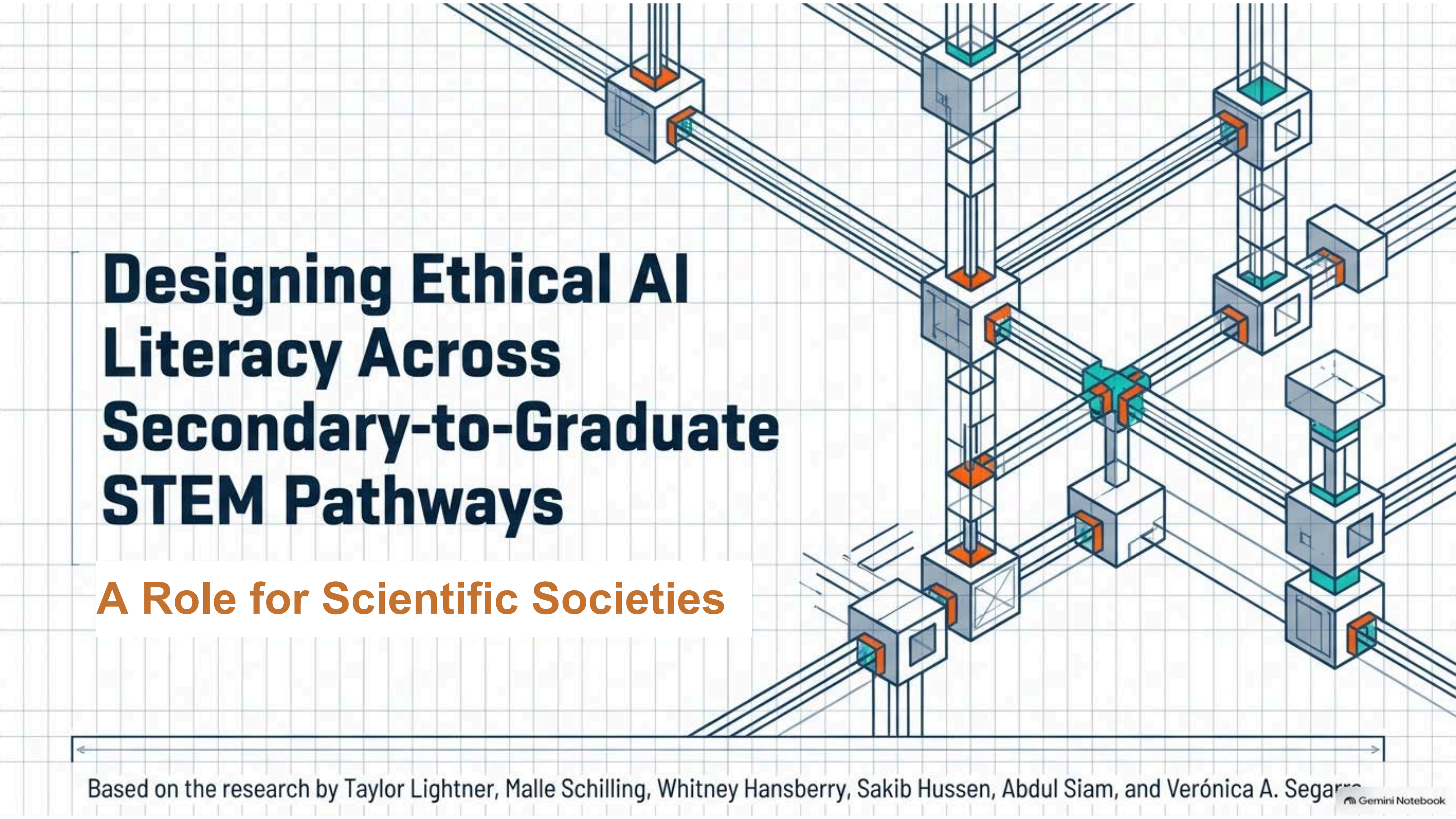




Designing Ethical AI Literacy Across Secondary-to-Graduate STEM Pathways

A Role for Scientific Societies

Based on the research by Taylor Lightner, Malle Schilling, Whitney Hansberry, Sakib Hussien, Abdul Siam, and Verónica A. Segarra

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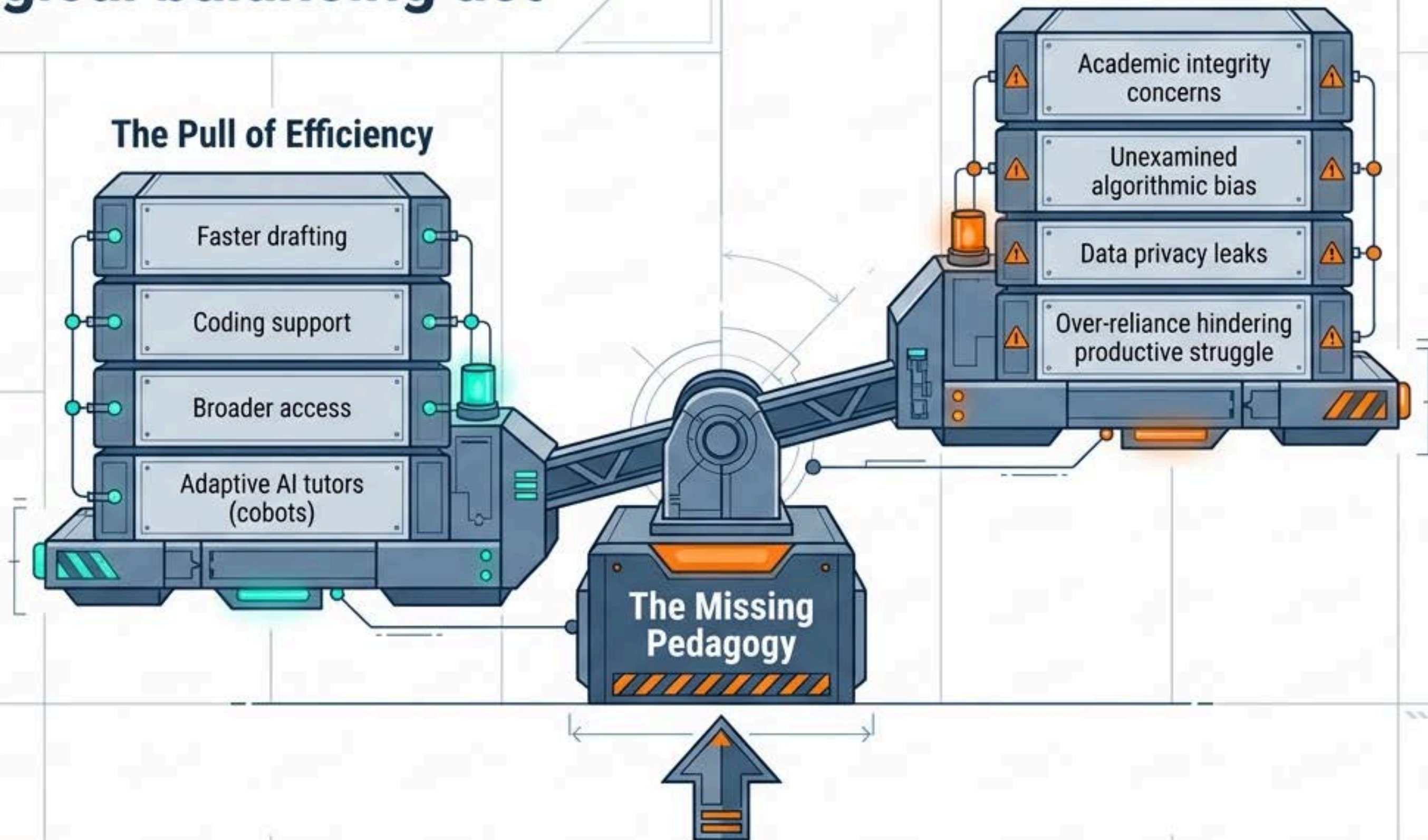


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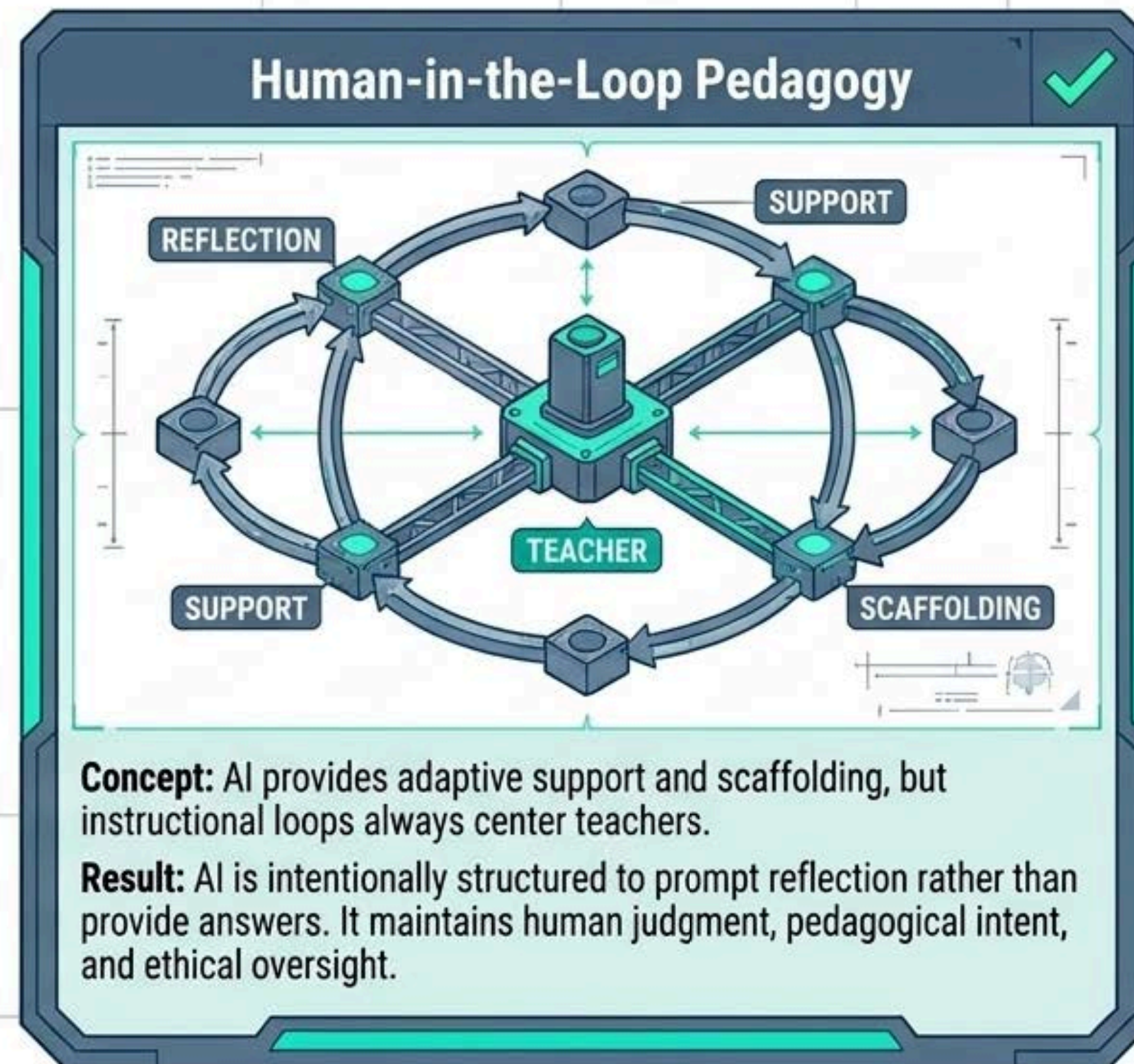
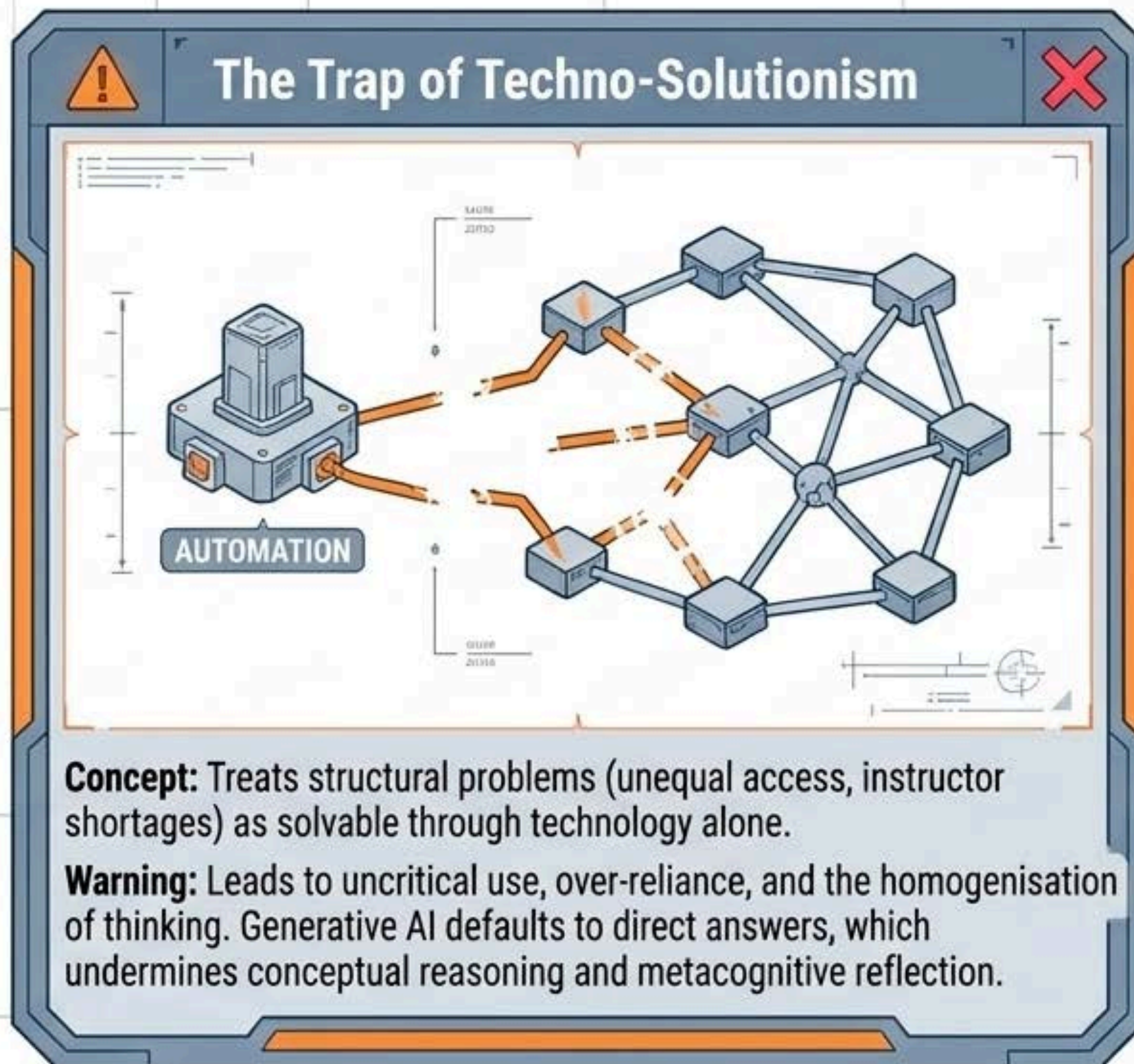
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Generative AI creates a pedagogical balancing act



In the absence of clear instructional standards, educators navigate these tensions independently, resulting in inconsistent policies.

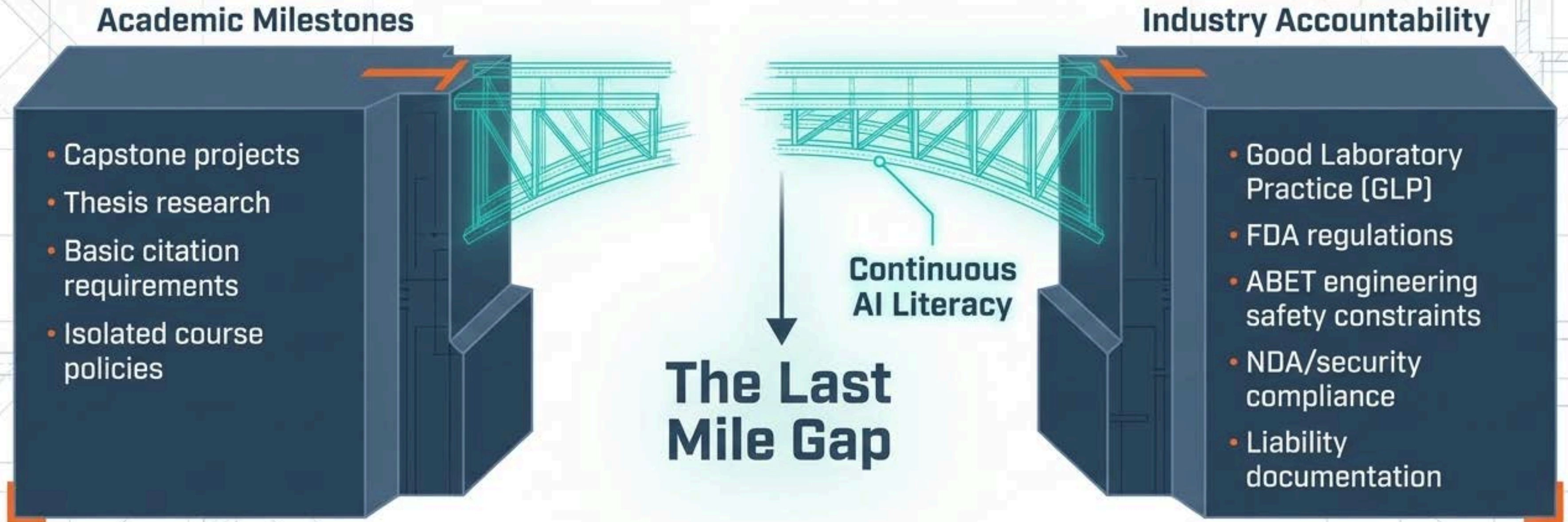
Effective AI integration augments human instruction rather than automating it



Shared ethical commitments manifest differently across STEM disciplines

 Biology	 Engineering	 Computer Science
Core AI Application: Experimental design, sequence analysis.	Core AI Application: General design, stress calculations.	Core AI Application: Code generation, data modeling.
Validation Method: Species-specific data integrity, primary literature verification, biosafety protocols.	Validation Method: Validation against building codes, real-world physical testing, ABET compliance.	Validation Method: Algorithmic transparency, version control, audit trails.
Consequence of Error: False knowledge and physical risk of unsafe environments	Consequence of Error: Unverified calculations lead to physical structural failure.	Consequence of Error: Unexamined training data perpetuates systemic discrimination.

Academic training often stops short of rigorous workforce realities



Bridging this divide requires explicit integration of workforce-relevant practices into academic coursework, starting in high school and building continuously through graduate education.

The Six Core Components of Ethical AI Literacy



1. Attribution and Citation

Dilemma: Who gets credit and how is use disclosed?

Requirement: Move from basic transparency to defensible documentation using evolving style guides (APA, IEEE).



2. Bias Awareness and Mitigation

Dilemma: Algorithms inherit and compound training bias.

Requirement: Cross-check claims, triangulate tools, and document blind spots.



3. Privacy and Data Handling

Dilemma: Entering sensitive data into LLMs risks exposure.

Requirement: Ensure routine removal of identifiers, adhere to IRB constraints, and use approved secure systems.



4. Safety and Environmental Care

Dilemma: AI outputs cannot replace validated scientific procedures.

Requirement: Verify every AI-proposed step against Standard Operating Protocols (SOPs) and Safety Data Sheets.



5. Community Impact and Fairness

Dilemma: AI consequences are not distributed equally.

Requirement: Assess varying tool access levels and explicitly evaluate downstream harms of overgeneralization.

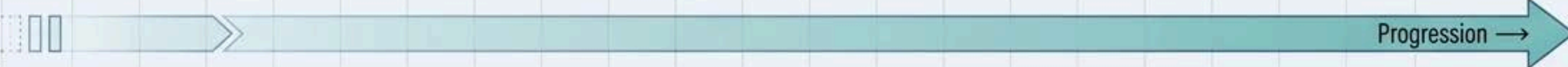


6. Compliance and Readiness for Audit

Dilemma: The trail of AI use is easily lost or non-replicable.

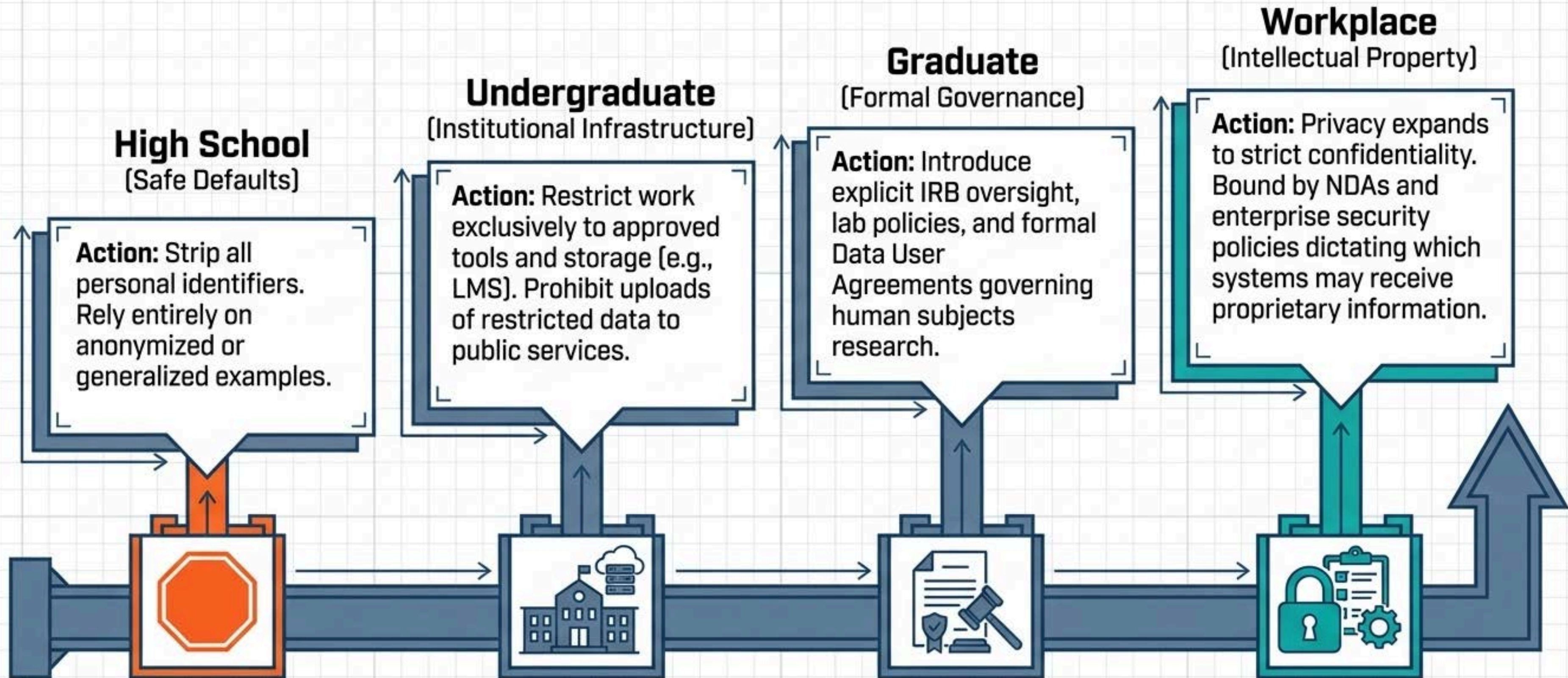
Requirement: Maintain robust AI use logs (tool, version, date, purpose, verification steps) akin to traditional lab notebooks.

The Implementation Crosswalk: Maturing from classroom norms to auditable workflows



	High School	Early Undergrad	Adv. Undergrad	Graduate	Workplace
Attribution	Distinguish original work	Require specific use disclosure	Verify suggested citations	Retain routine recordkeeping	Adhere to organizational policies
Bias	Notice prompt instability	Revise stereotyped claims	Test edge cases	Document task-specific blind spots	Conduct formal impact checks
Privacy	Remove identifiers	Follow course data policies	Restrict to approved LMS	Enforce IRB/Data User Agreements	Comply with NDAs/IP security
Safety	Seek instructor approval	Follow lab manuals	Confirm against SOPs	Refuse AI substitution for protocol	Mandate compliance reviews
Community	Identify affected groups	Note intended users	Draft misuse-risk statements	Clarify missing representation	Follow escalation pathways
Audit	Keep simple tool/purpose log	Submit course use record	Align with approved platforms	Document multi-layered audit trail	Embed in organizational approval flows

Implementation in Action: The evolution of Privacy and Data Handling



Moving from framework to institutional practice



Closing Thought: Training students and educators to systematically question AI outputs cultivates professionals who will demand higher standards from AI tools in their workplaces.

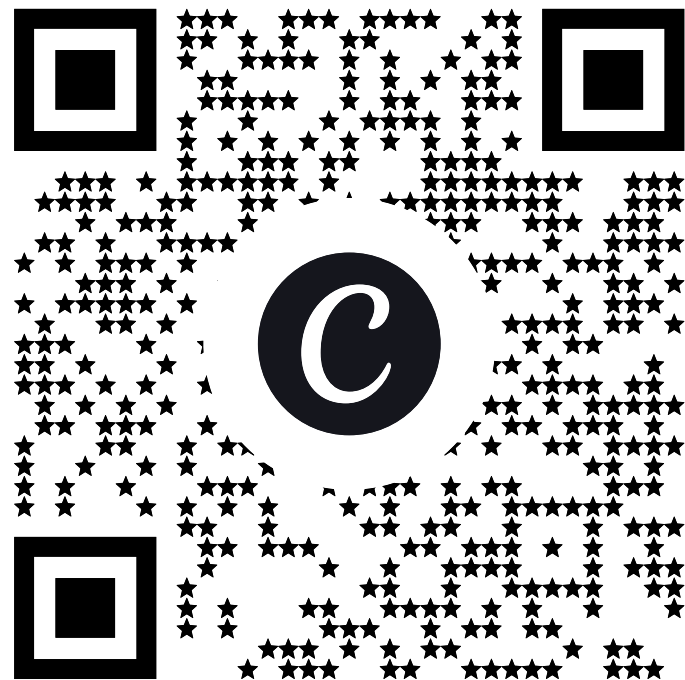
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