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TLIC PAPER

Generative Artificial Intelligence as a Transformative Catalyst for a Learning Paradigm Shift

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ABSTRACT

The rapid integration of Generative AI (Gen AI) into education has raised fundamental questions about its influence on learning, prompting debate on whether it represents a new learning paradigm. This inquiry exploration contributes to the discussion on whether the unique dynamics of learning with Gen AI implies a *new learning paradigm*. By establishing the criteria for a paradigm shift, we analyzed the anomalies that Gen AI creates for established traditional paradigms (i.e., Behaviorism, Cognitivism, and Constructivism) demonstrating their insufficiency to explain the dynamics of the human learning with Gen AI. Hence, we propose and formally define a new paradigm in which learning is understood as a distributed process enacted through a human engagement with Gen AI-artifact system. In this model, the learner acts as an orchestrator, guiding iterative sequence of prompting, generation, critique, and refinement. The new paradigm will provide educators and researchers with a coherent conceptual language to design and study learning in the *age of Gen AI*. The study concludes by outlining verifiable suggestions to guide future empirical validation of this new paradigm.

KEYWORDS

Learning paradigm, learning with generative AI, genreativism, artificial intelligence

1 INTRODUCTION

The rapid expansion of Generative AI (Gen AI) since late 2022 has stimulated extensive academic discussion about its effects on learning [1]. In a short period, the academic interests on Gen AI have evolved from initial explorations of the capabilities of the technology to deeper inquiries into its pedagogical and ethical implications. Researchers have investigated the perceptions of students and educators [2], the potential for improving learning outcomes [3], and the various challenges that Gen AI would bring to academic integrity and traditional assessment [4]. Amongst these increasing academic interests and discussions, a central, more fundamental

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question has emerged: how is a catalytic shift brought in by Gen AI affecting existing learning paradigms?

In a previous study, we explored this question through the lens of transformative learning theory, analyzing educators' initial responses to the use of Gen AI [5]. Our findings revealed that educators were deeply engaged in a state of 'critical reflection,' navigating a disorienting dilemma posed by Gen AI while showing both optimism for its potential and caution regarding its use. However, while the transformative influence of Gen AI on teaching practices was evident, the experiences of these educators did not yet provide definitive evidence of a complete paradigm shift. That research concluded by highlighting the need for a systematic inquiry to determine if learning with Gen AI meets the formal epistemological, ontological, and methodological criteria of a new learning paradigm.

Moving beyond perceptions to formal theory, we argue that learning with Gen AI does indeed constitute a new learning paradigm, which we term, *Generativism*, in which knowledge is constructed through dynamic interaction with Gen AI systems, by a critical thinker. The term 'Generativism' has recently been proposed to describe a practical methodology for course design using Gen AI [6]. Pratschke, for instance, defines Generativism as a "symbiotic approach" and skillfully adapts existing digital education frameworks, such as the Community of Inquiry, to map out practical roles for AI in the learning process. This design-focused approach provides a valuable 'how-to' guide for educators. The present study, however, addresses a more foundational question: *why* is a new paradigm necessary in the first place? While Pratschke's work focused on adapting existing frameworks, our research conducts a formal theoretical analysis, using a Kuhnian lens to demonstrate that Gen AI creates significant anomalies that existing paradigms cannot resolve. Therefore, this research provides the formal definition of *Generativism* as a distinct learning paradigm by articulating its unique ontological, epistemological, and methodological principles.

While simpler uses of Gen AI may be explained by existing frameworks, this transformative mode of engagement with Gen AI requires a new theoretical lens. This research aims to formally define that lens, providing a coherent set of concepts to describe the unique dynamics of learning with Gen AI.

Drawing upon Kuhn's foundational work [7], first, we review what criteria constitute a learning paradigm. Second, we will analyze the anomalies of existing paradigms—Behaviorism, Cognitivism, and Constructivism [8]—when confronted with the anomalies introduced by Gen AI. Third, we will formally define unique ontological, epistemological, and methodological characteristics of *Generativism*. We will conclude by proposing a research agenda, including falsifiable propositions, to empirically validate and refine this new framework.

2 LEARNING PARADIGMS

The term "paradigm," introduced by Thomas Kuhn, refers to a constellation of shared assumptions, values, and exemplars that guide a scientific practice [7]. Within education, this notion has been used to distinguish between competing theories of learning that not only explain how learning occurs but also instigate a corresponding instructional practice. Paradigms matter because they establish what counts as genuine knowledge, how learning occurs, how it is measured, and what roles instructors and learners play. According to Kuhn, scientific discovery begins with the realization of an anomaly—a recognition that some natural phenomenon

has violated the expectations established by the current paradigm [9]. Kuhn further explained that as these anomalies accumulate and become more profound, the resulting sense of crisis activates a search for alternative frameworks [9]. This provides a useful lens for considering whether learning with Gen AI might constitute a paradigm shift, which first requires clarifying what makes something a learning paradigm in the first place.

Several learning theories have been recognized as paradigmatic within education. Behaviorism, rooted in the work of Skinner [10], conceptualizes learning as a change in observable behavior resulting from reinforcement and conditioning. Cognitivism, emerging in the mid-20th century, emphasizes internal mental structures, schema acquisition, and information processing [11]. Constructivism, shaped by the work of Vygotsky [12] and Bruner [13], defines learning as active meaning-making through social interaction and contextualized problem solving. More recently, connectivism has been proposed as a digital-age learning theory, viewing learning as distributed across networks of people, information sources, and technologies [14]. Although emphasis here in connectivism is on including technologies, Gen AI is qualitatively different from what is meant by technologies in the connectivism context. The recognition of these as paradigms is not simply a matter of naming; each provides a coherent set of ontological, epistemological, and methodological commitments to organize practice and research of learning.

Each theory addresses core questions in distinctive but systemic ways: how learning occurs, what factors influence learning, how memory is conceived, how transfer is understood, and what instructional strategies are implied. For behaviorism, learning occurs through environmental stimuli and reinforcement, with transfer facilitated by similarity between conditions. Cognitivism frames learning as the encoding and organization of information, with transfer supported by schema activation and generalization. Constructivism sees learning as the co-construction of knowledge, with transfer understood as the ability to apply knowledge in novel, authentic contexts. Instructional implications flow accordingly—from sequenced reinforcement, to scaffolding and metacognitive strategies, to collaborative inquiry and situated learning environments. The value of these frameworks lies in showing that paradigms are not ad hoc collections of techniques but holistic systems of assumptions with clear instructional consequences [5].

This comparative lens also highlights what is at stake in proposing a new paradigm. To be recognized as such, a learning paradigm must:

1. Ontologically define what learning is, where it takes place, and how it contributes a distinctly new quality to our understanding of learning.
2. Epistemologically specify what counts as knowledge and how it is validated.
3. Methodologically delineate processes or mechanisms through which learning occurs.

These criteria help distinguish paradigms from theories, models, or techniques. While individual instructional strategies may be compatible with multiple paradigms, a paradigm provides the overarching framework that makes those strategies meaningful.

Considering the criteria mentioned above, we consider that connectivism could be debatable over whether it qualifies as a paradigm. Siemens articulated it as a response to the networked, digital environment, emphasizing the ability to find and connect information as a central learning skill [14]. In many respects, connectivism can be seen as an extension of constructivist commitments, particularly at the

epistemological level: knowledge remains understood as socially constructed, but the venue of construction shifts from immediate social interaction to the broader dynamics of digital networks. However, compared with behaviorism, cognitivism, and constructivism, connectivism has been less explicit in its epistemological grounding and methodological claims. Not every response to technological change achieves paradigmatic status; new paradigms require comprehensive and coherent articulation. Therefore, we will set Connectivism aside for the remainder of this paper.

This background sets the stage for our central proposition. If *Learning with Gen AI* is to be understood as a new Learning Paradigm, it must be described with the same rigor: offering an ontological account of what learning is when human create meaning utilizing Gen AI; an epistemological stance on how knowledge is validated in such setting (or whether it requires an additional validation); a methodological description of the mechanisms of iterative interaction; and prescriptive implications for instructional design, evaluation, and policy. In the sections that follow, we examine the existing paradigms and identify the anomalies they cannot adequately explain.

3 LEARNING AND GEN AI: EXAMINING EXISTING PARADIGMS

If behaviorism, cognitivism, and constructivism represent the established paradigms of learning, then the first step to justify a new paradigm is to examine how these frameworks respond under the conditions introduced by generative AI. Ertmer and Newby (2013) remind us that each paradigm is not merely a theory of cognition but a constellation of assumptions about how learning occurs, what factors shape it, how memory is conceived, how transfer is enabled, and what instructional implications follow. When tested against the realities of generative systems, these paradigms illuminate important aspects of learning, yet each shows systematic limitations that accumulate into anomalies.

3.1 Behaviorism and Gen AI

From a behaviorist perspective, Gen AI tools may appear to be the perfect extension of reinforcement learning environments. Adaptive tutoring systems (Reference will be added) powered by language models can provide immediate corrective feedback, generate practice items, and adjust difficulty in response to learner performance. Yet behaviorism seems not enough to explain the dialogic nature of Gen AI interactions. Learners are not merely conditioned by stimuli and reinforcement; rather, they engage in refining sequence of prompting, critique, and revision in which the iterative *interaction* itself becomes the learning process. Furthermore, the system is not a static environment but a generative system with a degree of autonomy—here understood not in the Kantian sense of moral self-legislation [15], [16], but in a more limited sense of producing novel and variable outputs that are not fully determined by external stimuli. The probabilistic aspect ("reasoning") inherent to Gen AI extends beyond behaviorist formulations of stimulus and response.

3.2 Cognitivism and Gen AI

Cognitivist theory emphasizes information processing, schema development, and metacognition [11], [17]. In many respects, Gen AI appears to align with this

view: learners externalize their thinking through prompts, receive fluent and coherent responses, and compare outputs with prior schemas. For instance, a student prompting an AI to explain a physics principle may uncover misconceptions by contrasting the response with existing knowledge. However, cognitivism proves insufficient when learners are not merely processing information internally. Instead, the locus of cognition shifts from being solely within the individual to being distributed across the human-AI system. This aligns with the theory of "distributed cognition" [18], which posits that cognitive processes are "intertwined" due to individual's mind meandering across tools, artifacts, and other people's contributions. In this case, the interaction creates a cognitive system where functions like analogy-making or problem decomposition are shared between the human learner and the generative tool—a phenomenon traditional cognitivist frameworks struggle to accommodate.

3.3 Constructivism and Gen AI

Constructivist theory emphasizes active meaning-making in social and cultural contexts [12], [13]. Many practices involving Gen AI appear constructivist: students engage in exploratory dialogue, iteratively build arguments, and reflect on AI-generated suggestions. However, constructivism assumes interlocutors share cultural grounding and lived experience. In contrast, when learners treat Gen AI as a "thinking" partner, the converser is no longer another human but a generative algorithm. They are thus interacting with a system that produces fluent but *decontextualized text* without embodied or cultural background in the sense of learner's. As a result, learners often give credit agency to an entity that is not a peer in the traditional sense, raising questions about authorship, authenticity, and the very meaning of co-construction through the process of the inquiry prompting.

3.4 Cross-cutting anomalies

Across paradigms, several anomalies emerge. First, the *unit of analysis* is shifting from individual cognition or social dialogue to interaction episodes that unfold among humans, AI, and artifacts. Second, the mechanisms of learning now include *iterative cycles* of prompting, generation, critique, and revision within AI—a dialogic practice distinct from reinforcement or schema processing (although similar to the traditional learning cycle). Third, *the distribution of agency* is being reconfigured: learners orchestrate generative processes, instructors curate conditions, and AI contributes to the process in a semi-autonomous capacity. Fourth, the *standards of evaluation are evolving*, with increasing emphasis not only on the correctness of products but also on the transparency, reflexivity, and ethical quality of the process.

Taken together, these anomalies indicate that while existing paradigms remain informative, they no longer provide a sufficient explanatory framework for learning with generative AI. This recognition indicates an emerging Learning Paradigm—one that locates its ontological core in human-AI-artifact interaction, its epistemic standard in reflexivity, and its methodological anchor in iterative episodes.

4 GENERATIVISM: A LEARNING PARADIGM FOR THE AGE OF GEN AI

Generativism is a learning paradigm in which knowledge is constructed through dynamic interaction with generative AI systems, by a learner-*critical thinker*. It emphasizes refining sequence of prompt-based inquiry, critique, and revision in which the iterative *interaction* itself becomes the learning process. If we take into consideration AI agents, we cautiously might say co-construction of meaning between human learners and AI agents.

The anomalies revealed in the examination of behaviorism, cognitivism, and constructivism indicate that a new framework is needed to account for the distinctive dynamics of learning with generative AI. We refer to this emerging configuration as *Generativism*. This paradigm reconceptualizes the foundations of learning by redefining its ontology, epistemology, and methodology, while also establishing a new unit of analysis, redistributing roles and agency, and advancing propositions that can be empirically examined.

4.1 Ontology

Ontologically, *Generativism* assumes that learning is not confined to the individual learner or to social interaction among humans. Instead, it is enacted within human-AI-artifact systems. Generative models introduce a semi-autonomous partner into the learning process, producing outputs that learners must interpret, critique, and integrate. The artifact—whether a generated text, image, or code—does not merely represent the outcome of learning but becomes a central participant in its ongoing trajectory. In this sense, learning emerges as a distributed process in which humans and AI systems co-constitute meaning. However, this process of co-constitution is fundamentally asymmetrical. Unlike in human dialogue where knowledge is validated reciprocally, in the human-AI system the burden of critical validation falls almost entirely on the learner who is a critical thinker. This creates the central paradox of learning with Gen AI: the learner must act as both a producer of knowledge and its sole critical evaluator. This ontological challenge is precisely what necessitates the paradigm's core epistemological stance, which we will now explore.

4.2 Epistemology

Epistemologically, *Generativism* shifts the emphasis from correctness or consensus toward epistemic reflexivity. In traditional paradigms, knowledge is validated through behavioral outcomes, cognitive coherence, or social negotiation. In *Generativism*, however, learners are expected to engage in critical reflection on both their own reasoning and the outputs produced by AI. This includes questioning sources, tracing assumptions, identifying biases, and justifying decisions. Knowledge, therefore, is defined not as the accumulation of accurate statements but as the ability to interrogate and refine claims within a multi-agent environment.

4.3 Methodology

Methodologically, *Generativism* places the interaction episode at the core of learning. A typical episode begins with a prompt, followed by an AI-generated

response, which the learner then critiques, revises, or builds upon. This cycle may repeat multiple times, generating a trajectory of co-production. Unlike behaviorist drills or constructivist seminars, these episodes are characterized by rapid iteration, unpredictability, and material engagement with generated artifacts. Instructional design within this paradigm thus emphasizes scaffolding around prompting, critical evaluation, and iterative refinement.

4.4 Interaction episode

In *Generativism*, the central unit of analysis is the interaction episode. This unit provides a lens for examining how learners orchestrate exchanges with AI and how knowledge evolves across cycles of generation and critique. Episodes are bounded not by a single task outcome but by the recursive processes through which understanding is negotiated and stabilized/claimed. Framing learning at this level enables researchers and educators to track not only what products are created but also how processes unfold over time.

4.5 Roles and Governance

A defining feature of *Generativism* is the redistribution of roles. Critical thinkers serve as meta-designers, establishing conditions under which generative interactions support learning goals and curating practices for ethical and transparent use. They act as orchestrators, managing iterative exchanges, judging the value of outputs, and developing strategies for effective use of AI. Generative systems themselves operate as semi-autonomous partners, contributing content that shapes the trajectory of learning while requiring critical oversight. Surrounding these shifts is a governance framework that emphasizes disclosure of AI use, equitable access, responsible attribution, and robust ethical safeguards.

4.6 Verifiable Propositions

For *Generativism* to function as a paradigm rather than a metaphor, it must be open to empirical testing. We therefore advance the following suggestions:

1. Learners under *Generativism* conditions will demonstrate higher levels of epistemic reflexivity—measured by the quality of justifications and critical evaluations—than learners in product-focused conditions.
2. Engagement with generative systems will shift the distribution of instructional and learner effort toward orchestration activities, observable through classroom interactions and self-reports.
3. Learning under *Generativism* will yield greater transfer to novel and complex tasks, as students practice adaptive orchestration across domains and contexts.

These suggestions invite empirical study through design-based research, quasi-experimental designs, and longitudinal analyses of classroom practice. They ensure that *Generativism* is not merely a rhetorical claim but a paradigm open to scrutiny, refinement, and potential falsification. Table 1 shows how *Generativism* differs from other traditional three paradigms.

Table 1. Comparison of the Critical Features of Four Paradigms

	Behaviorism	Cognitivism	Constructivism	Generativism
Epistemology	Knowledge is external, acquired via stimulus-response conditioning.	Knowledge is internally constructed through mental processing (memory, attention, schemas).	Learners actively construct knowledge through personal or social interaction, context, and prior experience.	Learners (critical thinkers) actively construct knowledge through reflexive inquiry, justification, and refinement claims generated within a human-AI system; truth is validated through critical evaluation.
Ontology	Learning resides in behavioral change.	Learning resides in internal mental structures.	Learning resides in socially constructed meaning.	Learning emerges in human-AI-artifact ecologies; artifacts contribute to meaning-making.
Methodology	Emphasizes drills, step-by-step guidance, immediate rewards, and repetition.	Focuses on scaffolding, hierarchical organization of info, and cognitive strategies (e.g., concept mapping).	Collaborative projects, inquiry-based, problem-based learning (PBL), and authentic contexts to promote meaning-making.	Focuses on iterative cycles of inquiry-prompting, AI generation, learner critique, and refinement through material engagement with co-produced artifacts.
Key Concepts	Stimulus, Response, Reinforcement (S-R bonds), Conditioning.	Information Processing, Schema, Metacognition, Cognitive Load.	(Cognitive) Developmental Stages, (Social) ZPD, Contextual Learning, Collaboration.	Human-AI-Artifact System, Epistemic Reflexivity, Interaction Episode, Orchestration, Prompt-Critique-Refinement Cycle.
Educational Goals	Acquire specified behaviors (performance focus): correct responses, desired habits, mastery of observable tasks.	Cognitive understanding, problem-solving, and memory organization; build effective strategies for complex tasks.	Foster deep conceptual understanding, higher-order thinking, and the ability to construct meaning in social contexts.	To develop high levels of epistemic reflexivity, foster skills in orchestrating human-AI collaboration, and enable transfer to complex, novel problems.
Definition of Learning	Learning is a change in observable behavior due to environmental stimuli.	Learning is the acquisition and structuring of knowledge.	Learning is an active process of constructing meaning based on experiences.	Learning is a critical thinker's distributed process of co-constituting meaning that emerges from iterative interactions within a human-AI-artifact system.
How Learning Occurs	Occurs through stimulus-response associations, reinforced by rewards or punishments.	Occurs via internal cognitive processes (encoding, storage, retrieval).	Occurs through active engagement, social interaction, and contextual experiences.	Occurs through recursive cycles of prompting an AI, critically evaluating the generated artifact, and refining the process to co-produce knowledge.
Role of Memory	Not explicitly addressed; habits form through reinforcement and practice.	A key component, structured storage of knowledge, aids retrieval and transfer.	Continuously evolving; knowledge is reconstructed with new experiences and social discourse.	Memory is distributed across the human orchestrator, the AI's outputs, and the evolving trail of artifacts from the interaction episodes.
Transfer of Knowledge	Transfer occurs via generalization across similar contexts.	Transfer depends on organization of knowledge and its meaningful application.	Transfer is facilitated by authentic tasks and meaningful problem-solving in real contexts.	Transfer is achieved by mastering the process of adaptive orchestration, allowing application of the critical thinker's method to novel problems.
Types of Learning Best Explained	Basic skills, factual recall, simple associations, procedural learning.	Problem-solving, reasoning, conceptual understanding, complex skills.	Complex problem-solving, higher-order thinking, context-dependentknowledge, collaborative tasks.	Ill-structured problem solving, creative co-production, critical inquiry, and tasks requiring high levels of metacognitive reflection and justification.

(Continued)

Table 1. Comparison of the Critical Features of Four Paradigms *(Continued)*

	Behaviorism	Cognitivism	Constructivism	Generativism
Instructional Strategies	Use of reinforcement, task analysis, structured instruction, step-by-step guidance.	Use of scaffolding, hierarchical organization of information, cognitive strategies.	Use of real-world tasks, collaborative learning, exploration, inquiry-based methods.	Use of scaffolding for effective prompting and critical evaluation of AI outputs; designing tasks that require iterative refinement.
Role of Instructor	Controls environment to elicit correct responses; manager of stimuli and reinforcement schedules.	A cognitive facilitator who organizes information, provides scaffolds, and guides learners through complex tasks.	A facilitator who creates meaningful contexts for exploration and collaboration; supports learner autonomy.	Acts as a meta-designer who establishes the conditions and ethical framework for learning and guides learners in the orchestration process.
Role of Learner	The learner is a passive being reacting to external stimuli; behavior is shaped by reinforcement or punishment.	The learner is an active cognitive processor, interpreting and organizing incoming information.	The learner is a meaning-maker, shaped by personal experience and cultural/social context; reality is partly constructed through interactions.	The learner is an orchestrator of generative processes, interacting with a semi-autonomous AI partner and co-constituting meaning with the generated artifact.
Assessment Approach	Focuses on measuring observable behavior via tests and performance tasks (correct vs. incorrect).	Assesses mental processes via concept maps, case studies, and structured evaluations of understanding.	Uses authentic assessments (portfolios, reflections, project-based evaluations); emphasizes process and metacognitive growth.	Emphasizes process-based assessment; evaluates the quality of interaction episodes and the learner's epistemic reflexivity (justifications, critiques).

In comparative perspective, each of the three established paradigms has been named for the mechanism through which it conceives knowledge to emerge. Behaviorism situates learning in the conditioning of behavior, where knowledge manifests as observable changes in response to stimuli and reinforcement. Cognitivism redefines learning as the internal processing of information, highlighting the formation and reorganization of mental schemas. Constructivism shifts the emphasis to social and cultural contexts, framing knowledge as actively negotiated and co-constructed through interaction.

By contrast, *Generativism* captures a qualitatively new process for how knowledge is created. In this paradigm, knowledge arises from a generative process that is directed and led (i.e., orchestrated) by the human learner- critical thinker. Through an iterative sequence of interaction, the human's prompts guide the AI to generate outputs. The resulting artifacts—such as text, plans, or images—are not just end products; they become a central part of the learning process itself. The focus of analysis thus shifts from static outcomes (e.g., behaviors, mental schemas, or cultural scripts) to the iterative episode itself—the repeated sequence of prompting, generation, critique/evaluation, and refinement—through which meaning is continuously reshaped.

5 CONCLUSION

This study attempted to answer a central question facing contemporary education: Is learning with Gen AI instigating a new learning paradigm? It has argued affirmatively, proposing *Generativism* as a framework to account for the

fundamental shifts occurring in learning. The justification for this new paradigm was established by demonstrating how Gen AI creates significant anomalies that traditional frameworks—behaviorism, cognitivism, and constructivism—cannot fully explain. This analysis highlighted the need for a new model centered on the human-AI-artifact system, the core process of iterative refinement, and the ultimate goal of epistemic reflexivity.

The primary contribution of this new learning paradigm, *Generativism*, is that it provides educators and researchers with a new language and a coherent set of concepts to move beyond viewing Gen AI as a mere tool and toward designing environments for learning that leverage its unique interactive potential. It is important to clarify that *Generativism* is not proposed as a universal framework for all uses of Gen AI, but rather as a model that describes a particularly advanced and pedagogically sophisticated mode of reflexive knowledge creation by a critical thinker. Furthermore, this paradigm is not presented as a technologically determined outcome; instead, it is an intentional pedagogical framework that requires critical adoption and skillful orchestration by human educators and learners to be fully realized.

As a final cautionary note, it is crucial to recognize that terms used in this paper to describe the process, such as framing the Gen AI as a 'partner,' are necessarily metaphorical. The Gen AI system is a tool operating on statistical patterns, not genuine consciousness or understanding. The core of the Generativism paradigm, therefore, lies in how the human learner critically orchestrates and assigns meaning to the outputs of this powerful tool.

Consequently, the work ahead for researchers will be to empirically test the propositions of this paradigm. Future research must investigate how to best scaffold orchestration skills, develop reliable methods to measure epistemic reflexivity—especially given the 'black box' nature of AI partners—and design robust ethical frameworks for this new mode of learning. Furthermore, a focus here was learning and knowledge creation by a critical thinker. An additional question to consider: How this might translate to the case of a novice learner/apprentice.

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6.1 Use of AI Tools

During manuscript preparation, we used Grammarly, Gemini 2.5 Pro, and ChatGPT 5 solely for grammar checking and phrasing refinement; the authors remain fully responsible and accountable for the content.

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