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November 18, 2025

Dear Editorial Team,

Artificial intelligence today achieves remarkable feats—but at an unsustainable energetic cost and with limited capacity for compositional and continuous growth. The rapid emergence of gigawatt-scale AI data centers underscores the urgency of this challenge. The next grand challenge in the field, Embodied AI (EAI), amplifies it even further: every act of learning requires actual physical interaction, multiplying both energy demands and redundancy. Conventional paradigms—incremental and transfer learning—treat agents as independent learners, resulting in massive duplication of experience and energy use. In our manuscript, "*Collective Simultaneous Learning and Discovery of Knowledge for Scalable Yet Sustainable Embodied AI*," we argue that true energetic efficiency—and genuine compositional growth of model capability—will emerge only by rethinking how knowledge is acquired, shared and propagated, and ultimately reused for new problems.

We build on the new concept of **collective learning (CL)**, a scalable and energy-efficient paradigm of multi-agent simultaneous learning and discovery. CL enables embodied agents to transform individual experience into shared, compositional knowledge—learning cooperatively and concurrently rather than repetitively and in isolation. This distributed approach accelerates skill acquisition while drastically reducing redundant computation, motion, and interaction. A dynamical-systems formulation identifies nine canonical regimes of knowledge-sharing dynamics, revealing how scalability, compositionality, and energy efficiency can coexist. Simulations in a realistic smart-factory scenario show that CL reduces the energy required for skill acquisition by more than an order of magnitude compared with paradigms lacking inter-agent sharing or compositional structure—**demonstrating that collective learning offers a scalable and sustainable foundation for embodied AI**.

This manuscript has not been published or submitted elsewhere. All data supporting our conclusions are available in the main text or Supplementary Materials, and accompanying code will be released publicly upon publication. The study involves no human or animal subjects.

Thank you for your consideration.

Sincerely,

Sami Haddadin
Vice President for Research
Professor of Robotics
Mohamed bin Zayed University of Artificial Intelligence (MBZUAI)