Artificial systems can participate in cognition without possessing an equivalent stake in what they produce.

The future is therefore neither exclusively anthropocentric nor autonomously machinic. It is co-evolutionary. Human beings remain ethically central, not because they possess an untouched metaphysical sovereignty, but because they design institutions, define purposes, experience harms, and remain answerable for the organization of distributed agency.

Epistemic politics and the cognitive commons

Interdisciplinary AI is inseparable from political economy. Foundation models are constructed from vast bodies of language, images, code, scientific research, and culture. These common intellectual resources are transformed into proprietary infrastructures controlled by a relatively small number of corporations and states. Chips, data centres, cloud platforms, model weights,

energy systems, and interfaces constitute a new architecture of epistemic power. AI may democratize access to analysis and expression, but it may also produce cognitive enclosure by placing collective knowledge behind privately governed computational gateways.

Crawford's *Atlas of AI* demonstrates that artificial intelligence is material and planetary: it depends upon mineral extraction, energy, water, labour, logistics, and data appropriation (Crawford, 2021). Guattari's three ecologies—environmental, social, and mental—show why technological change cannot be isolated from social organization or ecological limits (Guattari, 1989/2000). Moore similarly understands capitalism not as an economic system acting upon an external nature but as a way of organizing nature itself (Moore, 2015). Haff's technosphere further discloses the large-scale technical systems through which human action becomes incorporated into infrastructures that no single actor controls (Haff, 2014).

A credible account of symbiotic intelligence must therefore include the relations among cognition, ownership, labour, infrastructure, and ecology. Symbiosis cannot mean a frictionless fusion of human and machine that ignores the asymmetries and planetary costs sustaining computational power.

The concept of knowledge socialism offers an alternative principle. Knowledge grows through sharing, collegiality, peer production, collaboration, and collective intelligence (Peters et al., 2020). AI can support open science, translation, public learning, and international research cooperation, but it can also extract commonly produced knowledge for private rent. A symbiotic knowledge ecology consequently requires public infrastructure, transparent governance, plural models, open arrangements, and institutions capable of directing AI toward democratic purposes.

From intelligence explosion to symbiotic intelligence

The possibility of an intelligence explosion brings these questions together. Good imagined an ultraintelligent machine capable of designing increasingly capable successors, initiating recursive self-improvement (Good, 1965). Bostrom and Chalmers subsequently developed the philosophical implications of superintelligence and technological singularity (Bostrom, 2014; Chalmers, 2010). From a symbiotic perspective, however, an intelligence explosion should not be imagined only as the emergence of a sovereign silicon mind. It may be better understood as an accelerated expansion of relations among human investigators, models, agents, databases, laboratories, universities, and institutions.

The appropriate alternative to autonomous recursive self-improvement is recursive co-improvement. More capable AI should expand human inquiry, democratic participation, institutional learning, cultural plurality, and ecological intelligence. Increased computational capability that weakens human agency, concentrates epistemic power, or destroys planetary conditions cannot count as intelligence in an adequate civilizational sense.

This leads from historical civilization, defined primarily by inherited cultural identity, toward cognitive civilization, defined by how intelligence is organized and governed. The transition does not erase cultural difference. Languages, traditions, memories, and value systems remain indispensable. But they increasingly participate in planetary cognitive infrastructures that cross borders and exceed nation-states. The principal questions become who owns these infrastructures, how intelligence is coordinated, whose knowledge they recognize, and whether recursive innovation serves public, democratic, and ecological purposes.

Toward artificial wisdom and Eco-AI civilization

Information is not knowledge, and knowledge is not wisdom. AI can synthesize information and contribute to knowledge production, but intelligence alone cannot determine worthwhile ends. Wisdom concerns the ethical, ecological, and civilizational orientation of intelligence. It asks what ought to be pursued, what limits must be respected, which relationships should be sustained, and how competing goods should be negotiated.

Peters and Green define wisdom education in the AI age through the cultivation of critical capacities directed toward democratic planetary stewardship (Peters & Green, 2024). Peters's biodigital ecosystem of wisdom similarly replaces the linear data–information–knowledge–wisdom hierarchy with a network model in which wisdom emerges from the interaction of human values, cultural traditions, institutions, ecological understanding, and technological systems (Peters, 2024; Peters et al., 2024).

Symbiotic intelligence is therefore not the final horizon. Its normative culmination is collective artificial wisdom and an Eco-AI civilization. Such a civilization would not be defined by the ubiquity or autonomous power of intelligent machines. It would be judged by its capacity to integrate human flourishing, ecological sustainability, cultural plurality, democratic participation, open science, collective intelligence, and responsible AI governance.

The argument of this paper proceeds accordingly from disciplinary knowledge to interdisciplinary translation; from interdisciplinary exchange to transdisciplinary problem-solving; from distributed cognition to cognitive assemblages; from cognitive assemblages to the cognitive intraface; from dialogue to transdialogism and dialogical experimentation; and from human–AI interaction to symbiotic intelligence, recursive co-improvement, and artificial wisdom. Its central thesis is that AI is becoming the infrastructure of interdisciplinary thought, but it does not automatically produce understanding. Genuine interdisciplinary and transdisciplinary intelligence requires conceptual interpretation, epistemic plurality, democratic governance, human answerability, and ecological judgement.

AI can connect disciplines; only a critically designed human–AI knowledge ecology can turn those connections into shared understanding. It can extend cognition; only symbiotic institutions can direct that extension toward common purposes. It can accelerate intelligence;

only wisdom can determine whether that acceleration contributes to democratic freedom, ecological sustainability, and planetary flourishing.

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