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Digital communities of practice and the knowledge transformation cycle: Enabling sustainable food systems through AI and Metaverse technologies

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A R T I C L E I N F O

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A B S T R A C T

This study develops a conceptual framework to theorise how digitally augmented Communities of Practice (CoPs), such as the Slow Food Movement, can support sustainable food systems transformation through advanced knowledge management. Although digital innovation is increasingly applied in agri-food systems, much of the literature remains technocentric, focusing on infrastructure and automation, while overlooking how digital tools mediate community-based knowledge flows and adaptive capabilities. Addressing this gap, we integrate Nonaka and Takeuchi's SECI model with Teece's dynamic capabilities framework to examine how Artificial Intelligence (AI) and Metaverse technologies enable CoPs to create, share, and transform knowledge.

The main contribution is the DEKA-CoPs model (Digitally Enabled Knowledge Architecture in Communities of Practice), which explains how digital mediation can enhance epistemic agility, collaborative innovation, and system adaptability. Methodologically, the paper uses a theory-building approach to develop four propositions that can guide future empirical work.

This framework advances knowledge management and sustainability literature by shifting the focus from firm-based innovation to digitally enabled, community-led knowledge infrastructures. It offers practical implications for policymakers, technologists, and sustainability practitioners interested in designing inclusive, adaptive platforms that embed local knowledge in agri-food transitions.

1. Introduction

The imperative to transition towards sustainable food systems has become increasingly urgent considering escalating climate instability, biodiversity degradation, and entrenched socio-economic inequalities. While dominant narratives in policy and innovation often emphasise technological fixes and top-down interventions, such approaches frequently undervalue the epistemic contributions of traditional, local, and tacit forms of knowledge (see Table 1, Fig. 1).

These knowledge forms, rooted in generations of lived practice and cultural meaning, are often excluded from dominant frameworks that privilege codified, scientific, and universalist knowledge systems (Visser et al., 2022). Such asymmetry marginalises alternative ontologies and narrows the plurality of innovation pathways (Cacciolatti, 2024) required for resilient and inclusive food futures. Consequently, there is a pressing need to explore how diverse knowledge systems, particularly those embedded in community contexts, can be better recognised, integrated, and mobilised for sustainability transitions.

Although growing attention has been paid to digital innovation in agri-food systems, current scholarship often remains technocentric, focusing on infrastructure, efficiency, or automation (Dzreke, 2025; Klerkx, 2023; Vahdanjoo et al., 2025). Far less examined is how digital tools can support the integration of tacit and indigenous knowledge, particularly within participatory knowledge architectures.

Yet, the extant literature remains limited in three keyways. First, it tends to focus on efficiency gains, automation, or productivity without

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Table 1
SECI and dynamic capabilities dimensions of an innovation knowledge architecture for digital communities of practice in sustainable food systems.

	Sensing	Seizing	Transforming
Socialisation	CoPs use shared experiences to detect local signals (Tacit)	CoPs articulate experiential insights to mobilise responses (Tacit to Explicit)	Socialised knowledge prompts transformation of community values (Tacit)
Externalisation	Tacit insights are sensed and structured via AI (Tacit to Explicit)	Knowledge is codified into actions through digital artefacts (Tacit to Explicit)	Externalised knowledge transforms learning processes (Explicit)
Combination	Patterned explicit knowledge improves environmental scanning (Explicit)	Integrated data enables rapid prototyping and decision making (Explicit to Explicit)	Structured insights drive systemic governance transformation (Explicit)
Internalisation	Internalised digital content enhances intuitive sensing (Explicit to Tacit)	Learned practices are seized for adaptation (Explicit to Tacit)	Internalised routines restructure CoP norms (Tacit and Explicit)

adequately considering the socio-epistemic implications of digital transformation (Klerkx, 2023; Vahdanjoo et al., 2025). Second, studies rarely explore how digital tools interact with informal, local, and tacit knowledge practices, particularly in community-led or grassroots contexts. Third, there is a lack of integrated frameworks that explain how digital technologies can support collective learning and adaptive innovation over time. These omissions are significant not only because they hinder theoretical progress in knowledge management and sustainability research, but also because they risk excluding marginalised knowledge systems from influencing the design of future food systems.

It is important to address these gaps to advance inclusive and resilient pathways toward sustainability. Recent scholarship has begun to recognise that sustainability transitions do not depend only on technological innovation but also on the social architectures through which knowledge is produced and shared (Cacciolatti & Lee, 2022; Klerkx, 2023). Within this context, CoPs play a pivotal role in bridging the gap between scientific knowledge, local practices, and collective action. Yet, evidence from studies in agri-food innovation indicates that CoPs often remain fragmented and constrained by limited mechanisms for knowledge circulation and learning (Barrett et al., 2021; Cacciolatti & Lee, 2025). Digital mediation, through tools such as Artificial Intelligence (AI) and immersive technologies, offers new opportunities to strengthen these relationships by enabling more dynamic, distributed, and transparent knowledge flows. Building on these insights, this study contributes to a better understanding of how digitally augmented CoPs can serve as epistemic infrastructures that enhance collective capability, resilience, and innovation within sustainable food systems.

Accordingly, this study addresses a critical theoretical gap: how digital technologies reshape community-based knowledge processes in sustainability transitions. Despite a proliferation of research on digital transformation, little is known about how Artificial Intelligence (AI) and Metaverse tools mediate collective learning and dynamic capability formation within Communities of Practice (CoPs). By framing this question through an integration of SECI and dynamic capabilities frameworks, our study advances a socio-technical understanding of digital transformation that moves beyond firm-centred paradigms. At present, there exists a theoretical blind spot regarding the ways in which AI and Metaverse technologies might reshape knowledge dynamics in community-led contexts. The literature does not yet have a coherent conceptual framework that connects emerging digital affordances with the epistemic and organisational capacities of communities to engage in innovation. This study addresses this critical gap by developing a theoretical model that connects digital technologies, knowledge flows, and dynamic capabilities within digitally-augmented CoPs.

In this context, AI and Metaverse technologies offer both significant opportunities and complex challenges. On the one hand, these tools enable novel modalities for preserving, amplifying, and networking heterogeneous knowledge systems through intelligent processing and immersive interaction (Boccia & Covino, 2024; Shafik, 2025). AI can facilitate the transformation of tacit knowledge, such as oral traditions or context-specific farming practices, into structured, analysable formats through natural language processing, pattern recognition, and machine learning. Similarly, Metaverse platforms offer persistent and interactive digital spaces that enable collaborative learning, simulation, and storytelling. On the other hand, without deliberate attention to inclusion, access, and governance, these technologies risk reinforcing existing knowledge hierarchies by privileging dominant epistemologies and marginalising alternative forms of knowing. Critical engagement is therefore needed to ensure that digital tools act as enablers rather than gatekeepers of epistemic diversity.

To explore this potential, we turn to CoPs, which are defined as groups of individuals who share a concern or passion and deepen their knowledge through ongoing interaction, leading to setting the standards for a profession through a common sensemaking (Wenger, 1998). Within sustainable food systems, CoPs, such as the Slow Food Movement (SFM), have demonstrated a remarkable capacity to mobilise local knowledge, foster ethical consumption, and sustain agroecological practices across scales. These communities are anchored in mutual learning, shared values, and participatory governance.

As agri-food systems become increasingly digitised, CoPs face both the challenge of adapting their knowledge practices and the opportunity to enhance their epistemic and adaptive capacities through digital augmentation. The integration of AI and Metaverse tools into CoP environments can potentially reconfigure how these communities sense, share, and transform knowledge in complex socio-ecological settings (Ajani et al., 2023; De Giovanni, 2023).

Despite the expansion of digital tools in agri-food research, the conceptual intersection between digital technologies, community-based knowledge processes, and sustainability transitions remains under-theorised (Cerchione et al., 2023; Cheng et al., 2025). Existing studies

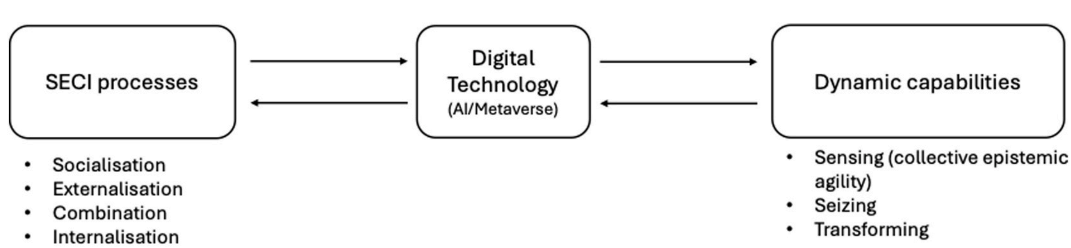

Fig. 1. DEKA-CoPs (Digitally Enabled Knowledge Architecture in Communities of Practice) model of digital mediation for sustainable food systems. The model illustrates the recursive interplay between SECI processes and dynamic capabilities within DEKA-CoPs. Digital technologies (AI, Metaverse) act as epistemic mediators, facilitating collective epistemic agility and community-led innovation orchestration. The model shows bi-directional flows between knowledge conversion (SECI) and capability enhancement (sensing, seizing, transforming), mediated by digital tools.

largely overlook the micro-foundations of knowledge flows and the structural capabilities required for adaptation within CoPs. Moreover, while dynamic capabilities theory (Teece, 2007) has been widely applied in firm-level innovation, its application to socially embedded, participatory knowledge systems such as the SFM is still nascent. This paper addresses this gap by developing a conceptual framework that integrates Nonaka and Takeuchi's (1995) SECI model of knowledge creation with the dynamic capabilities approach. Our aim is to theorise how AI and Metaverse technologies reshape the knowledge flows and adaptive capacities of CoPs to support sustainability transitions in food systems.

This study makes three core contributions. First, it extends knowledge management theory by conceptualising how emerging digital technologies mediate knowledge flows within digitally-augmented CoPs. Second, it advances the sustainability literature by theorising how knowledge architectures rooted in CoPs can foster innovation and resilience in food systems. Third, it offers practical insights for policymakers and digital infrastructure designers seeking to embed inclusivity and local knowledge into digital innovation processes. We frame the epistemic role of digitally-enabled communities, and we contribute to the broader debate on participatory knowledge systems in the AI–Metaverse era (Kaipainen, 2025; Vaz, 2024).

The paper is structured in the following way: section two presents the theoretical foundations of this study, rooted in Nonaka and Takeuchi's (1915) SECI model of knowledge management and Teece et al.'s (1993) dynamic capabilities theory; section three presents the conceptual model of SECI and Dynamic Capabilities Dimensions of an Innovation Knowledge Architecture for Digital Communities of Practice in Sustainable Food Systems, building some propositions; section four presents the discussion and implications, and section five concludes the paper.

2. Theoretical foundations

This study builds on and extends Cacciolatti and Lee's (2022) work on CoPs and innovation in food systems by bringing it into dialogue with two well-established yet rarely combined frameworks: Nonaka and Takeuchi's (1995) SECI model of organisational knowledge creation and Teece's (2007) dynamic capabilities theory. The SECI model, with its emphasis on the spiralling conversion between tacit and explicit knowledge, has been foundational in knowledge management scholarship, but its application to immersive and AI-enhanced contexts remains underdeveloped (Ribiere, 2023; Shen & Lin, 2024). Meanwhile, dynamic capabilities theory, typically applied to firms and market-facing innovation, has only recently been extended to community-based and sustainability-driven systems (Agnihotri et al., 2024; Pal et al., 2024). This paper contributes to this emerging conversation by exploring how dynamic capabilities (sensing, seizing, transforming) are embedded in participatory and digitally augmented epistemic infrastructures. Recent scholarship has also begun to theorise the role of digital technologies in augmenting or transforming organisational knowledge structures (Cerchione et al., 2023; Loia et al., 2025). For instance, Mancuso et al. (2024) highlight the importance of leadership and digital capability-building in Metaverse environments, while Mancuso et al. (2025) explore how explainable AI (XAI) mediates knowledge processing and decision-making in innovation systems. Our framework synthesises these insights with CoPs theory (Cacciolatti et al., 2024; Wenger, 1998), advancing the conceptualisation of what we term Digitally Enabled Knowledge Architecture in Communities of Practice (DEKA-CoPs). This novel construct integrates SECI knowledge flows with the recursive, adaptive mechanisms described in dynamic capabilities theory to explain how digital tools mediate innovation and learning in complex, decentralised food systems.

While the SECI model and dynamic capabilities have each been widely applied in innovation studies, prior work has predominantly focused on firm-level, technocratic implementations (Teece, 2007; von Krogh et al., 2012), often overlooking socially embedded and participatory knowledge contexts. Recent studies have begun to explore digital augmentation of knowledge systems (Cerchione et al., 2023; Cheng et al., 2025), but few integrate these frameworks to examine how AI and immersive technologies reshape the epistemic practices of grassroots communities. For example, Mancuso et al. (2025) explore the role of explainable AI in innovation processes, yet do not link it to community learning or sustainability transitions. Similarly, leadership in the Metaverse has been conceptualised in managerial contexts (Mancuso et al., 2024) but remains under theorised within decentralised food systems. Our DEKA-CoPs model responds to this gap by theorising how digital platforms mediate both knowledge flows (SECI) and strategic reconfiguration (dynamic capabilities) in a community-driven, systems-oriented framework. This moves beyond descriptive mappings of digital transformation to provide a layered, integrative architecture that reflects the complexity of food system transitions.

In our study, we draw upon recent advancements in knowledge management research that pinpoints the transformative role of digital platforms in learning and innovation systems (Cerchione et al., 2023; Cheng et al., 2025; Loia et al., 2025). It builds on tertiary analyses of knowledge processes, digitisation, and the dual dynamics of knowledge exploration and exploitation in complex, adaptive contexts (Agnihotri et al., 2024). These frameworks*, when integrated, offer a robust lens for understanding how distributed, local knowledge can be formalised, amplified, and adapted through digital means to promote sustainable food systems.

*Methodological note: methodologically, this paper adopts a conceptual theory-building approach (Jaakkola, 2020; Whetten, 1989), integrating and synthesising extant frameworks rather than empirically testing them. The propositions developed derive from iterative engagement with knowledge management, digital transformation, and the sustainability literatures, offering a theoretically grounded architecture for future empirical validation.

2.1. *Study rationale: the Slow Food Movement as a community of practice*

The rationale for this study lies in an inductive empirical observation of the Italian Slow Food Movement and its clear alignment with the defining characteristics of a CoP as outlined in previous studies (Cacciolatti et al., 2024; Cacciolatti & Lee, 2025). Originating in Italy in 1986, the SFM exemplifies a CoP built around a shared domain of interest, preserving traditional food cultures and promoting sustainable agrifood systems. It embodies mutual engagement through the collaboration of diverse actors, including producers, consumers, artisans, and intellectuals, who coalesce around shared practices and values (Cacciolatti & Lee, 2022).

What distinguishes the SFM is its mobilisation of collective knowledge deeply embedded in local agro-ecological contexts. This includes tacit knowledge of traditional food preparation, seasonality, biodiversity, and artisanal production, which is shared and externalised through mechanisms of participation and reification typical of CoPs. The movement's architecture of knowledge fosters social innovation, with consumers acting as co-producers and collective intelligence being harnessed through participatory mechanisms such as convivium, Earth Markets, and the Ark of Taste initiatives. Given its emphasis on recontextualising local knowledge within a global discourse on sustainable food systems, the SFM provides a pertinent empirical grounding for theorising digitally-augmented CoPs in the agri-food sector and inspired the rationale for this study, stimulating the generation of our main research question: How do AI and Metaverse technologies reshape knowledge creation and dynamic capabilities within digitally-augmented CoPs in sustainable food systems? This led us to explore the interplay between digital technologies and knowledge dynamics to support knowledge architectures in sustainable food systems.

2.2. The SECI model in digital knowledge for food systems transformation

The SECI model (Nonaka & Takeuchi, 1995) conceptualises organisational knowledge creation as a dynamic, spiralling process of interaction between tacit and explicit knowledge. It comprises four interrelated knowledge conversion modes.

Socialisation. This mode involves the informal and unarticulated transfer of knowledge through shared experiences. In Nonaka & Takeuchi's original framework, this mode refers to the transfer of knowledge from tacit to tacit. Traditionally embodied in practices like storytelling, mentorship, or communal food practices, socialisation facilitates the internal embedding of values, skills, and beliefs. In digital contexts, AI avatars and immersive Metaverse simulations can replicate and enhance these exchanges by simulating environments that support empathetic, embodied interaction, thus preserving and extending sensory and emotional knowledge typical of social systems (Ribiere, 2023).

Externalisation. This mode involves articulating tacit insights into formal language, often through metaphors, narratives, or diagrams, embodying the transfer of knowledge from a tacit to an explicit form. AI tools, especially those based on natural language processing and semantic analysis, can support this process by codifying oral traditions or subjective judgements into structured formats, creating knowledge artefacts that are communicable and transferable (Shen & Lin, 2024).

Combination. This process refers to systematising and synthesising existing explicit knowledge into more complex systems such as databases, taxonomies, or knowledge portals, allowing a horizontal transfer from explicit-to-explicit forms of knowledge. Metaverse environments facilitate this through collaborative digital spaces where CoP members co-create knowledge structures, integrating the indigenous and scientific data streams acquired (Oropallo, 2023).

Internalisation. Internalisation involves the absorption of explicit knowledge into an individual's tacit repertoire through practice, thus reinforcing learning by doing. In this mode, which transfers of knowledge from explicit to tacit, immersive technologies, such as gamified learning and AI-driven personalisation, allow for contextualised knowledge application, enhancing experiential learning and behavioural integration (Bersani & Koyava-Kipiani, 2024). Altogether, these processes constitute a self-reinforcing cycle of knowledge generation, essential for adaptive learning within CoPs.

Digitally augmented SECI processes have the potential to enable broader knowledge diffusion faster by allowing, for instance, farmers in remote rural communities to participate in virtual agricultural training programmes or by enabling diaspora communities to contribute ancestral culinary knowledge to shared digital repositories in real time. However, these processes also pose new challenges around epistemic authority, such as the potential marginalisation of local voices by algorithmic systems that prioritise dominant knowledge narratives. Thus, digital equity, i.e. uneven access to immersive or AI technologies, may exacerbate existing inequalities. Likewise, unclear Metaverse governance could raise questions about who controls, validates, and benefits from shared digital knowledge within global platforms.

2.3. Dynamic capabilities and knowledge flows

Dynamic capabilities are defined as the firm's ability to 'integrate, build, and reconfigure internal and external competencies to address rapidly changing environments' (Teece et al., 1997, p. 516). They are distinct from operational capabilities, which maintain the status quo, and instead enable innovation and transformation (Teece, 2007). Dynamic capabilities are context-dependent and path-dependent. Their activation requires the presence of enabling conditions such as leadership, absorptive capacity, and knowledge infrastructure. They operate at both individual and collective levels and are temporally bounded, i.e. they evolve through cumulative learning processes and are triggered by crises or strategic inflexion points (Zollo & Winter 2002), thus requiring a knowledge architecture to build stability in the knowledge system. The same authors proposed a triadic model, with three core elements: sensing, seizing, and transforming.

Sensing refers to the ability to identify, interpret, and prioritise opportunities and threats in the environment. Within sustainable food CoPs, AI-powered sensing can detect shifts in climate data, consumer preferences, or regulatory trends, thus enhancing community foresight and situational awareness (Pal et al., 2024). *Seizing*, on the other hand, is the capability to mobilise resources and reconfigure activities to act on sensed opportunities. In Metaverse-enabled environments, CoPs can explore and prototype novel forms of engagement, such as virtual farmers' markets or augmented storytelling for culinary heritage, which facilitate participatory innovation and inclusion (Rodríguez-Salazar & Torres-Huerta, 2025). Finally, *transforming* is the ability to renew and realign the organisation's structure, knowledge bases, and routines to maintain relevance. This includes embedding new digital tools into everyday practices, evolving governance mechanisms, and diffusing successful knowledge practices across the community (Bratianu et al., 2024).

In this study, we apply dynamic capabilities to digitally enhanced CoPs within sustainable food systems, framing them as distributed, socially embedded capabilities that co-evolve with technology. Dynamic capabilities allow sensing, seizing, and transforming and can be closely mapped onto the knowledge processes outlined in Nonaka's SECI model (Nonaka & Takeuchi, 1995). Specifically, the overlap between dynamic capabilities and SECI offers a more complete understanding of how knowledge flows in digitally mediated CoPs interacts with structural adaptations.

First, sensing, in the context of dynamic capabilities, refers to the organisation's capacity to identify, interpret, and filter signals from the environment to detect emerging threats and opportunities (Helfat & Peteraf, 2009; Teece, 2007). In the SECI model, socialisation facilitates tacit knowledge sharing through shared experiences. Digital sensing tools, such as AI-driven sentiment analysis or environmental scanning, support this process by augmenting CoPs' ability to interpret tacit knowledge embedded in local practices or social feedback loops (Raisch & Krakowski, 2021). Socialisation thus becomes technologically mediated, enabling richer, context-aware interactions that enhance the collective sensing capability of the CoP, enhancing tacit knowledge flows.

Second, seizing involves mobilising internal and external resources to capture value from identified opportunities through investments in new products, services, or processes (Augier & Teece, 2009; Teece, 2007). AI technologies can help codify tacit knowledge into explicit representations (externalisation) and integrate it with existing data systems or knowledge bases (combination), thus allowing us to align the seizing capability with SECI's externalisation. For instance, voice-to-text natural language processing (NLP) technology tools can help transform oral histories into structured knowledge repositories, while Metaverse-based simulations support collaborative synthesis of diverse knowledge domains, thus allowing a flow of knowledge from tacit to explicit.

Third, transforming refers to the organisation's capacity to renew itself by modifying its resource base and processes. It is the capability to continuously renew, realign, and reconfigure organisational assets, structures, and routines to sustain strategic advantage in dynamic environments (Eisenhardt & Martin, 2000; Teece, 2018). In the SECI model, internalisation denotes the embedding of explicit knowledge into tacit understandings through enactment. Immersive digital learning experiences in the Metaverse can simulate real-life agricultural scenarios, allowing members of a digital CoP to internalise new practices. Such technologically facilitated internalisation can trigger structural transformation in how CoPs govern, share, and apply knowledge.

Finally, the role of the combination is particularly powerful in an AI and Metaverse context because it facilitates the integration of diverse explicit knowledge streams, such as scientific data, market intelligence, and policy frameworks, into coherent, actionable formats that support strategic decision-making (Shehawy and Khan, 2025; Shukla et al., 2024). Through AI algorithms, communities can aggregate and analyse large datasets to uncover patterns. Likewise, Metaverse environments provide collaborative spaces where dispersed actors can visualise and experiment with this knowledge in real time. This aligns with the seizing dimension of dynamic capabilities, wherein organisations configure knowledge assets to design and implement innovative responses. The combination of processes and the technology from immersive and intelligent platforms allows CoPs to rapidly prototype solutions while aligning stakeholder interpretations and reducing the latency between insight and implementation (George et al., 2014; von Krogh et al., 2012).

Therefore, we posit that the SECI model and dynamic capabilities are not separate constructs but interconnected elements of a knowledge architecture that is both cognitive and structural. SECI explains the micro-foundations of knowledge flows, while dynamic capabilities frame how these flows are mobilised to adapt and innovate in turbulent environments. Knowledge architecture, as used here, encompasses both the technical infrastructure and behavioural patterns required to operationalise knowledge creation and renewal, bridging organisational epistemology with strategic action (Nonaka & Konno, 1998). This integration is particularly salient for CoPs involved in sustainable food systems, where local, tacit knowledge must continuously adapt to external pressures such as climate change, market volatility, global supply chains, and digitalisation. Thus, AI and Metaverse tools do not merely support information sharing but also shape the underlying capabilities of communities to learn, evolve, and co-create value; this constitutes the theoretical foundations of our conceptual model.

3. Digitally enabled knowledge architecture in communities of practice: A conceptual model and propositions

The conceptual model we developed in this paper integrates Nonaka and Takeuchi's (1995) SECI model of organisational knowledge creation with Teece's (2007) dynamic capabilities framework to explore how digitally augmented CoPs, e.g., alternative food networks, can support the transformation of sustainable food systems. We theorise that sustainable food systems can be enhanced by a dual-layered knowledge architecture: one that captures (i) the micro-foundations of knowledge dynamics and another that explains (ii) the strategic reconfiguration capabilities required for systemic adaptation.

In its essence, the SECI model maps the knowledge conversion processes through which organisations manage and evolve their tacit and explicit knowledge through knowledge flows. When enabled by AI and Metaverse technologies, these processes become digitally mediated and accelerated. For instance, socialisation, or the tacit-to-tacit exchange of knowledge through shared experience, is extended through immersive virtual environments where embodied practices such as cooking or farming are simulated and experienced collectively (George et al., 2014). Externalisation, where tacit knowledge is made explicit, is supported by AI tools capable of processing natural language and extracting semantic meaning from local oral histories or experiential narratives (von Krogh et al., 2012). Combination, i.e. the synthesis of explicit knowledge, is enhanced through collaborative digital platforms that allow diverse actors to integrate datasets, policy knowledge, and local insights into holistic models, and internalisation, i.e., the transformation of explicit knowledge into personal know-how, is augmented through gamification, scenario planning, and experiential simulations provided in the Metaverse, thus deepening learning (Leonardi, 2021).

At the macro level, these SECI-enabled flows support the development of dynamic capabilities (i.e., the ability to sense, seize, and transform). In this view, CoPs evolve from being communities of shared practice into agile, learning organisations capable of navigating volatile and complex socio-ecological systems. Digital transformation strengthens these capabilities by allowing CoPs to sense environmental changes (e.g. climate trends or consumer shifts) through AI-based forecasting; seize opportunities by reorganising knowledge into value propositions; and transform their routines, governance, and strategies in response to systemic feedback (Augier & Teece, 2009; Teece, 2018), constituting this way a digitally mediated knowledge architecture. Such a structure generates knowledge and mobilises it for innovation and sustainability transitions.

To deepen the theoretical richness of the framework and move beyond a series of discrete propositions, this study introduces the construct of Digitally Enabled Knowledge Architecture in Communities of Practice (DEKA-CoPs). This construct captures the systemic integration of SECI-based knowledge flows and dynamic capability routines within community-based networks operating in digitally mediated environments. Rather than treating SECI and dynamic capabilities as parallel frameworks, DEKA-CoPs conceptualise their intersection as a recursive and co-constitutive process, catalysed by immersive and intelligent technologies.

Within DEKA-CoPs, socialisation and externalisation activities are continuously shaped by digital affordances such as AI-based language models, gamified immersive learning (Loia et al., 2025), and real-time knowledge repositories. These tools not only facilitate the conversion of tacit to explicit knowledge but also scaffold the emergence of collective epistemic agility, i.e., the ability of CoPs to rapidly reconfigure shared understandings in response to systemic shocks or sustainability challenges.

This epistemic agility is tightly linked to the sensing capability in the dynamic capabilities framework; while sensing traditionally refers to detecting opportunities or threats, collective epistemic agility reframes this as a communal sensing mechanism whereby the distributed intelligence of CoPs enables rapid interpretation and integration of new knowledge. In DEKA-CoPs, sensing is thus no longer confined to data acquisition or individual leadership intuition; it is socially and digitally distributed across the community and the platforms it engages with.

Similarly, the combination and internalisation phases of SECI are digitally re-mediated through tools that support multilingual collaboration (Cheng et al., 2025) and automated decision support. In DEKA-CoPs, these processes underpin the seizing and transforming functions of dynamic capabilities, enabling not only resource mobilisation but also deep community-led innovation orchestration, a term introduced to denote decentralised innovation configurations enabled by digital tools.

The DEKA-CoPs model provides a holistic view of how digital augmentation transforms knowledge infrastructures in CoPs. It offers an interpretive lens to understand how epistemic, collaborative, and innovation processes are not simply supported, but fundamentally reconfigured, by digital technologies. This theoretical integration that we have introduced advances the field by moving beyond the application of existing models to proposing a novel architecture that highlights the mutual reinforcement between knowledge conversion and dynamic capability development in the digital age.

This conceptual model addresses a core gap in current sustainability and digital transformation literature. While there is increasing attention to the role of digital technologies in agriculture and food systems, most research adopts either a techno-centric or infrastructural lens (Zuboff, 2015). On the other hand, the 'how' of digitally-enabled knowledge dynamics is structurally and behaviourally embedded within CoPs and is neglected by the extant literature. Our model helps understand how these dynamics contribute to systemic innovation in complex, multi-actor environments such as food systems (Ferraris et al., 2022), bridging a gap between epistemic processes and strategic organisational change.

Unlike existing conceptual models that apply the SECI framework or dynamic capabilities in linear or firm-centric ways, DEKA-CoPs offer a digitally recursive and community-embedded architecture. Rather than positioning knowledge conversion and capability enhancement as parallel or sequential activities, our model reconceptualises them as mutually reinforcing and digitally mediated processes. DEKA-CoPs extend the boundaries of organisational learning by embedding innovation within decentralised, multi-actor networks, where platforms like AI and the Metaverse act as epistemic scaffolds. This contrasts with earlier models, which typically emphasise internal organisational routines. In doing so, DEKA-CoPs pinpoints the socio-technical assemblages that enable communities, not just firms, to become agents of systemic transformation in sustainability transitions.

3.1. Knowledge modulation for adaptability

In knowledge-intensive environments such as sustainable food systems, the adaptability of CoPs hinges upon their ability to flexibly convert between tacit and explicit knowledge. While tacit knowledge, often embedded in local food traditions and ecological know-how, is context-rich and deeply personal, its integration into broader innovation frameworks has historically been hindered by institutional biases favouring formalised, codified expertise (Visser et al., 2022). The interaction between tacit and explicit knowledge is recognised as central to innovation in complex environments, where experiential learning and codified frameworks must co-exist (Nonaka et al., 2000). In the context of sustainable food systems, this interplay is heightened by the pluralistic and culturally embedded nature of food-related knowledge. AI and Metaverse technologies, including machine learning and immersive virtual reality, offer affordances that can modulate these interactions by accelerating externalisation (via NLP and semantic extraction), enhancing socialisation (through shared virtual experiences), and deepening internalisation (via gamified and scenario-based learning). The underpinning mechanisms of socialisation, externalisation, and internalisation offer a useful lens for analysing how such technologies reconfigure knowledge flows in CoPs. For instance, AI tools facilitate ***externalisation*** by enabling the codification of tacit insights through pattern recognition and semantic interpretation, while Metaverse environments amplify ***socialisation*** and ***internalisation*** through embodied, experiential learning.

However, these affordances also introduce new complexities: there is the risk that AI-generated outputs might misrepresent or flatten the nuance of local knowledge systems, leading to epistemic alienation rather than empowerment (Leonardi & Contractor, 2018).

Similarly, the immersive fidelity of Metaverse platforms may overdetermine knowledge experiences, subtly shifting authority away from human narrators to platform designers and algorithms. These can function as epistemic mediators, translating experiential, local knowledge into formal artefacts while preserving contextual meaning (Faraj et al., 2018). Such digital tools act as epistemic mediators that restructure how knowledge is accessed, contextualised, and embodied across space and time (Faraj et al., 2018). Hence, their adoption by CoPs increases not only the velocity but also the granularity of knowledge flows, enhancing adaptability. When judiciously applied, AI and Metaverse platforms can enhance CoPs' adaptability by modulating the movement between tacit and explicit knowledge in more fluid, inclusive, and scalable ways. This modulation strengthens CoPs' responsiveness to emerging sustainability challenges, such as shifting climate patterns or socio-economic disruptions. Thus.

Proposition 1. *in CoPs with DEKA (digitally enabled knowledge architectures), AI and Metaverse technologies enhance the collective epistemic agility by modulating tacit-explicit knowledge flows, thus improving CoPs' adaptability to emerging sustainability challenges.*

3.2. Dynamic capabilities augmentation through digital platforms

Dynamic capabilities are characteristics of a learning organisation and are built upon an organisation's capacity to sense weak signals, interpret them meaningfully, and act on them strategically (Helfat & Peteraf, 2015; Teece, 2007). AI's ability to detect emergent patterns from complex data streams (e.g., climate indicators, market dynamics and supply chain status, or social media sentiment) augments the CoPs' sensing function, while Metaverse tools provide experiential formats for interpreting and engaging with this information, opening physical and digital environments up for remote collaboration.

As learning environments become more immersive and contextual, they support deeper behavioural change and faster capability transformation (Barrett et al., 2021), and dynamic capabilities play a role in it. *Sensing* is strengthened as AI systems interpret weak signals from environmental and social data, such as crop stress patterns or emerging dietary trends. These digital tools can augment CoPs' peripheral vision, helping identify threats and opportunities that might otherwise remain invisible. *Seizing*, i.e., the capability to mobilise resources and implement responses, is supported by Metaverse tools that allow rapid prototyping of new ideas, like virtual food cooperatives or immersive policy consultations, thereby lowering the cost of experimentation. Likewise, *transforming* becomes operationalised through the integration of digital routines and knowledge flows into CoPs' everyday practices, enhancing their capacity for organisational learning and resilience (Zollo & Winter 2002).

Digital technologies do not automatically confer such capabilities, though. Their integration requires coherent governance, contextual interpretation, and inclusive access to technological infrastructures (López-Cabarcos and Piñeiro-Chousa, 2024; Shehawy and Khan, 2025; Shukla et al., 2024). Nonetheless, AI and Metaverse tools provide the scaffolding through which CoPs can develop and institutionalise dynamic capabilities. In this way, digital tools shift CoPs from reactive to proactive agents of change, structurally embedding foresight into their everyday practices. Thus.

Proposition 2. *CoPs with DEKA (digitally enabled knowledge architectures) strengthen dynamic capabilities not only by digital sensing and simulation, but by embedding seizing and transforming routines into recursive community knowledge infrastructures.*

3.3. Co-creation and systemic innovation in food systems

Sustainable food systems require more than incremental improvements; they necessitate systemic innovation rooted in collaborative knowledge creation across actor boundaries. Traditional innovation pathways, however, often marginalise local communities, treating them as passive beneficiaries rather than active co-creators (Cacciolatti, 2024). Digitally-enabled CoPs offer a counter-model by reconfiguring the architecture of collaboration. As evidenced from open innovation and value co-creation studies (Barrett et al., 2012; Chesbrough, 2003), the integration of local food knowledge into AI and Metaverse platforms allows a broader set of actors, including farmers, chefs, policy makers, and consumers, to co-create solutions.

Food systems innovation is inherently systemic, involving diverse actors with often divergent ontologies, interests, and knowledge claims. Traditional and local knowledge systems, when digitised and networked, provide a counterbalance to dominant techno-scientific narratives and help anchor innovation in local, place-dependent realities. AI can translate indigenous knowledge into standardised formats that are interoperable across domains (e.g. policy, science, commerce, to mention a few), while Metaverse platforms allow stakeholders to co-experience this knowledge, enhancing mutual understanding and trust (Levinthal & March 1993). The mechanism of *combination* underpins this process; therefore, when enabled by digital platforms, it facilitates cross-fertilisation between heterogeneous knowledge domains. For instance, indigenous seed knowledge can be systematised alongside climate models to design more adaptive cropping systems. AI acts as a knowledge integrator while the Metaverse provides a sandbox for visualising and negotiating these integrations in collaborative virtual spaces. These technologies shift innovation from linear dissemination to dialogical non-linear co-creation patterns, aligning with non-hierarchical models of knowledge politics and innovation systems. This convergence supports multi-stakeholder collaboration, where value is co-created not only through products or technologies but also through shared meanings, relationships, and governance structures. Such collaborative architectures are especially critical in contexts where local knowledge holds underutilised innovation potential but lacks formal representation. AI and Metaverse tools, when grounded in inclusive design and governance, offer a mechanism of multi-stakeholder collaboration to bridge that gap. Thus.

Proposition 3. *through DEKA-CoPs, traditional and local food knowledge is mobilised as a resource for systemic innovation via digitally enabled community-led innovation orchestration, facilitating inclusive co-creation across actor boundaries*

3.4. Scaling knowledge and innovation diffusion in complex systems

Sustainability transitions require the diffusion of innovative practices across heterogeneous contexts, often characterised by cultural, ecological, and institutional complexity (Geels, 2011). However, the diffusion of knowledge in food systems is not a straightforward process because cultural, linguistic, and ecological differences often obstruct knowledge transfer; this makes scalability a complex challenge. AI and Metaverse platforms offer tools for overcoming these barriers, but only if they are designed with sensitivity to context. AI systems can translate knowledge across languages and contexts, while Metaverse platforms can replicate site-specific realities in immersive formats, enhancing both understanding and trust. This process aligns with the *internalisation* phase, where explicit knowledge becomes absorbed and transformed through practice. In digital environments, such internalisation can occur via simulation, gamification, or scenario planning, making knowledge more actionable. These tools also allow for real-time feedback, enhancing the refinement of knowledge artefacts and practices over time (Majchrzak et al., 2012).

CoPs equipped with AI and Metaverse tools are better positioned to navigate this complexity by tailoring knowledge to local conditions while maintaining connectivity to global networks. AI enables scalable curation and translation of knowledge, while the Metaverse fosters inclusive participation through immersive storytelling and collaborative spaces.

However, the expansion of knowledge through digital means must contend with questions of digital equity, epistemic justice, and infrastructural asymmetries. Without equitable access and culturally responsive design, such tools risk reproducing the very exclusions they aim to remedy (Zuboff, 2015). Therefore, while AI and the Metaverse can support knowledge diffusion under conditions of complexity, their success depends on socio-technical alignment with community needs and values. This dual modality promotes both vertical diffusion (policy uptake, academic recognition) and horizontal spread (peer-to-peer learning), creating a distributed innovation ecosystem rooted in local realities yet globally resonant (Leonardi, 2021). Thus.

Proposition 4. *CoPs with DEKA (digitally enabled knowledge architectures) enable horizontal and vertical diffusion of innovations by translating knowledge across contexts and actors through immersive, inclusive, and context-responsive digital mediation.*

4. Discussion and implications

This study contributes to the theoretical integration of knowledge management and dynamic capabilities by reframing them through the lens of digitally augmented CoPs, which serve as epistemic anchors that organise distributed knowledge within sustainable food systems. Our DEKA-CoPs model shows how digital mediation enhances their capacity for sensing, seizing, and transforming in complex environments.

Specifically, our work builds on foundational work by Nonaka and Takeuchi (1995) on knowledge creation and Teece (2007) on dynamic capabilities, while extending more recent efforts to contextualise these frameworks in digital and sustainability-oriented environments (Agnihotri et al., 2024; Cerchione et al., 2023; Loia et al., 2025). Our model proposes that the convergence of SECI knowledge flows with dynamic capabilities, namely sensing, seizing, and transforming, constitutes a robust conceptual foundation for understanding how CoPs adapt to technological, ecological, and socio-economic challenges in digitally mediated contexts.

Notably, this integration addresses a persistent limitation in both literatures: the under-theorisation of knowledge flows in community-based innovation and the context sensitivity of dynamic capabilities beyond the firm level (Teece, 2007; Nonaka & Von Krogh, 2009). This supports Proposition 1, which posits that AI and Metaverse technologies enhance CoPs' capacity to modulate tacit and explicit knowledge in ways that foster greater adaptability and responsiveness to sustainability imperatives.

Our conceptual model supports the view that AI and Metaverse technologies are not merely tools for knowledge digitisation but act as epistemic infrastructures that modulate the velocity, granularity, and reach of knowledge within and across CoPs, allowing for the potential creation of a knowledge architecture. For instance, AI's semantic processing capabilities enable the codification of oral traditions into searchable repositories, thereby externalising tacit knowledge (Nonaka & Takeuchi, 1995; Shen & Lin, 2024). Likewise, Metaverse platforms create shared experiential environments where community members engage in socialisation and internalisation of agrifood-related practices, enabling experiential learning across spatial and temporal boundaries (Faraj et al., 2018; Zuboff, 2015). These capabilities extend the socio-cognitive dynamics found in the SECI framework by enabling more diverse and distributed knowledge interactions. As we outlined in Proposition 2, this technological augmentation enhances the sensing and learning capabilities of digitally-enabled CoPs, reinforcing their dynamic capabilities in complex, evolving contexts.

Crucially, the findings emphasise that DEKA-CoPs are not simply technologically-enhanced replications of traditional CoPs but represent a shift in epistemic infrastructure design. In contrast to traditional models where knowledge creation is localised and sequential, DEKA-CoPs enable synchronous, multi-directional flows of knowledge, governed by both human actors and digital agents. This redesign allows communities to respond iteratively to complex stimuli such as climate volatility, food insecurity, or market disruptions. As such, DEKA-CoPs create hybrid intelligence systems in which community learning is augmented through AI-assisted foresight and Metaverse-based experiential adaptation.

Our conceptual model also aligns with the broader scholarship on distributed innovation and learning (Barrett et al., 2021; Leonardi, 2021). Dynamic capabilities function not just at the level of firms but are seen as emergent properties of collective knowledge architectures. The ability of CoPs to adapt through digitally mediated sensing, seizing, and transforming suggests a rethinking of dynamic capabilities as embedded in sociotechnical ecosystems rather than organisational boundaries alone (Teece, 2018; Helfat & Martin, 2015). These findings resonate with studies on platform-based ecosystems, which show how external actors can be integrated into innovation logics through boundary-spanning knowledge flows (Jacobides et al., 2018). In alignment with Proposition 3, this perspective highlights how integrating traditional and local food knowledge into these ecosystems enables cross-sector collaboration and supports systemic innovation.

On the other hand, our propositions challenge the assumption that knowledge digitisation inherently results in innovation or inclusivity, which is a critique also raised by scholars examining the epistemic risks of digital transformation (Faraj et al., 2018; Leonardi & Contractor, 2018; Zuboff, 2015). Rather than neutral tools, digital platforms and AI systems function as epistemic infrastructures that must be critically governed. The positionality of knowledge holders and the culturally situated nature of tacit knowledge are essential considerations for equitable design. For instance, while natural language processing (NLP) algorithms may externalise local knowledge, they also risk encoding dominant epistemic norms and marginalising non-standardised linguistic forms, reinforcing power asymmetries in digital spaces (Shen & Lin, 2024; Visser et al., 2022).

This suggests the need for participatory epistemologies and critical design approaches in the development of AI and Metaverse platforms (Barrett et al., 2021). This caveat is central to Proposition 4, which argues that higher levels of knowledge diffusion and innovation among CoPs depend on their ability to navigate and respond to cultural and ecological complexity through inclusive digital engagement.

Overall, our findings propose that digitally augmented CoPs operate as dual infrastructures. They are simultaneously knowledge repositories and engines of systemic change. Their embeddedness within social and technical environments allows for adaptive feedback loops between knowledge creation and innovation deployment, something often overlooked in linear models of organisational learning. As hybrid actors, DEKA-CoPs represent a new locus of strategic capability formation, especially in pluralistic fields such as food system sustainability.

4.1. Theoretical implications

The findings suggest that digitally enabled CoPs enrich the theoretical landscape of knowledge management and dynamic capabilities by demonstrating how community-based epistemic infrastructures adapt within digital environments. Building on Cacciolatti and Lee (2022), who emphasise the importance of CoPs in fostering innovation in agri-food contexts, our study extends this logic into digital spaces where knowledge flows are mediated by AI and immersive technologies. This adds granularity to Nonaka and Takeuchi's (1995) SECI model by showing how digital tools externalise and recombine tacit knowledge in novel ways (Propositions 1 and 2). It also redefines dynamic capabilities as emergent properties of socio-technical ecosystems rather than firm-level processes alone (Teece, 2018; Helfat & Martin, 2015).

Furthermore, the DEKA-CoPs model highlights that digital augmentation transforms CoPs into hybrid infrastructures capable of synchronous, multi-directional knowledge exchange. This supports and extends Cacciolatti and Lee's (2022) argument that innovation capacity depends not only on resource endowments but also on the ability to orchestrate knowledge across boundaries. When situating CoPs within digitally mediated environments, we propose a reframing of distributed innovation (Barrett et al., 2021; Leonardi, 2021) that reflects the epistemic and governance dimensions of digital infrastructures. From a theoretical perspective, our study advances the debate on digital transformation by embedding epistemic pluralism and inclusivity within knowledge management frameworks.

4.2. Practical implications

The results also carry important practical implications. Proposition 3 shows that DEKA-CoPs facilitate cross-sector collaboration by enabling traditional and local food knowledge to be integrated with scientific expertise through boundary-spanning platforms. This aligns with Cacciolatti and Lee (2022), who argue that the mobilisation of dispersed knowledge is central to sustainable agri-food innovation. Policymakers can build on this insight by funding digital infrastructures that not only increase efficiency but also create inclusive arenas for knowledge co-creation, as suggested by our Proposition 3, whereby policymakers can leverage our DEKA-CoPs framework to build participatory infrastructures that connect local and scientific knowledge. Agencies such as DEFRA or the FSA, for instance, could support Metaverse-based participatory simulations that allow stakeholders to test adaptive responses to biodiversity loss or climate shocks in safe, low-cost environments.

Propositions 1 and 4 highlight that AI and immersive technologies can enhance community adaptability but also risk reproducing epistemic asymmetries. As Proposition 1 emphasises, digital mediation enhances epistemic agility by modulating tacit-explicit knowledge flows, allowing CoPs to adapt collectively to uncertainty. This implies that technologists and platform developers must prioritise participatory design processes to ensure inclusivity and cultural resonance (Visser et al., 2022). For example, AI models designed with local semantic inputs can preserve indigenous practices while avoiding the deletion of minority epistemologies (Shen & Lin, 2024). Similarly, Metaverse spaces can serve as 'living laboratories' (Cacciolatti et al., 2025) where farmers, consumers, and policymakers co-develop regenerative practices (Mancuso et al., 2024), as highlighted by Proposition 4, which maintains that inclusivity in digital platforms is vital for equitable diffusion of innovation across CoPs.

Finally, Proposition 2 underlines the importance of AI as a codification tool for tacit and oral knowledge. Here, practical implications extend to NGOs and community educators, who can leverage AI-driven knowledge repositories to document and disseminate traditional farming and food preparation methods. This strengthens innovation ecosystems by ensuring that digital transformation enhances, rather than replaces, the cultural and experiential depth of food system practices.

5. Conclusions

This paper has proposed a novel conceptual framework integrating the SECI model of knowledge creation and the dynamic capabilities perspective to explain how digitally augmented CoPs can enhance knowledge management and innovation in the transition to sustainable food systems. We considered the affordances of AI and Metaverse technologies, and we theorised how CoPs can become digitally enabled knowledge infrastructures capable of sensing, seizing, and transforming in response to ecological and socio-economic pressures.

Our framework suggests the need to reframe knowledge management in food systems from a predominantly firm-centric and codified view to one that appreciates community-based, tacit, and place-bound knowledge. The SECI model, when digitally enhanced, accelerates knowledge flows and transforms CoPs' nature, raising them to active agents while raising critical questions about epistemic equity and the governance of digital knowledge systems. Simultaneously, we show that dynamic capabilities, often explored in corporate contexts, operate in decentralised, socially embedded settings, suggesting the need for a more pluralistic view of organisational adaptability.

The theoretical integration developed here offers several implications for theory and practice. First, it enriches knowledge management theory by grounding the socio-technical dynamics of knowledge flows in the AI-Metaverse era. Second, it challenges assumptions in digital transformation research by highlighting the cultural and epistemic dimensions of technology adoption in CoPs, thus denying a technocratic approach to technology adoption and innovation diffusion, proposing human centrism. Third, it informs sustainability and agri-food system transitions by identifying digitally enabled CoPs as critical agents in food system innovation, particularly through their ability to co-create value and adapt under complex, shifting conditions.

We believe our propositions could be explored further in future research. For instance, future studies should empirically test the propositions laid out in this conceptual paper. Mixed-methods research designs involving ethnographic fieldwork, digital trace data, and participatory action research could help assess how AI and Metaverse technologies affect knowledge flows and dynamic capabilities in real-world CoPs. Also, given the cultural specificity of food knowledge, comparative research across different geographic contexts could reveal how digital tools mediate knowledge creation differently. This could inform more culturally sensitive AI/Metaverse development and challenge the universality of current digital epistemologies.

In terms of research on digital governance, there is an urgent need to examine the governance structures, data ownership, and ethical implications of digitising community knowledge. This includes analysing the role of public institutions, private tech firms, and community organisations in shaping who benefits from digital transformation. Likewise, linking this framework with policy innovation and systems thinking could yield insights into how CoPs interact with institutional structures and how digital knowledge architectures can support systemic change across agri-food networks. Finally, future work could explore human-centred design methodologies that translate the theoretical insights of this study into actionable design principles for inclusive, equitable, and resilient digital platforms for knowledge co-creation.

We believe this study lays a theoretical foundation for exploring the intersection of digital transformation, knowledge management, and sustainability transitions in food systems. However, while this conceptual paper proposes a robust theoretical model, it necessarily remains abstract in the absence of empirical validation. Thus, this study advances our understanding of how digital mediation reshapes the relational dynamics between CoPs and sustainable food systems. The synthesis of insights from knowledge management and sustainability innovation literature (Cacciolatti & Lee, 2022; Klerkx, 2023; Leonardi, 2021), allowed us to derive the DEKA-CoPs framework, which demonstrates that digital tools do more than facilitate efficiency, as they enable the reconfiguration of collective learning processes across geographical, disciplinary, and epistemic boundaries. CoPs can transition from isolated learning communities into distributed, adaptive knowledge ecosystems through the integration of AI-assisted knowledge codification and immersive, experiential platforms. This theoretical advance highlights the potential of digital mediation to foster epistemic inclusivity and sustainability-oriented innovation, positioning CoPs as critical agents in the governance of digital transformation for resilient food systems.

This paper is primarily conceptual, and thus its propositions require empirical validation. Future studies should apply the DEKA-CoPs framework across diverse contexts, comparing how AI and immersive technologies mediate knowledge flows in different cultural, geographic, and institutional settings.

In terms of generalisability, the DEKA-CoPs model remains conceptual and context-sensitive, reflecting the specificities of community-based innovation in sustainable food systems. Future research should test its applicability in other domains, such as energy or health innovation, to assess its cross-sector transferability. Additionally, the propositions developed here could inform comparative analyses of CoPs across varying digital maturity levels, helping refine the theoretical boundaries of digitally enabled knowledge architectures. Mixed-method approaches, such as ethnography, participatory design research, and computational modelling, could be employed to develop specific measures, test, and refine the model. Furthermore, comparative studies across cultural and geographic contexts would be valuable to understand how digital infrastructures mediate food knowledge differently in various settings.

Limitations also include the challenge of capturing tacit knowledge in digital infrastructures, where linguistic and cultural biases persist (Leonardi & Contractor, 2018; Zuboff, 2015). Further research should therefore explore governance mechanisms for digital platforms, particularly regarding data ownership, algorithmic transparency, and the co-production of digital epistemic infrastructures. Further limitations of this study include potential over-reliance on technocentric assumptions and a lack of engagement with critical perspectives on digital epistemologies, which future work could address. We invite future researchers to use our propositions to generate new sets of hypotheses, test them empirically, and challenge these ideas through interdisciplinary and praxis-oriented research, in a multidisciplinary context and with a collaborative approach, of course.

CRediT authorship contribution statement

Luca Cacciolatti: Writing – review & editing, Writing – original draft, Supervision, Conceptualization. **Soo Hee Lee:** Writing – review & editing, Conceptualization. **Michael Christofi:** Writing – review & editing. **Ioannis Christodoulou:** Writing – review & editing. **Su Ha Van:** Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

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