

Agentic Science: Orchestrating MAS and LLMs for Multidisciplinary to Transdisciplinary Discovery

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ABSTRACT

Scientific discovery increasingly requires collaboration across disciplinary and societal boundaries. While large language models (LLMs) support individual research tasks, they lack the structure to engage in sustained, multi-actor inquiry. Multi-Agent Systems (MAS) offer complementary strengths in coordination, negotiation, and distributed reasoning. This paper presents a vision for integrating MAS and LLMs to support multidisciplinary, interdisciplinary, and transdisciplinary science. We argue that intelligent agents can move beyond task automation to become epistemic participants in the co-production of knowledge. We identify key challenges—technical, ethical, and institutional, and outline a research agenda for building collaborative, adaptive, and socially aware AI systems for science.

KEYWORDS

Multi-Agent Systems, Large Language Models, Scientific Discovery, Transdisciplinary Research, Interdisciplinary Integration, Multidisciplinary Coordination, Human-AI Interaction

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1 INTRODUCTION

The number of scientific knowledge production has rapidly grown over the past two years, reflected by the number of submissions of papers in leading Artificial Intelligence conferences such as International Conference on Autonomous Agents and Multiagent Systems (AAMAS). Yet, even as published knowledge expands, many of society’s most complex challenges remain difficult to resolve. Disaster response, antimicrobial resistance, energy transitions, social inequality, public health crises to name a few, persist, evolve, and in some cases worsen, despite decades of active scientific engagement [11, 16, 25]. These persistent failures suggest that the problem is not simply one of insufficient knowledge, but also on how knowledge is organized, integrated, and applied across scientific domains and societal systems [27, 38].

Artificial intelligence (AI) has become a central driver of modern scientific discovery [13] and LLMs are now increasingly embedded in scientific work [3, 33, 38]. LLMs have shown considerable promise across various scientific tasks. They are increasingly being used to retrieve and summarize literature [15], generate hypotheses, propose research designs, write papers [21], and even simulate

expert discussions [23]. The growing availability of foundation models trained on vast text corpora has enabled new forms of interaction between humans and machines in several domains such as biomedical research, environmental modeling, and computational social science [41]. These tools are especially useful for navigating complex information landscapes and accelerating individual research workflows.

However, LLMs are most often used by individual researchers to complete isolated tasks such as writing summaries or generating ideas [14]. Therefore, despite their potential, LLMs remain mainly peripheral to the potential collaborative and institutional structures that underpin scientific discovery. In fact, they are rarely integrated into broader knowledge-production ecosystems, nor are they designed to support multi-actor epistemic processes [41].

MAS as a long-established paradigm for modeling autonomous agents in dynamic and interactive environments, could offer the necessary scaffolding for this next step. Designed to support collaboration, coordination, negotiation, and shared task execution among distributed agents [37], MAS provides a natural framework for representing the collective and iterative nature of scientific inquiry. Within a MAS, agents can embody different roles, goals, or disciplinary perspectives, interacting not only with data but also with each other and with human researchers [6, 12]. These capabilities make MAS well suited for structuring collaborative scientific workflows that unfold across domains, institutions, and epistemic cultures [20, 26].

In this paper, we argue that one of the potential for AI in science lies not in automating isolated tasks, but in enabling new modes of collaborative knowledge production. Specifically, we focus on the long-term role that MAS, augmented by LLMs, could play in supporting scientific discovery across multiple epistemic modalities: multidisciplinary, interdisciplinary, and transdisciplinary research. These three approaches, although often used interchangeably, represent distinct modes of organizing knowledge [35], each with its own demands and opportunities for intelligent system design.

This vision is necessarily long-term. Many of the technical, ethical, and organizational challenges are unresolved. We do not claim that fully autonomous, epistemically aware agents are feasible in the immediate future. Rather, we argue that now is the time to begin designing toward that goal by exploring how agent based systems could meaningfully support scientific inquiry, not only in their technical capabilities but also in how they interact, adapt, and collaborate with human scientists. This requires rethinking not just system architecture but the dynamics of human agent co-discovery across diverse epistemic settings.

2 BACKGROUND

Scientific discovery increasingly unfolds across disciplinary, institutional, and societal boundaries, requiring coordination among

heterogeneous actors with diverse expertise and constraints. Yet contemporary AI systems, including LLMs, are still mostly deployed as tools for individual tasks such as search, summarisation, or drafting, rather than as contributors to collective knowledge production [15]. Within this landscape, it is essential to distinguish between multidisciplinary, interdisciplinary, and transdisciplinary collaboration. Multidisciplinary work assembles several disciplines around a shared problem while largely preserving their theoretical and methodological autonomy [19, 35]. Interdisciplinary work actively integrates disciplinary frameworks, generating new concepts, models, or methods that cannot be reduced to their sources [19, 35]. Transdisciplinary work includes societal actors, policy-makers, practitioners, and communities in the co-production of knowledge and explicitly targets real-world transformation [19, 35]. These modalities differ in epistemic commitments, interaction patterns, and success criteria, and any MAS-LLM architecture intended to support scientific inquiry could benefit to accommodate these differences in how it organizes coordination and reasoning [30, 32].

To move forward, we can conceive intelligent as participants in distributed scientific ecosystems. Such participation entails interacting with the conceptual, adapting to its norms and uncertainties, and engaging constructively with both disciplinary and societal diversity. The convergence of MAS and LLMs presents a timely opportunity to design such systems.

3 OUR VISION

The future of scientific discovery will depend not only on better algorithms or faster computation, but on the ability of intelligent systems to support diverse and distributed forms of knowledge production. We envision a shift from task-centric automation to epistemically grounded participation, where agents are collaborators embedded within evolving research ecosystems. This section presents a vision for how MAS, enhanced with LLMs, can be designed to support three major modalities of contemporary science: multidisciplinary, interdisciplinary, and transdisciplinary collaboration. In fact, scientific problems rarely fall neatly within the boundaries of a single discipline and complex challenges require insights from multiple fields. Our vision emphasizes designing agent-based infrastructures that are sensitive to the unique coordination, integration, and reflexivity required by each modality.

3.1 Scientific Collaboration as an Epistemic Landscape

At the center of our vision is the concept of an epistemic infrastructure [40]: a socio-technical system that enables the production, validation, and integration of knowledge across diverse agents: both human and artificial. In such a system, agents can play distinct roles, disciplinary identities, or stakeholder perspectives. MAS provides the structural and computational paradigm to support these requirements, while LLMs serve as mediators of language, context, and domain-specific knowledge.

3.2 Multidisciplinary Science: Coordinating Knowledge Silos

Multidisciplinary research brings together experts from different disciplines who work in parallel on a shared problem. There is

typically limited integration of methods or theories; instead, each participant contributes within the boundaries of their domain. The primary challenge is coordination: aligning timelines, tasks, and outputs to produce a coherent whole [8, 9].

In this setting, MAS can support distributed task management, knowledge tracking, and collaboration scaffolding. Agents can be assigned to represent specific disciplinary competencies or institutional roles, each with its own goals, resources, and vocabularies. The system as a whole will have the goal to maintain a dynamic map of the project structure, dependencies, and information flows.

LLMs play a complementary role by mediating communication between agents and human researchers, translating between specialized terminologies, and synthesizing results into shared formats. While deep integration of knowledge is not the goal in multidisciplinary work, agents must still ensure consistency, avoid redundancy, and manage conflicts arising from different standards of evidence or modeling practices [34]. For example, in a large-scale environmental study, agents representing climatologists, economists, and ecologists could manage their respective simulation models while exchanging summary-level findings via LLM-generated briefs. MAS facilitates orchestration, while LLMs ensure communicability.

3.3 Interdisciplinary Science: Synthesizing Concepts Across Boundaries

Interdisciplinary science seeks to move beyond parallel contributions by integrating concepts, methods, or frameworks from different disciplines into a unified approach. This process is inherently epistemically demanding. It requires negotiation over terminology, reconciliation of assumptions, and the development of hybrid conceptual spaces [4, 10].

Supporting interdisciplinary work demands a more ambitious role for agents. MAS architectures must enable argumentation, belief revision, and trust modeling among agents with partially aligned goals and differing priors. Epistemic roles become central: agents need to represent not only content knowledge, but also positions within ongoing conceptual negotiations [7].

LLMs enhance these interactions by modeling context, rephrasing ideas across domain boundaries, translate content and supporting the iterative development of shared vocabularies. The system functions as a space for exploratory dialogue—where agents help identify contradictions, propose redefinitions, and assess the compatibility of methods or data.

Such a system might support a collaboration between cognitive scientists and roboticists developing a model of embodied reasoning. Agents would manage the translation between cognitive theories and robotic control algorithms, using LLMs to reframe key concepts in ways intelligible across fields. Over time, the system helps surface integrative pathways and synthesize a common modeling framework.

3.4 Transdisciplinary Science: Engaging Society in Co-Production

Transdisciplinary research introduces a deeper challenge: the co-production of knowledge by scientists and societal actors. This mode demands engagement with non-academic expertise, practical constraints, and ethical concerns. The process is not only epistemic

but also societal, political, requiring deliberation, mutual respect, and adaptability [1, 22].

In this setting, agents must go beyond representing disciplinary roles to include civic, policy, or community perspectives. MAS architectures can support the inclusion of diverse agents with varying norms, communication styles, and levels of formal expertise. Crucially, they must model power asymmetries, manage conflict, and enable participatory processes that can consider stakeholder group.

LLMs assist by translating technical language into accessible terms, eliciting value-driven concerns, and adapting discourse based on social and cultural context. They help agents engage in inclusive dialogue, bridging gaps between scientific knowledge and lived experience.

3.5 Embedding the Human

AI is being used more and more in science, but its adoption varies because some support it while others do not. A Nature survey of 5,000 researchers finds contrasting views on when it's acceptable to involve AI in research papers and what needs to be disclosed [21]. Therefore, in all three modalities, humans should remain central. Intelligent agents are not replacements for researchers, but collaborators that support reasoning, translation, and integration. Thus, human scientists remain indispensable epistemic agents as scientific discovery is not a purely computational process; it is shaped by judgment, tacit knowledge, normative assumptions, and social negotiation.

Embedding the human in AI-supported science requires more than supervisory roles or reactive control. It calls for system architectures that preserve and enable the forms of reasoning, deliberation, and responsibility that define scientific inquiry beyond the classic Human-in-the-Loop, Human-on-the-Loop and Human-in-Command. MAS can be designed with interfaces that promote transparency, allow for human override, and support reflexive engagement. Human agency is essential, particularly when dealing with normatively loaded decisions, uncertain evidence, or contested concepts.

4 CHALLENGE

As intelligent systems become more entwined with the production of scientific knowledge, a number of challenges emerge [34, 41]. These challenges are not only technical but span epistemic, ethical, institutional, and human-centered dimensions. Addressing them is critical if agent-based systems and language models are to meaningfully support multidisciplinary, interdisciplinary, and transdisciplinary research.

A central challenge lies in representing and reasoning across diverse forms of knowledge [36]. Scientific disciplines differ in how they construct, validate, and communicate knowledge. Agent systems must be capable of handling these epistemic differences, not merely at the level of terminology, but in how assumptions, standards of evidence, and methods interact. This is especially difficult in interdisciplinary work, where fundamental concepts are often in tension, and in transdisciplinary contexts, where non-academic actors bring experiential or context-dependent knowledge that may not align with formal scientific categories [4, 19, 35].

Human-agent collaboration in such environments introduces complex interactional challenges [17]. Existing systems often operate under simplified models of collaboration, assuming clear task delegation or stable goals. Scientific discovery, in contrast, involves distributed, evolving constellations of actors, each with partial knowledge and varying priorities. Designing agent systems that can participate meaningfully in these open-ended, reflexive processes while enabling coordination without central control remains an open problem.

The integration of LLMs with MAS compounds these difficulties. While LLMs offer impressive capabilities in generating text, summarizing arguments, and navigating large corpora, they also introduce new risks. One of the main issue is the problem of hallucination [18]: the generation of plausible but factually incorrect or misleading content. In scientific contexts, such errors are not merely inconvenient; they can distort reasoning, propagate misinformation, or undermine trust. Agents must be able to assess the reliability of LLM outputs, cross-reference them with verified knowledge, and communicate uncertainty when appropriate.

There is also a concern about the erosion of scientific expertise. As researchers increasingly rely on intelligent assistants for literature review, hypothesis generation, or writing, there is a risk that critical thinking, methodological awareness, and domain-specific judgment may atrophy [21]. This is not merely a matter of skill substitution, but of shifting the locus of epistemic authority. When systems propose hypotheses or construct arguments, who is accountable for the resulting knowledge? Without clear boundaries and human oversight, there is a concern that automated systems could shape scientific agendas in ways that are opaque, uncritical, or biased.

Ethical and normative concerns further complicate the picture. Transparency and explainability are essential but insufficient [29]. Researchers need to understand not only how an output was produced, but what assumptions, trade-offs, or values were embedded in the process. In transdisciplinary settings, where social, cultural, and political dimensions intersect with scientific reasoning, this becomes even more pressing. Responsible systems must be able to reflect on their own position in the knowledge ecosystem and make visible the choices that shape their contributions.

Adaptability and flexibility are also essential. In fact, as new insights emerge or team structures evolve, agent roles may need to shift, delegate authority, or recalibrate goals. This is particularly salient in interdisciplinary and transdisciplinary research, where projects evolve iteratively and may be shaped by political, social, or institutional constraints. Adaptive MAS systems should be able to track the evolving structure of inquiry, respond to new stakeholder input, and engage in reflexive reasoning about their own contributions.

Linguistic and cultural inclusivity presents an additional layer of responsibility. Many researchers operate in non-English linguistic environments, and some face challenges expressing complex ideas due to limited proficiency in dominant scientific languages [5]. LLMs can play a crucial role in supporting multilingual communication, enabling more equitable participation in global research networks. However, this goal must be carefully handle to avoid the erasure of nuance, epistemic distortion, or overstandardization.

Finally, institutional and infrastructural challenges cannot be ignored. Scientific knowledge is not produced in a vacuum. It emerges through peer review, funding structures, disciplinary norms, and community practices. Intelligent systems that participate in this process must be evaluated not only on accuracy or efficiency but on their compatibility with the broader social dynamics of science. Without careful attention, these systems risk reinforcing existing hierarchies, marginalizing alternative perspectives, or privileging consensus over innovation.

5 RESEARCH AGENDA

Confronting these challenges demands a sustained and multi-layered research agenda, one that redefines the relationship between artificial agents and scientific knowledge. This agenda must move beyond task automation to envision intelligent systems as epistemic participants capable of contributing to collaborative, reflective, and socially grounded knowledge production.

In the near term, a key priority is the development of hybrid systems that combine the symbolic reasoning of multi-agent architectures with the generative capabilities of LLMs [28]. Such integration should not be ad hoc or superficial. Instead, it must be grounded in a principled understanding of how language, reasoning, and coordination interact in scientific contexts. One promising direction is to model agents with explicit epistemic roles—such as synthesizer, challenger, mediator, or translator—that can be adopted or reconfigured dynamically depending on the stage and structure of inquiry.

Mid-term efforts should focus on building systems that support heterogeneous collaboration [24]. Rather than optimizing for individual productivity, agents should be designed to facilitate group reasoning, mediate conflicting perspectives, and negotiate shared conceptual frameworks. New protocols will be needed to support many-to-many interactions among agents and humans with different expertise, goals, and values. These protocols should incorporate mechanisms for turn-taking, consensus-building, disagreement management, and trust calibration. Such capabilities are important for interdisciplinary and transdisciplinary projects where success depends not on solving a predefined problem, but on co-constructing the problem space itself.

Another crucial research direction involves ethical alignment, explainability and responsibility modeling [29, 39]. As agents increasingly contribute to the content and direction of research, mechanisms are needed to attribute authorship, trace influence, and surface value assumptions. This calls for new frameworks of accountability that go beyond transparency in model internals. Agents must be able to justify their actions within the context of evolving epistemic communities.

Longer-term, we envision systems capable of sustaining engagement over extended periods. Scientific inquiry often unfolds over months or years, with shifting goals, actors, and institutional constraints. Supporting this requires agents that can learn continuously, remember past interactions, adapt to changing contexts, and revise their roles as needed. This kind of temporal coherence is essential for transdisciplinary impact, where outcomes depend not only on novel insights but on building long-term relationships between researchers, communities, and policymakers.

Finally, new evaluation paradigms are urgently needed. Traditional AI benchmarks centered on prediction accuracy or task completion are inadequate for assessing success in complex scientific collaboration. We propose the development of new experimental testbeds and shared environments that simulate realistic research scenarios, including partial knowledge, epistemic conflict, and societal relevance. Metrics should include epistemic robustness, diversity of perspectives, reflexivity, and the ability to contribute to actionable understanding across domains.

6 SOCIETAL IMPACT AND GLOBAL CONSIDERATIONS

The integration of MAS and LLMs into scientific research carries significant societal implications. These technologies will not only affect how knowledge is produced but also who participates in that production and whose perspectives are prioritized. If left unexamined, such systems risk amplifying existing disparities in scientific infrastructure, access, and influence.

This concern is particularly relevant in the context of developing countries, where many urgent scientific challenges are concentrated [31]. Issues such as public health, food security, and climate resilience are especially pressing in these regions, yet they often lack the institutional resources and visibility in global research agendas [2]. At the same time, they possess deep repositories of local, indigenous, and experiential knowledge that are rarely captured by dominant scientific paradigms.

Intelligent systems designed for scientific discovery must therefore account for this epistemic diversity. MAS and LLMs can help mediate across languages, bridge disciplinary and cultural divides, and support inclusive collaboration. However, achieving this requires infrastructure that is globally accessible, models that reflect diverse knowledge systems, and participatory approaches that actively engage local actors in the design and validation of AI-supported research.

7 CONCLUSION

As global challenges grow in complexity, scientific inquiry must evolve beyond disciplinary silos and individual workflows. Addressing issues like public health, and societal inequality requires knowledge integration, societal engagement, and sustained collaboration. While recent advances in LLMs and MAS offer promising technical capabilities, intelligent systems must be reimagined as epistemic participants—supporting coordination, negotiation, and reasoning across diverse domains and stakeholders.

Achieving this vision calls for a shift in priorities. It requires developing systems that are responsive to epistemic diversity, transparent in their decision-making, and reflective of the social contexts in which science operates. This is not merely a technical endeavor. It demands new approaches to responsibility, agency, and evaluation, grounded in real-world scientific practices. The embedding MAS and LLMs within collaborative scientific ecosystems can open the door to more inclusive, accountable, and impactful modes of discovery capable of meeting the challenges of the 21st century.

REFERENCES

- [1] Karoline Augenstein, David PM Lam, Andra-Ioana Horcea-Milcu, Philip Bernert, Lakshmi Charli-Joseph, Jessica Cockburn, Teresa Kampffmann, Laura M Pereira, and My M Sellberg. 2024. Five priorities to advance transformative transdisciplinary research. *Current Opinion in Environmental Sustainability* 68 (2024), 101438.
- [2] Collins Ayoo. 2022. Poverty reduction strategies in developing countries. *Rural development-education, sustainability, multifunctionality* 19 (2022).
- [3] Jinheon Baek, Sujay Kumar Jauhar, Silviu Cucerzan, and Sung Ju Hwang. 2025. ResearchAgent: Iterative Research Idea Generation over Scientific Literature with Large Language Models. In *Proceedings of the 2025 Conference of the Nations of the Americas Chapter of the Association for Computational Linguistics: Human Language Technologies (Volume 1: Long Papers)*, Luis Chiruzzo, Alan Ritter, and Lu Wang (Eds.). Association for Computational Linguistics, Albuquerque, New Mexico, 6709–6738. <https://doi.org/10.18653/v1/2025.naacl-long.342>
- [4] Drazen Barkovic. 2010. Challenges of interdisciplinary research. *Interdisciplinary Management Research* (2010).
- [5] Rachel Bernier, Erin Halpin, Steven J Staffa, Lindsey Benson, James A DiNardo, and Viviane G Nasr. 2018. Inclusion of non-English-speaking patients in research: a single institution experience. *Pediatric anesthesia* 28, 5 (2018), 415–420.
- [6] Ziru Chen, Shijie Chen, Yuting Ning, Qianheng Zhang, Boshi Wang, Botao Yu, Yifei Li, Zeyi Liao, Chen Wei, Zitong Lu, et al. 2024. Scienceagentbench: Toward rigorous assessment of language agents for data-driven scientific discovery. *arXiv preprint arXiv:2410.05080* (2024).
- [7] Mark Coeckelbergh. 2023. Democracy, epistemic agency, and AI: political epistemology in times of artificial intelligence. *AI and Ethics* 3, 4 (2023), 1341–1350.
- [8] Haydee Maria Cuevas, Cheryl A Bolstad, Robert Oberbreckling, Noelle LaVoie, Diane Kuhl Mitchell, James Fielder, and Peter W Foltz. 2012. Benefits and challenges of multidisciplinary project teams: "lessons learned" for researchers and practitioners. *Benefits and Challenges of Multidisciplinary Project Teams: Lessons Learned for Researchers and Practitioners* 33 (2012), 58.
- [9] Amaris Dalton, Karin Wolff, and Bernard Bekker. 2021. Multidisciplinary research as a complex system. *International Journal of Qualitative Methods* 20 (2021), 16094069211038400.
- [10] Kristy L Daniel, Myra McConnell, Anita Schuchardt, and Melanie E Peffer. 2022. Challenges facing interdisciplinary researchers: Findings from a professional development workshop. *Plos one* 17, 4 (2022), e0267234.
- [11] Karin De Bruijn, Joost Buurman, Marjolein Mens, Ruben Dahm, and Frans Klijn. 2017. Resilience in practice: Five principles to enable societies to cope with extreme weather events. *Environmental Science & Policy* 70 (2017), 21–30.
- [12] Alireza Ghafarollahi and Markus J Buehler. 2025. SciAgents: automating scientific discovery through bioinspired multi-agent intelligent graph reasoning. *Advanced Materials* 37, 22 (2025), 2413523.
- [13] Carla P. Gomes. 2020. AI for Advancing Scientific Discovery for a Sustainable Future. In *Proceedings of the 19th International Conference on Autonomous Agents and MultiAgent Systems (Auckland, New Zealand) (AAMAS '20)*. International Foundation for Autonomous Agents and Multiagent Systems, Richland, SC, 1.
- [14] Xuemei Gu and Mario Krenn. 2025. Interesting Scientific Idea Generation using Knowledge Graphs and LLMs: Evaluations with 100 Research Group Leaders. *arXiv:2405.17044 [cs.AI]* <https://arxiv.org/abs/2405.17044>
- [15] Sikun Guo, Amir Hassan Shariatmadari, Guangzhi Xiong, Albert Huang, Myles Kim, Corey M Williams, Stefan Bekiranov, and Aidong Zhang. 2025. Ideabench: Benchmarking large language models for research idea generation. In *Proceedings of the 31st ACM SIGKDD Conference on Knowledge Discovery and Data Mining V. 2*, 5888–5899.
- [16] Dan Hendrycks, Nicholas Carlini, John Schulman, and Jacob Steinhardt. 2021. Unsolved problems in ml safety. *arXiv preprint arXiv:2109.13916* (2021).
- [17] Sirui Hong, Mingchen Zhuge, Jonathan Chen, Xiaowu Zheng, Yuheng Cheng, Jinlin Wang, Ceyao Zhang, Zili Wang, Steven Ka Shing Yau, Zijuan Lin, et al. 2023. MetaGPT: Meta programming for a multi-agent collaborative framework. In *The Twelfth International Conference on Learning Representations*.
- [18] Lei Huang, Weijiang Yu, Weitao Ma, Weihong Zhong, Zhangyin Feng, Haotian Wang, Qianglong Chen, Weihua Peng, Xiaocheng Feng, Bing Qin, et al. 2025. A survey on hallucination in large language models: Principles, taxonomy, challenges, and open questions. *ACM Transactions on Information Systems* 43, 2 (2025), 1–55.
- [19] Muhammad Irfan-Maqsood. 2025. Multidisciplinary vs. Interdisciplinary vs. transdisciplinary approaches: key differences and in-depth analysis. *IMAQ Journal* 2 (2025), 44–48.
- [20] Sarit Kraus. 1997. Negotiation and cooperation in multi-agent environments. *Artificial intelligence* 94, 1-2 (1997), 79–97.
- [21] Diana Kwon. 2025. Is it OK for AI to write science papers? Nature survey shows researchers are split. *Nature* 641, 8063 (2025), 574–578.
- [22] Mark G Lawrence, Stephen Williams, Patrizia Nanz, and Ortwin Renn. 2022. Characteristics, potentials, and challenges of transdisciplinary research. *One Earth* 5, 1 (2022), 44–61.
- [23] Ziyue Li, Yuan Chang, and Xiaoqiu Le. 2024. Simulating expert discussions with multi-agent for enhanced scientific problem solving. In *Proceedings of the Fourth Workshop on Scholarly Document Processing (SDP 2024)*. 243–256.
- [24] Yifan Lu, Yue Hu, Yiqi Zhong, Dequan Wang, Yanfeng Wang, and Siheng Chen. 2024. An extensible framework for open heterogeneous collaborative perception. *arXiv preprint arXiv:2401.13964* (2024).
- [25] Johan P Mackenbach. 2017. Persistence of social inequalities in modern welfare states: explanation of a paradox. *Scandinavian Journal of Public Health* 45, 2 (2017), 113–120.
- [26] Diego Maldonado, Edison Cruz, Jackeline Abad Torres, Patricio J Cruz, and Silvana del Pilar Gamboa Benitez. 2024. Multi-agent systems: A survey about its components, framework and workflow. *IEEE Access* 12 (2024), 80950–80975.
- [27] Amogh Mannekote, Adam Davies, Jina Kang, and Kristy Elizabeth Boyer. 2025. Can llms reliably simulate human learner actions? a simulation authoring framework for open-ended learning environments. In *Proceedings of the AAAI Conference on Artificial Intelligence*, Vol. 39. 29044–29052.
- [28] Aditya Mehra. 2024. Hybrid AI models: Integrating symbolic reasoning with deep learning for complex decision-making. *Journal of Emerging Technologies and Innovative Research* 11, 8 (2024), f693–f695.
- [29] James W Navalta, Whitley J Stone, et al. 2020. Ethical issues relating to scientific discovery in exercise science. *International journal of exercise science* 12, 1 (2020), 1.
- [30] Roxanne Parrott and Matthew W Kreuter. 2011. Multidisciplinary, interdisciplinary, and transdisciplinary approaches to health communication: Where do we draw the lines? In *The Routledge handbook of health communication*. Routledge, 33–47.
- [31] Yoesoep Edhie Rachmad. 2025. Development of CBDC in Developing Countries: Potentials and Barriers. *The United Nations and the Nobel Peace Prize Awards* (2025).
- [32] Gheorghe Savoiu, Dinu Vasile, and Laurentiu Tăchiciu. 2014. An inter-, trans-, cross-and multidisciplinary approach to higher education in the field of business studies. *Amfiteatru Economic Journal* 16, 37 (2014), 707–725.
- [33] Chenglei Si, Diyi Yang, and Tatsunori Hashimoto. 2024. Can LLMs Generate Novel Research Ideas? A Large-Scale Human Study with 100+ NLP Researchers. *arXiv:2409.04109 [cs.CL]* <https://arxiv.org/abs/2409.04109>
- [34] Harjit Singh and Avneet Singh. 2023. ChatGPT: Systematic review, applications, and agenda for multidisciplinary research. *Journal of Chinese economic and business studies* 21, 2 (2023), 193–212.
- [35] Henrik Von Wehrden, Maria Helena Guimaraes, Olivia Bina, Marta Varanda, Daniel J Lang, Beatrice John, Fabienne Gralla, Doris Alexander, Dorit Raines, Allen White, et al. 2019. Interdisciplinary and transdisciplinary research: finding the common ground of multi-faceted concepts. *Sustainability Science* 14, 3 (2019), 875–888.
- [36] Qinghe Wang, Zihao Wang, Ying Su, Hanghang Tong, and Yangqiu Song. 2024. Rethinking the Bounds of LLM Reasoning: Are Multi-Agent Discussions the Key?. In *Proceedings of the 62nd Annual Meeting of the Association for Computational Linguistics (Volume 1: Long Papers)*, Lun-Wei Ku, Andre Martins, and Vivek Srikumar (Eds.). Association for Computational Linguistics, Bangkok, Thailand, 6106–6131. <https://doi.org/10.18653/v1/2024.acl-long.331>
- [37] Michael Wooldridge. 2009. *An introduction to multiagent systems*. John Wiley & sons.
- [38] Hongliang Xin, John R Kitchin, and Heather J Kulik. 2025. Towards agentic science for advancing scientific discovery. *Nature Machine Intelligence* (2025), 1–3.
- [39] Feiyu Xu, Hans Uszkoreit, Yangzhou Du, Wei Fan, Dongyan Zhao, and Jun Zhu. 2019. Explainable AI: A brief survey on history, research areas, approaches and challenges. In *CCF international conference on natural language processing and Chinese computing*. Springer, 563–574.
- [40] Youngjin Yoo. 2024. Evolving epistemic infrastructure: The role of scientific journals in the age of generative AI. *Journal of the Association for Information Systems* 25, 1 (2024), 137–144.
- [41] Yu Zhang, Xiuxi Chen, Bowen Jin, Sheng Wang, Shuiwang Ji, Wei Wang, and Jiawei Han. 2024. A comprehensive survey of scientific large language models and their applications in scientific discovery. *arXiv preprint arXiv:2406.10833* (2024).