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Orchestrating AI as Tool, Mediator, and Environment: Towards Inclusive Learning Ecosystems

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AI in Education: A Disruptive Force with Dual Potential

Artificial Intelligence is reshaping education, offering transformative opportunities for personalization, accessibility, and inclusion. However, its integration is not without challenges.

Potential

Personalization: Adapting educational pathways to individual needs.

Accessibility: Overcoming barriers for students with special educational needs (e.g., text-to-speech, automated descriptions).

Efficiency: Automating repetitive tasks and supporting instructional design.

Prediction: Identifying students at risk of poor learning outcomes or dropout.

Criticalities

Ethical Concerns: Algorithmic bias, data privacy, and fairness.

Teacher Uncertainty: Lack of clarity on how to integrate AI into practice and concerns about professional roles.

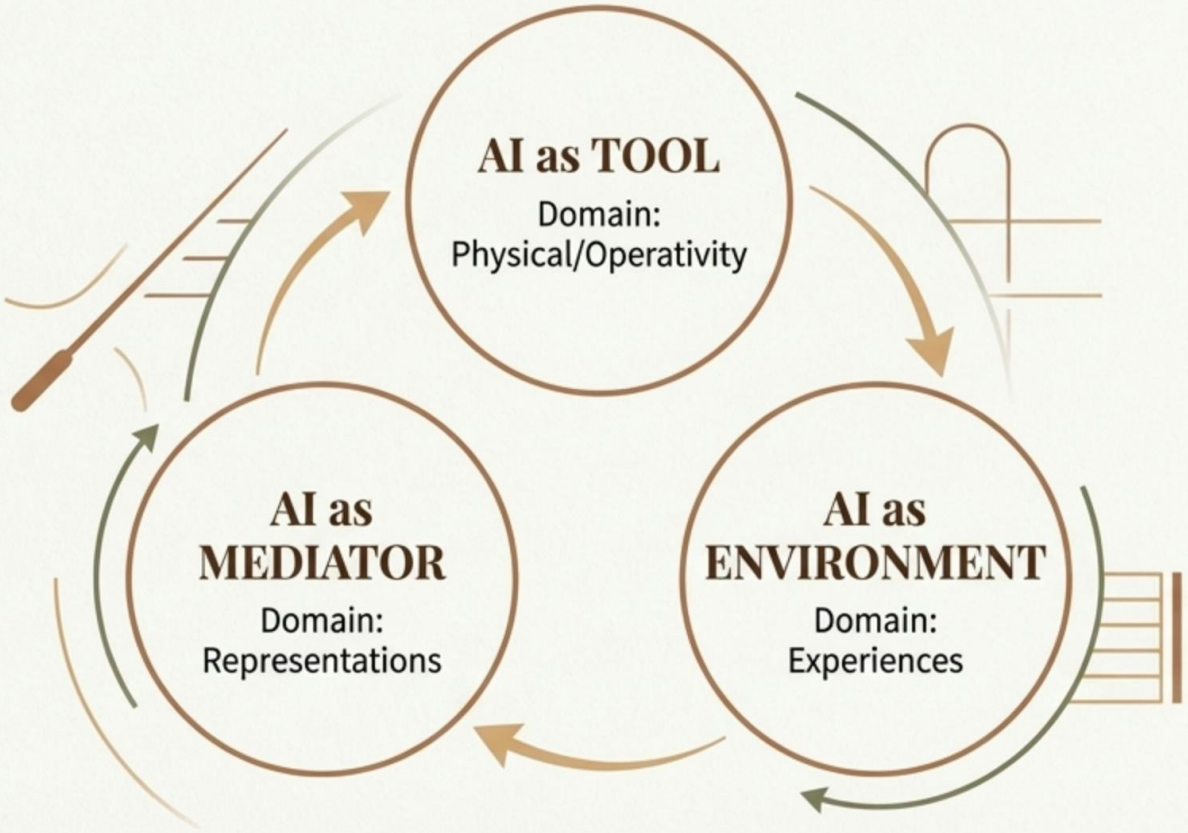
Pedagogical Risks: Potential to displace ‘productive struggle,” encourage surface learning, and foster over-reliance.

Systemic Gaps: Lack of institutional guidance and governance.

Key Takeaway: The current landscape is a mix of high potential and significant risk. We need a new mental model to navigate this complexity with intention.

A New Mental Model: AI as Tool, Mediator, and Environment

To move beyond a fragmented, technology-centered view, we propose a functional tripartition. This framework helps us understand and orchestrate AI's interconnected roles within an inclusive pedagogical design. It re-reads AI not as a monolithic entity, but as a dynamic set of functions.



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Function 1: AI as a Tool

Providing targeted support and functionality.

In this role, AI provides specific, practical support to meet diverse needs. It is the most concrete application, focused on delivering personalized and individualized interventions.

Assistive Technologies: Advanced screen readers, voice recognition systems.

Adaptive Learning Tools: Software that adjusts content difficulty based on user performance.

Compensatory Instruments: Speech-to-text and text-to-speech software.

Critical Consideration

"When AI is used exclusively as a tool, it remains anchored to the medicalizing model of disability, focusing on the subject's limitations rather than on the structural barriers present in the environment."

This approach, if not integrated into a broader strategy, risks further isolating the student.

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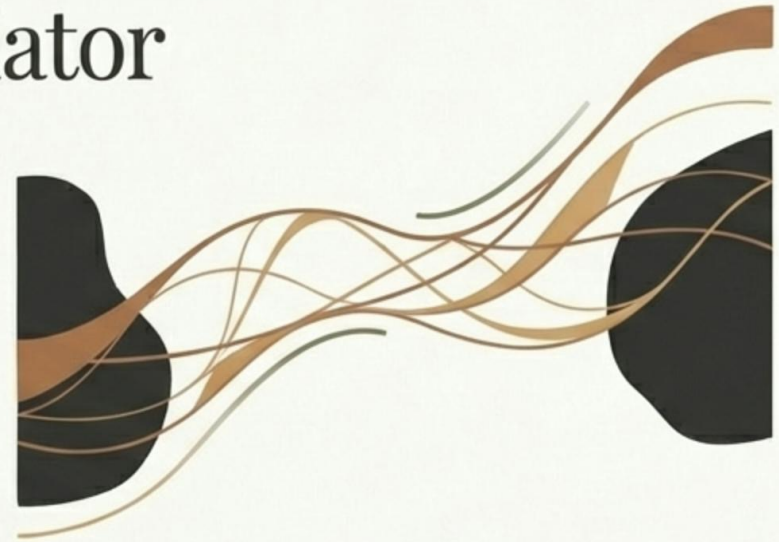
Function 2: AI as a Mediator

Shaping interaction and building meaning.

As a mediator, AI functions as a bridge, facilitating interactions between the student, the teacher, the content, and peers. It helps construct and negotiate meaning within the educational journey.



Key Capabilities:

- **Facilitating Communication:** Intelligent tutoring systems and conversational agents that probe understanding.
- **Mediating Access:** Adapting content presentation based on individual needs to overcome barriers.
- **Promoting Collaboration:** Platforms that support cooperative and individualized activities.

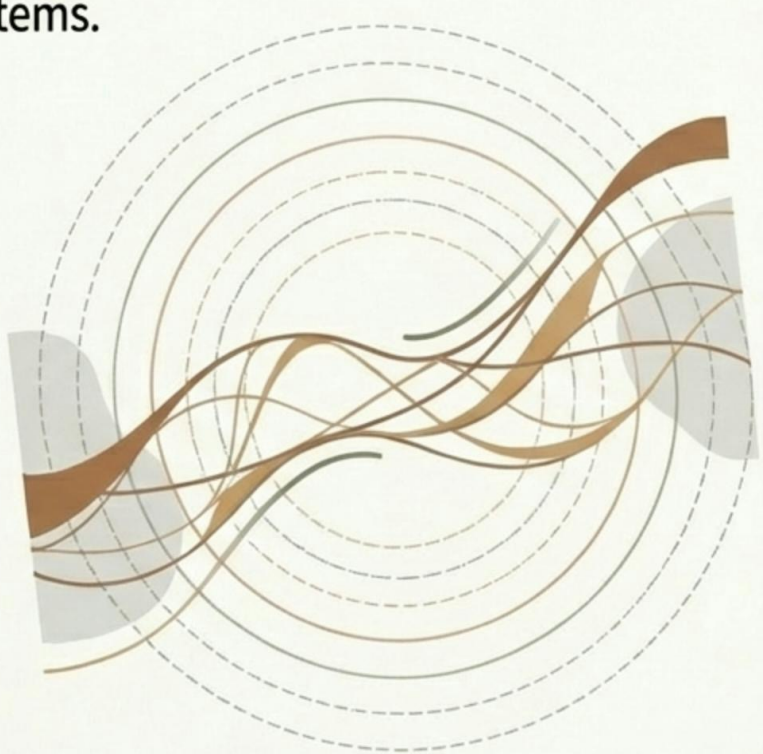
Transformative Potential

This function can absorb the 'dispensatory' role into the 'compensatory,' transforming assistive tools into universal resources that promote full participation for every student.

3 Function 3: AI as an Environment

Creating responsive and integrated learning ecosystems.

In its broadest role, AI becomes an integral part of the educational ecosystem. The technology is woven into the totality of the educational experience, making the entire environment more responsive and adaptive.



Core Characteristics

- **Ecological Perspective:** AI is not an add-on but a fundamental part of the system, influencing all dimensions and variables.
- **Integrated System:** Platforms, workflows, and analytics work together to support teaching and learning.
- **Agent of Change:** Requires a critical approach, recognizing that AI can transform from a passive 'object' to an 'agent and engine of possible changes.'

Key Takeaway: This perspective intertwines pedagogy with institutional governance, data stewardship, and regulatory awareness.

Orchestration heuristic (practice)

- Neurocognitive: tune scaffolds for self-regulation.
- Technological: close reading of affordances + human-in-the-loop.
- Methodological–didactic: intentions first; transparent AI roles.
- Tool→fit/universalise; Mediator→productive struggle; Environment→governance/transparency.

A Pragmatic Pathway: The Action-Research Design

We propose a feasibility-first, single-case design that functions as a “natural laboratory” for implementation under ordinary school constraints. The aim is thick description and analytical transferability, not causal claims.

1. Readiness Assessment

Establish a baseline of teacher competencies (DigCompEdu-informed), stakeholder priorities, and institutional policies. Output: A context profile and negotiated priorities.

2. Teacher AI Literacy Pathway

A ~60-hour, job-embedded program combining foundations (models, data, ethics) with co-design of classroom scenarios and peer feedback.

3. Mini-Pilots

Two or three pilots that operationalize the orchestration heuristic (e.g., one on accessibility, one on conversational mediation), documented with a digital audit trail.

4. Integrated Analysis

A formative account that synthesizes findings, highlights tensions, and produces a school-facing toolkit (templates, checklists, reflection guides).

Measuring What Matters: Feasibility, Acceptability, and Fidelity

Evaluation focuses on the quality of implementation and ethical compliance, explicitly recording barriers, workarounds, and thresholds for adoption.

Key Implementation Indicators

Feasibility: Can the intervention be practically carried out in this context?

Acceptability: How do stakeholders perceive and react to the intervention?

Appropriateness: Is there a good fit between the intervention and the setting?

Fidelity: Was the intervention implemented as intended?

Evidence Sources

- Logs, short probes, member-checked reflections, portfolios of authentic teacher tasks, and lesson annotations.

A Note on Learner Data

Learner-level traces remain descriptive (observations of engagement, artifact analysis, journals) to avoid risks of over-automation, bias, and the displacement of productive struggle.

The Foundation: Pedagogy First, Ethics Always

Responsible AI integration is conditional on a robust ethical and institutional framework. These are not afterthoughts; they are preconditions for practice.

Governance as Pedagogy

- **Transparency Registers**: Enumerate tools in use, their purpose, and responsible roles.
- **Model-Cards-for-Classrooms**: Clarify capabilities, limits, and local safeguards.
- **Legal Compliance**: Adherence to GDPR and the EU AI Act is integral, ensuring data minimization, purpose limitation, and accountability.

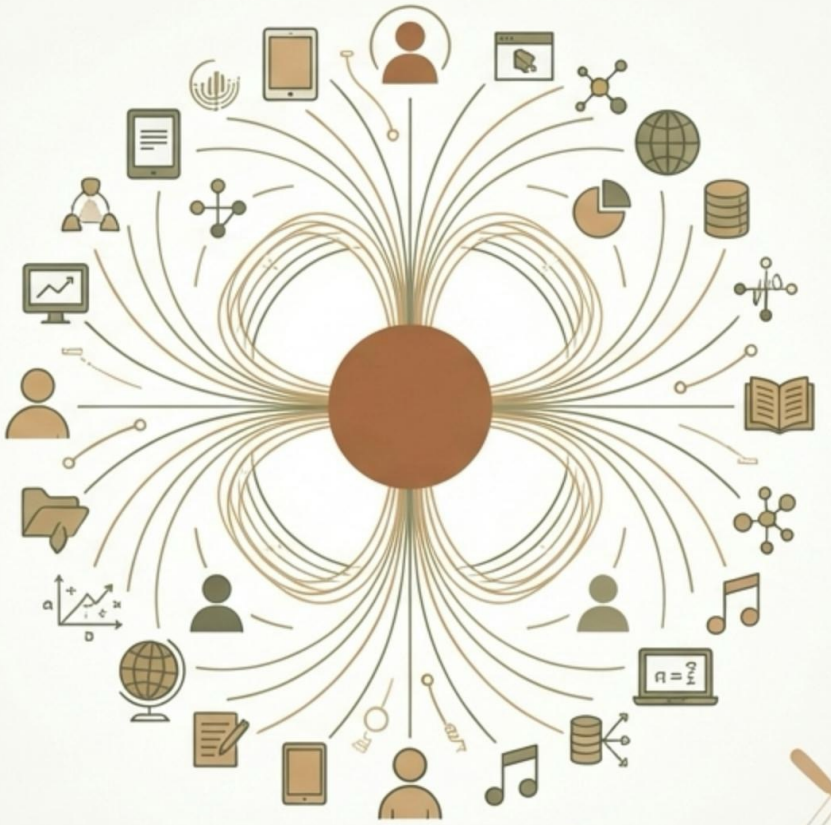
Addressing Teacher Workload

- The principle is substitution only where pedagogically neutral or positive.
- AI is adopted where it amplifies feedback richness or enables access otherwise impractical.
- The teacher retains final say on appropriateness.

The Teacher as Principal Orchestrator and Ethical Steward

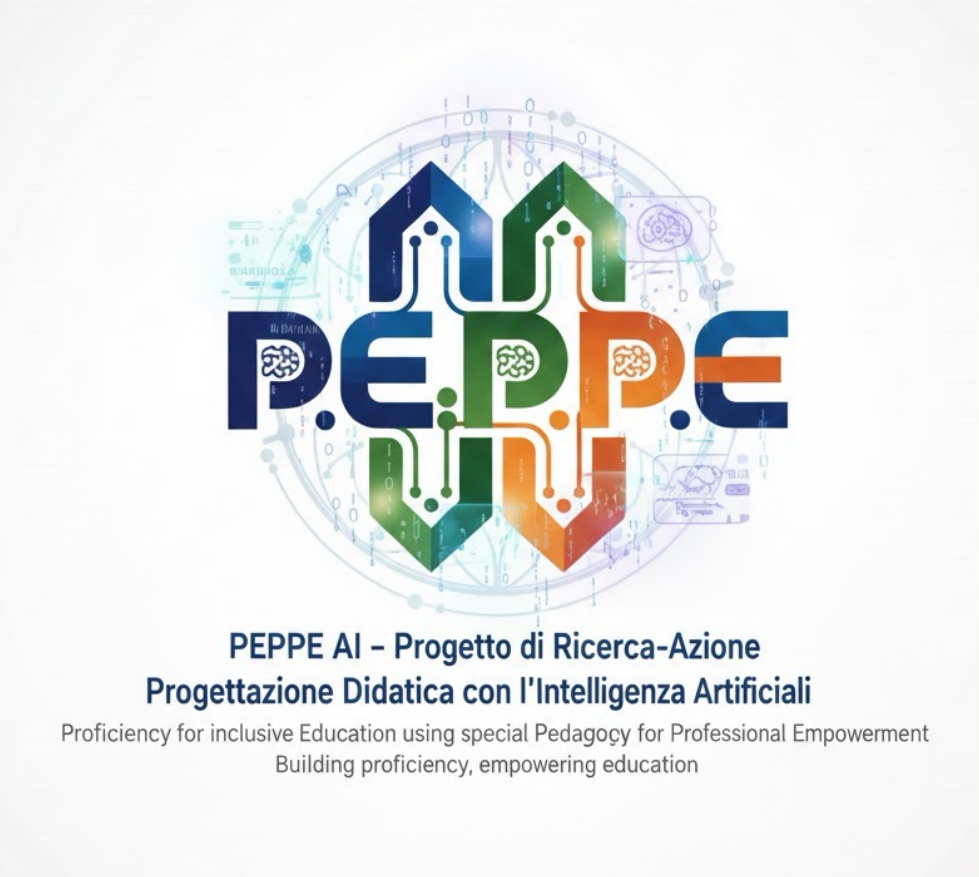
The teacher remains the central actor. This framework is not about automating pedagogy, but about augmenting the teacher's capacity to design and lead rich, inclusive learning experiences.

- The **Trifocal Framework** (Tool, Mediator, Environment) provides the conceptual understanding.
- The **Orchestration Heuristic** (the 3x3 matrix) provides the practical instrument for design and reflection.



Contribution & next steps

- Now: orchestration framework + draft measurement toolkit.
- Not yet: causal claims (single-case trades external for ecological validity).
- Next: replication (multi-case), meta-synthesis, follow-ups; AI literacy scale-up.
- Take-home: AI needs orchestration—pedagogy, ethics, governance in the lead.



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