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Rethinking Assessment and Feedback in the Age of AI through GEm Lab: Product versus Process

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Abstract

AI compels higher education to rethink how learning, assessment, and feedback are designed and enacted. Early institutional responses have focused on regulating AI use, yet a more productive strategy is to explore how assessment can foster the capabilities that AI cannot replicate. This article introduces the Generativity and Emergence Laboratory (GEm Lab), a research and education infrastructure at the University of Gothenburg, as a sociotechnical and pedagogical model for this rethinking. GEm Lab embeds students and teachers in digital ecosystems where AI is developed, debated and implemented, linking academic learning to real-world practice. Conceptually, it integrates constructive alignment, action design research, and student agency within coevolution that shifts assessment from product to process. Biggs' SOLO taxonomy is extended with relational verbs, namely *affiliate, engage, collaborate, and communicate*, to reflect coevolutionary learning and assessment in ecosystem contexts. A pilot in postgraduate trade and transport law courses illustrate how engagement with ecosystem actors, iterative feedback, and ethical reasoning make the learning process itself assessable. This process-oriented assessment model enhances validity and resilience to AI misuse by evaluating participation, reflection, negotiation, and judgement. The article concludes with four broad principles: embed assessment in learning cycles, strengthen student agency, connect tasks to societal challenges, and recognise adaptive competencies alongside disciplinary knowledge.

1 Introduction

Artificial intelligence (AI) has entered higher education in ways that are both rapid and disruptive. Since the release of large language models such as ChatGPT, universities have responded with a mixture of excitement and anxiety. On the one hand, AI promises efficiency and new opportunities for learning. On the other hand, it raises concerns about plagiarism, authenticity, and the meaning of original thought. The first wave of university policies has therefore, been defensive, focusing on regulating student use of AI and safeguarding academic integrity (Farazouli et al., 2023). Although such steps are necessary, they are not sufficient. By treating AI mainly as a challenge to be controlled, universities risk missing a larger opportunity to rethink their role in helping societies adapt to AI and defining the competencies needed for that adaptation.

Current debates often emphasise the technological aspects of AI, yet it is equally important to recognise its social and organisational dimensions. Understanding AI requires more than technical literacy such as how algorithms are designed or deployed. It also involves understanding the value created through AI, the distribution of its benefits and risks, and the legal and ethical challenges that accompany its use in business, government, and civil society.

This article adopts a sociotechnical perspective on AI in education. It argues that the rise of AI demands a new approach to knowledge production, acquisition, and assessment. It presents the conceptual framework of the Generativity and Emergence Laboratory (GEm Lab), an initiative at the School of Business, Economics and Law (SBEL) at the University of Gothenburg (GU). GEm Lab functions as a research and education infrastructure that provides sustained access, method, and partnerships for embedding research and courses into real-world digital ecosystems where AI is developed, debated and used. It enables experimentation with new forms of assessment that are more formative, collaborative, and socially engaged than traditional examinations.

These assessment practices are not minor adjustments but essential steps for preparing students to live and work responsibly in an environment saturated by AI. Assessment and feedback provide a productive starting point for this rethinking because they link teaching, learning, and the legitimacy of knowledge. Rather than serving only to certify achievement, assessment also makes visible what counts as learning, which values are prioritised, and which competencies are recognised. As AI transforms how knowledge is created, acquired, and used, assessment must evolve in response.

The discussion that follows presents both the conceptual foundation of GEm Lab as an infrastructure and its practical application through teaching pilots that use the infrastructure. It draws on two courses in trade and transport law at GU to illustrate how learning and assessment can be connected to real digital ecosystems. Although these courses serve as initial pilots, the GEm Lab infrastructure is designed for the social sciences and can integrate a range of disciplines, including law, business, economics, political science, and psychology. This flexibility makes it possible to design learning activities and outcomes that respond to the specific context of each course while maintaining a shared commitment to responsible and process-oriented learning in the age of AI.

2 Beyond Policy Debates to Ecosystem-Based Learning

A central theme about AI in universities focuses narrowly on whether students use chatbots to write essays and how they should be regulated (Criddle and Jack, 2025; Stilerman, 2025). This emphasis on regulation reflects a defensive posture. Universities rightly worry about plagiarism and fairness, but if the response stops there, higher education risks becoming a referee rather than a shaper of technological futures. There is, however, another way to frame the role of universities. They are not only custodians of academic integrity but also laboratories for society's engagement with new technologies. This dual orientation involves exploring how AI can enhance learning in line with societal values and how it might reshape the broader pursuit and purposes of knowledge.

Kiron and Schrage (2019) describe such a dual orientation as the difference between strategy *for* AI and strategy *with* AI. This distinction is not semantic gamesmanship; it goes to the core of how digital innovation unfolds within organisations such as universities. The two strategies are complementary. *For AI* refers to how universities adopt and apply AI to enhance research and pedagogy, for example, by developing new courses, programmes, or methods that sharpen inquiry and learning (Nieminen, 2025). *With AI*, by contrast, highlights how universities can pursue strategic opportunities opened up by AI, such as new forms of collaboration, partnerships, and models of knowledge creation. Fulfilling this dual orientation requires universities to recognise that AI is not an isolated tool but part of a wider sociotechnical system.

GEm Lab embodies this dual orientation by grounding its work in both the *for* and *with* AI paradigms and by employing an ecosystem approach. Ecosystems can be understood as multi-layered sociotechnical systems that connect technological, economic, behavioural, and institutional dimensions (Autio, 2022). The ecosystem approach adopted by GEm Lab encourages sociotechnical thinking, which is crucial because digital transformation involves not only technology but also its societal context. This approach distinguishes GEm Lab from other initiatives at GU, such as Bitlab and Knowledge Lab, which focus primarily on technological development rather than on the societal dimensions of digital transformation.

3 Conceptual Framework and Blueprint of GEm Lab

AI is typically embedded in digital platforms that enhance functionality, personalise experiences, and automate complex tasks (Gawer, 2022). These platforms bring together diverse actors

including businesses, software developers, regulators, and civil society organisations who collectively form ecosystems (Moore, 2006; Jacobides et al., 2018; Hou and Shi, 2021). Put simply, platforms are about technologies, whereas ecosystems are about interorganisational relations (Jacobides and Lianos, 2021). To prepare students for the realities of a digital society, universities must therefore create opportunities for direct engagement with such ecosystems.

The GEm Lab infrastructure, developed at GU, is designed precisely to enable this form of ecosystem-based learning and collaboration. It provides the agreements, access mechanisms, and methodological scaffolding needed to embed researchers and students in real-world digital ecosystems where AI is developed, debated and implemented. Rather than confining discussions about AI to the classroom or the library, GEm Lab connects teachers and students directly to the environments in which AI evolves. At present, the Lab engages with one trade and transport ecosystem, anonymised as Ecosystem X1, but future collaborations may include areas such as retail, commodities, manufacturing, and healthcare, where challenges related to data sharing, trust, legitimacy, governance, and evolving ecosystem dynamics are particularly pressing.

In practice, GEm Lab establishes agreements with partnering ecosystems to grant students access to living labs, community meetings, and collaborative working groups. Teachers, acting in their capacity as senior researchers, participate alongside students, ensuring that the boundaries between research, teaching, and practice remain open and dynamic.

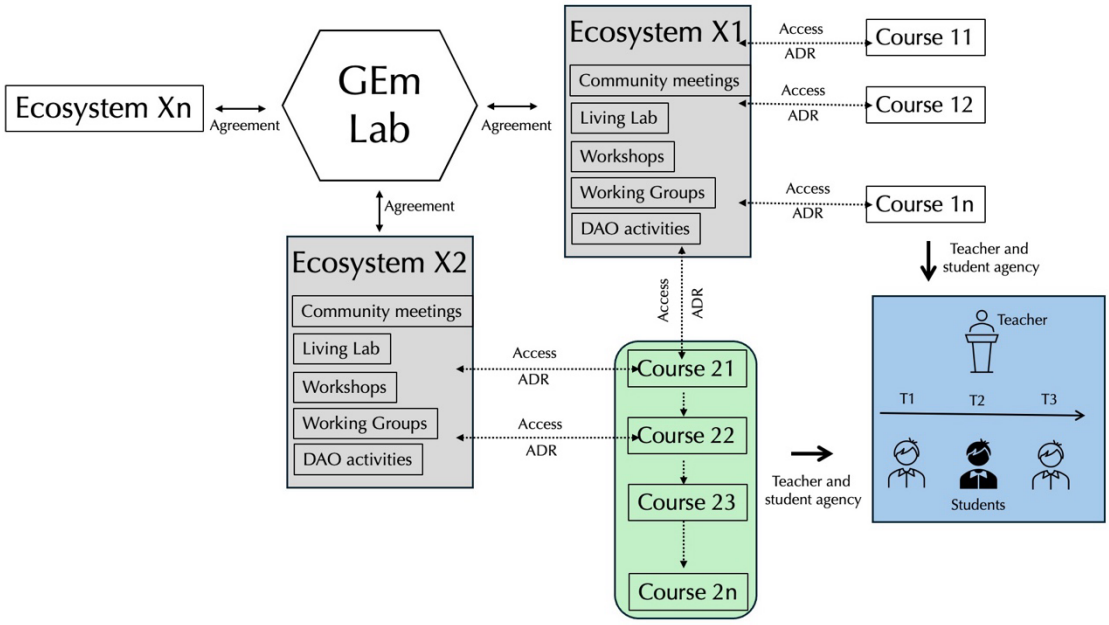

Figure 1. Blueprint of GEm Lab

Figure 1 illustrates the blueprint of GEm Lab. It shows how agreements with ecosystems provide teachers and students with access to participate in ecosystem activities. Courses may link to one or more ecosystems. For instance, a single course may connect with one ecosystem, while others may engage with several or be integrated within a larger programme (see green box). Teachers sustain these collaborations over time through Action Design Research (ADR) cycles, as explained in section 5, while students participate during designated course periods (see blue box). For the present discussion, it is sufficient to note that ADR provides the iterative structure through which courses in GEm Lab connect to ecosystems on a continuing basis.

GEm Lab treats ecosystems not as case studies observed from a distance but as lived environments where learning develops through participation. Within these settings, researchers

and students engage directly with the institutional, behavioural, economic, and technological dimensions of ecosystems. This approach embodies 'learning by dwelling' (Perrotta, 2024), in which understanding emerges through situated interaction and reflection. Such engagement is possible because ecosystems themselves depend on collective processes to thrive as communities (Ostrom, 2008; Bridoux and Stoelhorst, 2022; Benedict, 2024; Basu Bal, 2024).

A concrete example illustrates this learning by dwelling approach. Consider the trade and transport ecosystem where firms are reluctant to share data because of competitive concerns. Students working in this environment identify sources of mistrust, map the interests of different actors, and propose governance mechanisms that could promote fairer data exchange. The teacher's role is to emphasise the learning process and connect it to assessment, while students engage with the challenges of inclusion, trust, and accountability in shaping AI-enabled processes. The students' task involves not only theoretical analysis but also dialogue, persuasion, creativity, and ethical reflection. This form of learning cannot be captured by a multiple-choice exam or a solitary essay.

Emphasising the learning process, in addition to the final product such as essays, provides fertile ground for experimenting with new forms of assessment that are more formative, collaborative, and socially engaged than traditional examinations. Assessment in the courses using GEm Lab therefore, reflects not only knowledge but also engagement, collaboration, and societal contribution. A key feature of this model is that it moves beyond traditional summative approaches to create a multidimensional process that values knowledge, reflection, and participation equally. In doing so, GEm Lab prepares students to coevolve with the sociotechnical systems that shape the digital era.

4 The Roots and Canopy of GEm Lab: Theoretical Underpinnings

Metaphorically, GEm Lab, illustrated as a tree in figure 2, is grounded in three foundational roots: constructive alignment, ADR, and student agency. Together, these roots provide structural anchorage, methodological sap, and vitality and ownership, enabling the living canopy of coevolution to grow, extend, and interact with its surrounding environment.

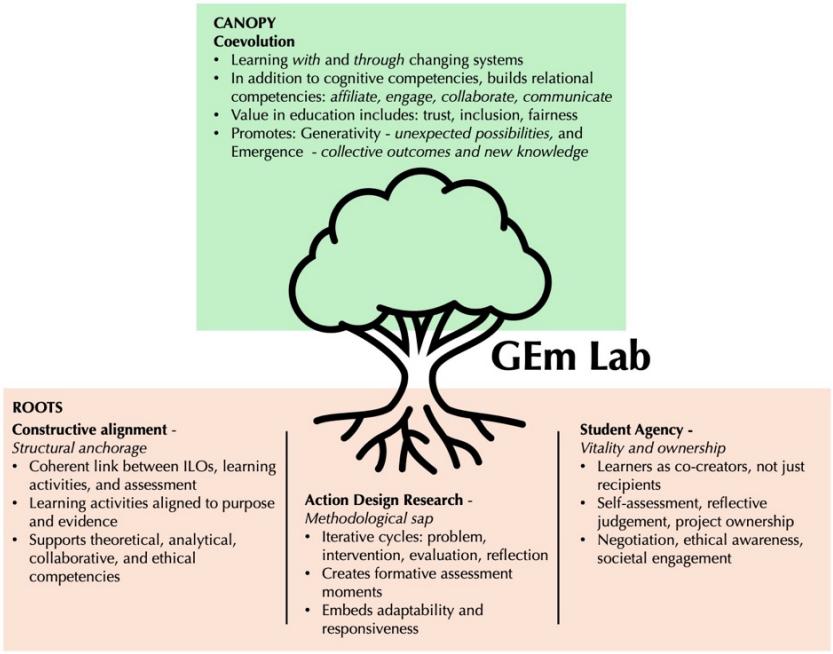

Figure 2: The roots and canopy of GEm Lab: theoretical underpinnings

Constructive alignment forms the first root, providing structural anchorage by linking learning design to purpose and coherence. It ensures that intended learning outcomes (ILOs), learning activities, and assessment are explicitly connected and mutually reinforcing (Biggs, 2003; Biggs, 2014). The 'constructive' element draws on constructivist learning theory, which holds that students build understanding through active engagement rather than passive reception. The 'alignment' element ensures that the teacher designs learning activities and assessments that directly support and evidence the ILOs. This root nourishes coherence in GEm Lab, enabling students to develop theoretical, analytical, collaborative, and ethical competencies through participation in real digital ecosystems. The ILOs extend beyond mastering theory and analysis to include critical engagement with ecosystem actors, ethical reflection on algorithmic decision-making, and the ability to communicate insights across academic, industry, and societal contexts.

ADR forms the second root, supplying the methodological sap through iterative cycles of problem formulation, intervention, evaluation and reflection (Sein et al., 2011). These cycles create natural points for formative assessment, which are explored further in section 6.2. ADR offers an authentic, process-oriented structure that complements constructive alignment and enhances student agency (Panadero and Jonsson, 2020; Boud and Molloy, 2013). It treats learning as adaptive and evolving rather than linear, inviting students to navigate uncertainty, test solutions and revise their understanding in practice.

Student agency constitutes the third root, feeding the Lab's vitality by positioning learners as co-creators rather than passive recipients of knowledge. Research shows that opportunities for self-assessment, project ownership and reflective judgement deepen engagement and enhance learning (Nieminen et al., 2025). In GEm Lab, agency is embedded in assessment as students define research problems, negotiate with ecosystem actors and articulate the societal implications of their work. Assessment, therefore, becomes an expression of ownership and responsibility, emphasising learning as an evolving process rather than a static product.

Coevolution is learning *with* and *through* changing systems rather than learning *about* them. Accordingly, in GEm Lab, students do not apply fixed theories to static problems. Instead, they adapt their understanding as the ecosystem in which they participate itself evolves, engaging in continual negotiation of meaning, ethics, and design in partnership with others (Hou and Shi, 2021). The competencies that emerge are not only cognitive but also relational, including the ability to *affiliate*, *engage*, *collaborate*, and *communicate* across diverse contexts. These relational capacities are elaborated through the adapted SOLO taxonomy in section 5.

Coevolution also redefines *value* in education. In a datafied society, where data operates as a *non-rivalrous* resource that multiple actors can share and reuse simultaneously, generating powerful network effects (Fadler and Legner, 2022), value extends beyond substantive knowledge and understanding to include trust, inclusion and fairness (Basu Bal, 2024). Students must, therefore, develop ethical judgement and sensitivity to wider public benefit alongside mastery of substantive content in order to navigate within ecosystems responsibly.

Finally, coevolution lies at the heart of GEm Lab's name, the Generativity and Emergence Laboratory. *Generativity* refers to the potential for new and unexpected possibilities to arise when diverse participants such as students, teachers and ecosystem actors, collaborate (Zittrain, 2006), while e*mergence* captures the collective outcomes of such collaboration, where new practices, insights, or solutions appear that no single participant could have produced alone (Thomas and Tee, 2022). Both concepts reinforce the central idea that assessment in GEm Lab is not about verifying predefined answers but enabling students to participate in the creation of genuinely

new knowledge. Assessment thus becomes a space where unexpected learning and collaboration emerge.

5 Assessment and Feedback in GEm Lab: Product versus Process

Building on the three pedagogical roots of constructive alignment, ADR, and student agency, GEm Lab adapts Biggs' Structure of Observed Learning Outcomes (SOLO) taxonomy to conceptualise how assessment shifts from product to process.

In GEm Lab, assessment is iterative and formative. This shift mirrors the dual nature of AI, which exists both as a product, visible in outputs such as text or images, and as a process, characterised by ongoing cycles of training, feedback and recalibration. Pedagogy reflects the same duality: while essays, reports and presentations remain visible outputs, learning itself is rooted in the deeper processes of inquiry, analysis, reflection, collaboration, ethical reasoning, and revision.

This approach stands in contrast to traditional assessment models, which are often summative, individualistic and focused on knowledge reproduction (Panadero and Jonsson, 2020). Final examinations, for example, offer only a snapshot of what students can recall at a fixed moment (Biggs, 2003). Such approaches are ill-suited to ecosystem-based learning, where understanding evolves through collaboration, iteration and engagement with real-world dynamics.

GEm Lab seeks to *make the learning process itself visible*. Constructive alignment provides coherence, ADR structures iterative touchpoints for reflection, and student agency embeds participation and responsibility. Together, these elements transform assessment into a *scaffold for growth* rather than a terminal judgment, ensuring it remains rigorous, formative, collaborative and oriented toward societal engagement.

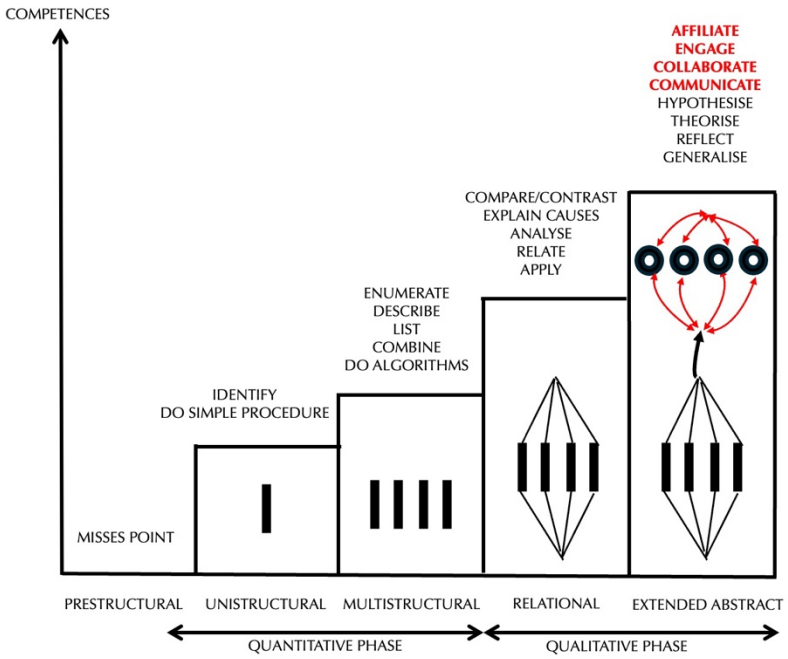

Figure 3: SOLO taxonomy (adapted from Biggs, 2003).

To connect product and process, GEm Lab draws on Biggs' SOLO taxonomy, which describes progressive levels of learning from surface recall to deep conceptualisation (Biggs, 2003). At its

highest level, the extended abstract captures the learner's ability to generalise and apply knowledge in new contexts. GEm Lab extends this level through the lens of coevolution to highlight the adaptive and relational character of ecosystem-based learning. In doing so, it moves beyond SOLO's original emphasis on cognitive complexity to encompass learning and assessment as living, coevolutionary processes.

In the adapted model shown in figure 3, the verbs *affiliate, engage, collaborate and communicate* (appearing in red) are added above those at the extended abstract level to represent higher-order, relational forms of learning. Bi-directional arrows (also in red) illustrate the dynamic and iterative nature of learning within ecosystems. Together, these additions extend SOLO's original cognitive focus toward a coevolutionary perspective, emphasising that in GEm Lab students do not merely apply knowledge but respond to evolving systems, negotiating with ecosystem actors, rethinking methods, and reconciling competing values as their learning develops.

By broadening the extended abstract level, GEm Lab recognises that learning in complex ecosystems requires continual adaptation, reflexivity and ethical awareness. This extension aligns with recent literature arguing that constructive alignment should foster not only academic achievement but also student agency, identity formation and epistemic inclusion (Loughlin et al., 2021). The adaptation of Biggs' SOLO taxonomy and its contextualisation within GEm Lab provide the conceptual grounding for the assessment practices outlined in Section 6.

6 Piloting GEm Lab in Trade and Transport Law

6.1 The courses and learning context

The pilot uses the GEm Lab infrastructure within two postgraduate courses in trade and transport law, offered at GU. Traditionally, these courses emphasise legal reasoning and attract students from law and management backgrounds. Within the pilot, however, in addition to classroom teaching, students are connected to a real-world digital ecosystem, anonymised as Ecosystem X1.

Ecosystem X1 is a collaborative innovation environment funded by the Swedish Innovation Agency that brings together ports, shippers, transport companies, logistics operators, digital solution providers, regulators, research institutes and universities to improve data sharing and coordination in trade and transport. GU is an active actor in this ecosystem and has played a pivotal role in developing the governance framework. Within this ecosystem, students engage with practical challenges, working alongside ecosystem actors to explore how legal frameworks, business, technology, and organisational practice intersect. They collaborate with the ecosystem actors to analyse live or simulated problems and propose legally and ethically robust solutions.

Through this engagement, students experience how legal reasoning operates within complex sociotechnical systems, developing insight into how law shapes and is shaped by digital transformation. Teachers, acting as both researchers and facilitators, guide students in connecting legal theory to practice while maintaining a reflective focus on learning as an evolving process.

The existing ILOs of the two courses provide a strong foundation for this pilot. They already require students to demonstrate the ability to apply legal frameworks, analyse complex problems, and communicate research findings. Using the GEm Lab infrastructure, these ILOs are reinterpreted rather than replaced. For instance, 'applying legal knowledge to practical problems' is extended to include critical reflection on how law interacts with emerging technologies and platform governance. Similarly, ILOs concerning 'independent research and problem-solving'

are broadened to encompass ethical reasoning, adaptability, and collaboration across disciplinary boundaries. This operationalisation fosters process-oriented and situated learning, whereby students engage with real-world challenges sourced from ecosystem partners, apply legal analysis to live scenarios, and undertake reflective assessment that values participation and learning development alongside final outcomes.

An illustrative example shows how this plays out in practice. A group of students might collaborate with a port authority and software developers on an AI-enabled port call optimisation system. Initially, they may approach the problem through established theories of efficiency and contractual arrangements. However, as they engage with stakeholders, they encounter competing priorities: shipping companies seek faster turnaround, regulators emphasise safety and environmental standards, and cargo owners demand reliability and cost-effectiveness. The students' task is to navigate these competing priorities, integrate stakeholder perspectives, and propose governance mechanisms and revised contractual arrangements that balance efficiency, fairness, and sustainability. This iterative process of aligning theory and practice exemplifies how GEm Lab transforms learning and assessment into a coevolutionary process, where understanding develops through real-world participation.

6.2 From product to process-based assessment

Building on the reinterpreted ILOs and learning activities, the established assessment structure of the trade and transport law courses is retained but reinterpreted through the methods provided by GEm Lab for process-oriented learning. Assessment is restructured around iterative and situated learning cycles that integrate feedback, reflection, and collaboration as essential elements of student progress. Students demonstrate understanding not only through final deliverables but also through their ability to explain, justify, and adapt their ideas in dialogue with peers, teachers, and ecosystem actors. In this way, the learning process itself becomes visible and assessable, revealing students' capacity for reflection, agency, and adaptation.

Assessment is organised around three interrelated components:

Essay abstract: A short two-page submission where students outline their topic, research question, tentative structure, and theoretical grounding. Within GEm Lab, this becomes an exercise in situated inquiry, where students define problems within Ecosystem X1, framed through dialogue and feedback.

Essay: Traditionally a 15-page analytical text accompanied by an oral defence, it now serves both as a product and a reflective process. Students document how their arguments evolve, how discussions and feedback reshape their reasoning, and how they critically engage with AI-enabled research tools, in a research journal and attach that to the essay and discussed them jointly during the oral defence.

Assessed seminars: These remain vital spaces for collective dialogue, where students test ideas, exchange feedback, and link theory to practice. Within GEm Lab, they also become reflective spaces for ethical reasoning and peer learning, where teachers facilitate adaptive and inclusive learning practices.

Through this interrelated approach, the courses using GEm Lab transform assessment from a measure of performance into a mechanism for coevolutionary learning. The processes of inquiry, communication, and adaptation become as important as the final written product, enabling students to develop the substantive, procedural, and ethical competencies needed to navigate

and shape complex ecosystems. Building on this foundation, assessment integrates written, oral, and collaborative components that unfold over time. This design reduces reliance on single forms of evidence, accommodates diverse learning preferences, and enhances fairness and validity across disciplinary backgrounds (Crooks, Kane and Cohen, 1996).

7 Concluding remarks

The spread of AI in higher education presents both challenges and opportunities. Institutions can respond defensively by policing the use of new tools, or they can use this moment to rethink what counts as learning and how it is assessed. This article has argued for the latter, positioning assessment and feedback as instruments of pedagogical renewal rather than mechanisms of control.

Although developed in the context of trade and transport law, the GEm Lab infrastructure offers insights that extend across disciplines. By providing access to real-world digital ecosystems and supporting iterative, dialogic forms of assessment and feedback, it enables courses to situate students in authentic learning environments where knowledge remains academically rigorous, ethically grounded, and socially relevant. Conceptually, GEm Lab reframes assessment as a site of coevolution where students and sociotechnical systems learn together, emphasising process as much as product.

This direction aligns with international trends. UNESCO calls for embedding ethics into AI education (Mochizuki, Bruillard and Bryan, 2025), and pedagogical research highlights the importance of formative, process-oriented assessment (Panadero and Jonsson, 2020; Boud and Molloy, 2013). GEm Lab contributes to this momentum by extending assessment beyond the classroom into real-world digital ecosystems where learning is relational, adaptive, and socially embedded.

The broader message for higher education is not to replicate the GEm Lab infrastructure in full but to apply its underlying principles. Embedding assessment within learning processes, fostering student agency, linking assignments to societal challenges, and recognising adaptive competencies alongside disciplinary knowledge can make assessment more resilient, meaningful, and future-oriented. A more constructive response to AI is to design assessments that make misuse irrelevant by focusing on what cannot be automated: collaboration, reflection, ethical reasoning, and situated judgement.

Ultimately, assessment should not only measure what students know but also shape how they learn to act collaboratively, ethically, and creatively in a world where human and machine intelligence are increasingly intertwined. GEm Lab provides a model for this transformation and a foundation for developing educational practices that prepare students to navigate and contribute to the evolving landscape of the digital age.

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