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Assuring quality learning in a gen AI-integrated future: The role of adaptive capabilities

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Contents

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This document was commissioned by TEQSA to support institutions as they reflect upon and address the impact of generative artificial intelligence (gen AI) on learning outcomes. The advice contained within this document is not part of TEQSA's suite of Guidance Notes and is not intended to be prescriptive. There will likely be considerable variation in how individual institutions approach the assurance of quality learning. This, and the related resources (listed below), are therefore offered to support institutions in considering their approach to assuring students are meeting learning outcomes, while avoiding formulaic solutions. Together these resources provide insight, from sector experts, into how and why quality assurance may need to change in response to evolving gen AI technologies.

Related resources include:

- Assessment reform for the age of artificial intelligence
- Enacting assessment reform in a time of artificial intelligence

Purpose

This document builds on the Assessment reform for the age of artificial intelligence principle that "assessment and learning experiences equip students to participate ethically and actively in a society where generative AI is ubiquitous". It outlines the critical importance of adaptive capabilities in Australian higher education within the context of generative artificial intelligence (gen AI) and automated decision-making systems, such as AI agents (henceforth, collectively, gen AI).

While the Australian *Higher Education Standards Framework (Threshold Standards) 2021* (Threshold Standards) requires institutions to ensure that students develop higher-order learning outcomes, ethical reasoning and the capability to engage effectively in digital environments, these expectations are articulated at a high level and do not specify how such capabilities should be developed or assured in gen AI-integrated contexts. The rapid emergence of gen AI and automated decision-making systems intensifies this gap, challenging traditional approaches to evidencing learning and maintaining academic integrity.

> This resource offers an evidence-informed conceptualisation of adaptive capabilities, along with practical mechanisms for cultivating and assuring them, to support institutions in operationalising the Threshold Standards within a rapidly evolving technological landscape.

This focus on durable, human-centric capabilities is strongly supported by national and international-level analysis. Jobs and Skills Australia (2025) finds that gen AI is "augmenting, not replacing, work" and is actively "lifting demand for digital literacy and 'human' skills". Similarly, the Organisation for Economic Co-operation and Development (OECD) recently highlighted the critical importance of human capabilities in the age of gen AI (OECD, 2026). Drawing on current research and expert insights, this resource offers evidence-informed recommendations for institutions, educators and policymakers to cultivate adaptive capabilities in students.

The adaptive capabilities outlined here are critical for institutions to strengthen the assurance of learning in a gen AI-integrated context, and they complement the extensive work carried out across the sector since 2022 to respond to the emergence of gen AI. This resource offers an evidence-informed conceptualisation of adaptive capabilities, along with practical mechanisms for cultivating and assuring them, to support institutions in operationalising the Threshold Standards within a rapidly evolving technological landscape.

> This resource provides a sustainable, evidence-informed pathway for supporting students to develop persistent, transferable human capabilities that extend beyond what gen AI systems can reproduce — capacities shaped by lived experience, embodied understanding, ethical awareness and the integration of knowledge across personal, cultural and disciplinary contexts (de Barba, 2025).

By focusing on developing persistent, transferable adaptive capabilities, such as evaluative judgement, metacognitive regulation and ethical reasoning, this resource offers a nuanced,

pedagogically grounded account of how learning quality can be maintained and enhanced as gen AI becomes increasingly embedded in higher education.

The propositions outlined will equip institutions to:

- design for learning and assessment that provides a basis for managing risks to academic integrity (Threshold Standard 5.2)
- create a foundation for valid and trustworthy evidence of the achievement of learning outcomes relevant to the age of gen AI (Threshold Standard 1.4)
- consider the suitability of graduate attributes (Threshold Standard 1.1).

This resource serves as a vital tool for quality assurance, demonstrating how a focus on learning processes is fundamental to meeting regulatory standards in a gen AI-integrated future. We argue for 5 propositions of practice that collectively re-orient Australian higher education towards adaptive learning in a gen AI-transformed era:

1. Adaptive capabilities must be recognised as core graduate attributes, ensuring students develop the agility and self-regulation required to thrive in dynamic, technology-mediated contexts.
2. Institutions need to build infrastructure capable of gathering and analysing evidence of learning processes, not merely learning products and outcomes.
3. Learning environments should be intentionally designed to promote adaptive capabilities through evidence-informed pedagogical practices.
4. Assessment must evolve toward process-focused approaches that value learning as development, not just performance.
5. Sustainable progress depends on cross-institutional collaboration and innovation that enables shared experimentation, data exchange and the scaling of effective practice.

This resource complements the curriculum-wide recommendations developed in TEQSA's *Assessment reform for the age of artificial intelligence*, *Enacting assessment reform in a time of artificial intelligence* and *Australian framework for artificial intelligence in higher education* (Lodge et al., 2025). Building on these foundational resources, the principles and propositions outlined here provide actionable guidance for developing adaptive capabilities. The ethical and moral implications of gen AI use and its potential impact on students, particularly equity-bearing students, as outlined in the *Australian framework for artificial intelligence in higher education*, inform core considerations throughout this document.

Defining adaptive capabilities for the age of gen AI

This resource defines ***adaptive capabilities*** as the high-level, integrated capacities that enable graduates to navigate complex, novel and gen AI-integrated environments. These capabilities empower individuals to deploy, adapt and transfer their specific, demonstrable ***skills*** effectively and ethically.

This definition is intended to complement the national effort, led by Jobs and Skills Australia, to establish a *National Skills Taxonomy* as a common language for *skills* (Jobs and Skills Australia, 2024b), by providing the pedagogical framework for developing the human skills (Jobs and Skills Australia, 2025; OECD, 2026) and generalist capabilities (Future Skills Organisation, 2025) essential for a future-ready workforce.

Importantly, adaptive capabilities that will prepare graduates for navigating complex and ever-changing environments need to be built on and must be learned within the context of deep disciplinary knowledge.

Our working definition of adaptive capabilities for the age of gen AI draws from 4 distinct yet complementary capabilities:

1. ***Digital literacy*** refers to using digital tools (including gen AI) effectively, ethically and safely.

The understanding of digital literacy in this recourse is consistent with the national approach to digital capability. The *Australian Digital Capability Framework* (Department of Employment and Workplace Relations, 2022), which is based on the European *Digital Competence Framework for Citizens* (DigComp) (Department of Employment and Workplace Relations, 2025), defines this capability as encompassing 5 key areas:

- information and data literacy (e.g. verifying content)
- communication and collaboration (e.g. digital conduct)
- digital content creation
- protection and safety (e.g. privacy, wellbeing)
- technical proficiency and problem-solving.

This resource extends this definition to include a critical understanding of the principles, methods, limitations, ethics, societal impact and underlying power structures associated with gen AI, as advocated by industry bodies (Future Skills Organisation, 2025).

2. ***Distributed cognition*** refers to how cognitive processes, information and tasks are shared across people, tools, artefacts and gen AI systems.

Distributed cognition focuses on **the structure and organisation** of the cognitive system, not the regulation of that system. This capability encompasses the ability to understand and participate effectively in cognitive networks by recognising what humans, gen AI tools and other artefacts contribute to thinking and how these elements interact in complex problem-solving environments. It includes:

- working effectively in teams and human–gen AI collaborations
- using external representations, tools and gen AI agents to extend thinking
- understanding how knowledge and tasks flow across a distributed system
- coordinating roles and resources within a cognitive network.

Distributed cognition describes the **architecture of thinking** across people, tools and technologies, providing the context in which regulatory processes are applied.

3. ***Hybrid metacognition*** refers to the regulation of thinking and learning within any cognitive system, including human–gen AI networks.

Hybrid metacognition involves planning, monitoring, evaluating and adjusting cognitive processes — whether those processes reside within the individual or are distributed across people and technologies. This capability ensures learners maintain agency, intentionality and ethical awareness in environments where gen AI participates in meaning-making. It includes:

- evaluative judgement
- monitoring and evaluating AI-generated information
- deciding when to rely on or override gen AI
- co-regulation within teams or human–gen AI collaborations
- ethical reasoning about the use of gen AI in learning and decision-making.

Hybrid metacognition **operates on** distributed cognition: the cognitive system may be shared, but regulation of that system remains a fundamentally human capability, enacted individually or collaboratively.

4. ***Life-long learning*** refers to sustaining motivation, capability and adaptability to learn continuously in evolving, uncertain and gen AI-mediated contexts.

It is not only the willingness to upskill but also the ability to recognise when new knowledge is needed, seek out learning opportunities, evaluate emerging information and integrate new insights across contexts. It includes:

- adapting to evolving technologies, contexts and challenges
- identifying knowledge gaps and independently acquiring new skills
- transferring learning across tasks, domains and tools
- sustaining motivation and engagement in unfamiliar or demanding environments
- developing a learner identity grounded in agency and continuous growth.

Life-long learning is a core national policy objective, identified by both the *Australian Universities Accord* (Department of Education, 2023) and Jobs and Skills Australia (2024a) as essential for a "joined-up tertiary education system".

Although elements of digital literacy, ethical engagement, collaboration and higher-order reasoning appear across the Threshold Standards these expectations are articulated at a high level and do not specify the mechanisms through which such capabilities develop or how they should be assured in gen AI-integrated learning environments. This paper positions the 4 adaptive capabilities — digital literacy, distributed cognition, hybrid metacognition and life-long learning — as an evidence-informed framework that clarifies the conceptual relationships and practical mechanisms needed to operationalise these expectations across disciplines in contemporary tertiary learning.

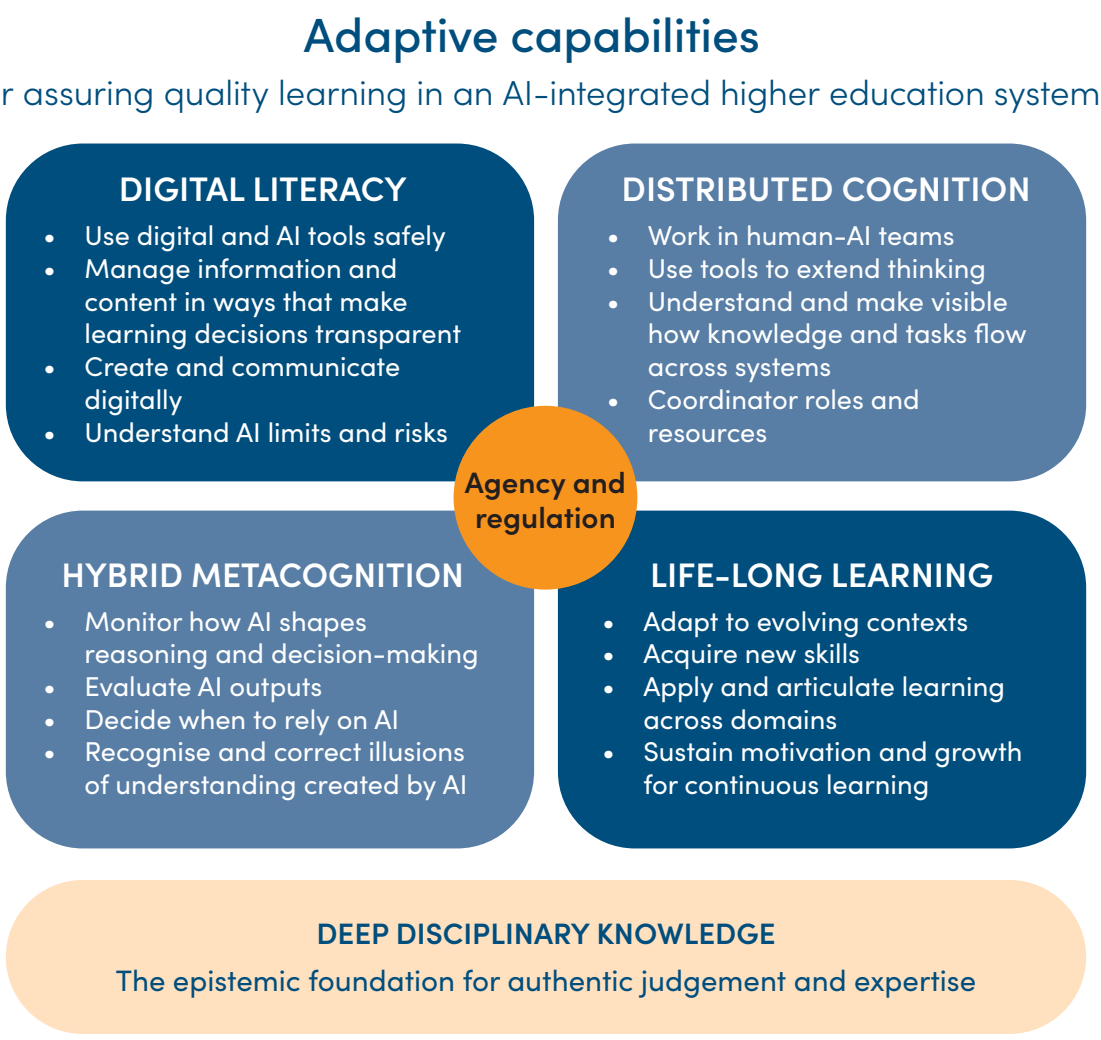
At the centre of these 4 capabilities are **agency and regulation** — the human capacity to plan, monitor, evaluate and adjust one's learning and decision-making across diverse contexts. Agency and regulation encompass both individual and collaborative processes, including self-regulated and co-regulated learning, and enable learners to maintain autonomy, exercise judgement and manage cognitive offloading in complex, gen AI-mediated environments.

These regulatory processes underpin all adaptive capabilities:

- learners regulate how they participate in distributed cognitive systems
- how they engage critically with AI-generated information
- how they sustain and direct their learning across evolving contexts.

Taken together, the 4 distinct yet complementary capabilities, supported by agency and regulation, form a holistic and human-centred foundation that enables graduates to navigate increasingly complex professional environments where human–gen AI collaboration is the norm.

Figure 1. Adaptive capabilities that operationalise human-centred learning, agency and regulation for assuring learning in gen AI-enabled systems



The changing context of higher education

Australian higher education faces unprecedented changes due to rapid technological advancements, shifts in the post-pandemic learning environment and widening participation initiatives (Department of Education, 2023). The emergence of gen AI tools (such as ChatGPT, Claude, Gemini and Perplexity) and automated decision-making systems (also known as 'agentic AI' or 'AI agents') has intensified discussions about academic integrity.

Gen AI technologies fundamentally alter how students interact with information and the learning process, requiring new approaches to curriculum and assessment design that go beyond securing assessment. To effectively assure learning, there needs to be clarity about what that learning is and what it should be, along with staff development opportunities and support to facilitate the transformations that are needed.

The focus on new approaches to curriculum and assessment design directly align with the 'Human-centred education' principle (Principle 1) articulated in the *Australian Framework for Artificial Intelligence in Higher Education*, which prioritises human connection, critical dialogue, the development of wisdom and expert judgement, and capacities embodied in the adaptive capabilities such as, hybrid metacognition, outlined in this document. Principle 6 of the Framework also highlights the importance of adaptive capabilities.

Gen AI intensifies existing self-direction demands in higher education

The emergence of gen AI technologies coincides with (and significantly complicates) a growing divergence between secondary and tertiary educational approaches. While school environments become increasingly structured, success in higher education requires students to self-direct their learning within gen AI-enhanced contexts that involve additional decision-making about when and how to use gen AI tools effectively (Zhai et al., 2024).

This situation presents compounded challenges for first-year students transitioning from structured school environments, who must simultaneously navigate academic independence (Vosniadou, 2020) and the integration of gen AI tools (Lim et al., 2025). Adults returning to higher education often encounter distinct challenges, particularly as they re-enter a gen AI-transformed educational environment.

The shift to online learning, both during and after the COVID-19 pandemic, has accelerated these trends. In online environments, students must make decisions about when, where and how to adapt their study strategies, as the external structures that physical classrooms provide

are often absent. This increased flexibility necessitates stronger self-regulated learning capabilities (Broadbent & Poon, 2015) (a core component of hybrid metacognition defined previously), which only some students have developed (Dittman & Stephens, 2017).

Simultaneously, widening participation initiatives, which have regained prominence in part due to the *Australian Universities Accord* (Department of Education, 2023), are bringing students with increasingly diverse academic backgrounds into higher education. Given the diversity of students' educational backgrounds and self-regulated learning capabilities, there are serious equity considerations regarding how universities can ensure all students are prepared for the educational demands of higher education in the age of gen AI.

Research shows that students differ substantially in the self-regulated learning skills they possess (e.g. some may be skilled at goal setting but struggle with monitoring; Antonelli et al., 2020; Broadbent & Fuller-Tyszkiewicz, 2018) and that many learners use ineffective learning strategies (e.g. re-reading instead of self-explanation; Bjork & Bjork, 2020). Such variability has important implications for how higher education providers support students in developing these essential capabilities.

This document adopts a strength-based perspective, focusing on identifying and leveraging students' existing abilities, experiences and cultural resources as the foundation for learning (Lester et al., 2023).

Institutions must recognise that diverse student cohorts bring rich experiences and varied learning approaches. Doing so can enhance relevance, motivation and equity. Aligned with widening participation principles, a strengths-based approach offers a productive starting point for equitable learning design while still supporting learners who encounter challenges.

The task for institutions is to create educational environments that acknowledge students' existing abilities, experiences and cultural resources, and deliberately develop the adaptive capabilities essential for success in gen AI-integrated, self-directed learning contexts.

Understanding the need for adaptive capabilities in the age of gen AI

Public discussion about preparing students for a gen AI-integrated future often centres on a narrow, technical form of "AI literacy" (e.g. Laupichler et al., 2022), typically focused on operational skills associated with current tools. In contrast, this document emphasises ***adaptive capabilities*** as the broader, high-level capacities that enable learners to navigate changing technological and disciplinary landscapes. While operational competencies remain important, they are insufficient on their own in contexts where tools evolve rapidly and students must make continual decisions about how, when and why to engage with gen AI.

Two ongoing challenges in current discourse help illustrate the need for this broader framing:

1. Gen AI literacy lacks a stable, widely accepted definition

The term is used to capture clusters of technical skills, sometimes with limited attention to metacognition, ethics or the contextual factors shaping learning (Southworth et al., 2023; Miao & Shiohira, 2024). This definitional variability is not unique to gen AI literacy; rather, it reflects a broader challenge of operationalising high-level capabilities within local contexts. The adaptive capabilities outlined in this document respond to this challenge by focusing on the underlying human capacities learners require to make sense of, evaluate and act within gen AI-integrated environments, irrespective of the specific tools in use.

2. The operational skills associated with today's gen AI systems may not remain relevant as technologies evolve

The operational skills associated with gen AI may not be as durable as the capacities that enable learners to adapt, transfer knowledge and exercise sound judgement across changing contexts, which are more enduring. This perspective is supported by employer-facing bodies such as Future Skills Organisation (2025), which identifies that a future-ready workforce requires a blend of technical skills and "transferable generalist skills" or "foundational employability skills" (including critical thinking, problem-solving and continuous learning). In this sense, adaptive capabilities complement technical skills by supporting learners' ability to navigate uncertainty, evaluate emerging technologies and sustain their learning over time.

> What students need are foundational adaptive capabilities that support learning and performance across varied technological contexts. These include the capacity to plan, monitor, evaluate and adapt their learning — what the literature describes as self-regulated learning (Broadbent & Poon, 2015).

In this document, these regulatory processes are situated within **hybrid metacognition**, reflecting the need to regulate not only one's own thinking but also one's interactions with gen AI. Self-regulated learning distinguishes human learning from the pattern-matching operations of gen AI systems and encompasses cognitive, motivational, emotional, contextual and behavioural processes.

Central to this metacognitive capacity is **evaluative judgement**: the ability to assess the quality of one's own work and that of others (Tai et al., 2017). As a core component of self-regulated learning, evaluative judgement enables students to:

- critically engage with AI-generated content
- assess its relevance and credibility
- maintain agency in their learning.

Together with other self-regulatory skills, such as strategy switching, effective goal-setting, managing motivation and knowing when to seek help, evaluative judgement constitutes one key adaptive capability essential for the age of gen AI. The development of these capabilities is rooted in deep disciplinary knowledge, which provides the epistemic grounding against which gen AI outputs can be evaluated.

In a gen AI-integrated context, evaluative judgement extends beyond work quality to encompass ethical dimensions, including the ability to critically assess gen AI outputs for bias, fairness and transparency, aligning with national expectations for "Fairness, Accountability, Transparency, and Ethics" (FATE; Memarian & Doleck, 2023).

The need for adaptive capabilities becomes even clearer as gen AI reshapes what it means to interact with technology. The conversational interfaces of gen AI tools have lowered barriers to sophisticated technological engagement (Bansal et al., 2024), shifting the challenge from *access* to *regulation*. When machines present information fluently and interact in human-like ways, technical proficiency becomes secondary to human regulatory capabilities, including co-regulation — the dynamic coordination of regulation across learners and other agents (Järvelä et al., 2023). While regulation has always been central to learning, the accessibility and influence of gen AI amplify its importance.

As Lodge et al. (2023a) argue, "the foundational skill for the AI era is self-regulated learning" (p. 3). This perspective shifts focus from concerns about gen AI-enabled cheating toward understanding how students can develop effective learning partnerships with gen AI. This "network of co-regulation" (Lodge et al., 2023a, p. 4) is a clear example of the **distributed cognition** defined in this document, where decision-making and learning are distributed among humans and machines (Hollan et al., 2000).

The Threshold Standards require students to demonstrate higher-order learning outcomes, ethical reasoning and effective engagement with digital technologies. How these capabilities develop in environments where gen AI mediates information, reasoning and assessment presents a new challenge for higher education providers.

Meeting the expectations presented in the Threshold Standards requires a clearer understanding of the interplay between digital literacy and hybrid metacognition. Students must not only know how to use gen AI but also activate the regulatory processes that enable them to evaluate AI-generated content, recognise illusions of understanding and make deliberate decisions about when to rely on or step away from gen AI.

These regulatory mechanisms are central to ensuring that learning remains authentic by making visible the student's own reasoning and decisions, and enabling assessment to capture the capabilities the student has developed (not the gen AI system). When students regulate their engagement with gen AI, evaluating outputs, monitoring their understanding and deciding when to accept or reject gen AI assistance, they make their learning processes visible. This transparency allows assessment to differentiate between the student's own capabilities and the contributions of external tools, helping to ensure that evidence of learning is credible, trustworthy and aligned with the expectations of the Threshold Standards. . However, this transparency should not be seen by default as sufficient evidence to assure learning. By outlining the empirical foundations of these processes, this paper provides conceptual clarity and practical insight into how institutions can support adaptive capability development in ways that complement and operationalise the high-level Threshold Standards.

Students who are effective at learning and thinking *with* gen AI in ethical ways are generally effective learners and ethical thinkers *first*. Their adaptive capabilities draw on cognitive, motivational, emotional, contextual and behavioural regulatory skills, in addition to disciplinary knowledge. As posited by Mirriahi et al. (2025), students utilise gen AI as part of their self-regulated learning repertoire; therefore, a combined strategy of fostering self-regulated learning skills and responsible gen AI use is necessary.

Evidence-informed foundations in a gen AI-enhanced context

Understanding how these adaptive capabilities function in gen AI-enhanced contexts requires examining the challenges and opportunities that emerge when students learn with gen AI. Most immediate is the effect of gen AI on students' metacognitive awareness. Lodge describes how digital resources can create "a mismatched sense of familiarity and comprehension… that does not align with how much they have actually learned" (2023, p. 239). Gen AI can present accurate and inaccurate information with equal fluency, leading learners to overestimate their understanding while reducing their engagement in verification (Fan et al., 2025).

When students use gen AI to obtain simplified explanations, they may mistake surface-level comprehension for the deeper understanding expected in higher education. The ability of gen AI to present complex ideas in a straightforward manner can lead to overconfidence, stemming from the fluent presentation (Carpenter et al., 2013). While similar risks existed with other technologies, gen AI amplifies this challenge through its capacity for personalised, on-demand simplification.

This situation encourages what Fan et al. (2025) termed "metacognitive laziness", the tendency to avoid metacognitive exertion when using gen AI. When learning feels easy, students may bypass important processes that contribute to deep learning, including struggling with concepts or retrieving information from memory.

This tendency is a form of cognitive offloading, which, as Panadero and Broadbent (2025) warn, can lead to regulatory erosion: as learners increasingly delegate metacognitive and evaluative functions to gen AI, they risk losing opportunities to practice these capabilities independently. This tendency is concerning because capacities not regularly exercised tend to atrophy. When gen AI consistently performs these functions instead of supporting students to develop them, the very capacities essential for navigating complexity may weaken.

Critical thinking is essential for questioning AI-generated content rather than accepting it simply because it appears authoritative (Zhai et al., 2024). Students with well-developed evaluative judgement actively interrogate the logic and evidence underlying gen AI responses. However, developing these capabilities requires consistent practice and a foundation of deep disciplinary knowledge.

These generalised possibilities will play out differently across contexts and knowledge domains, underscoring the need for institutions to understand their specific student populations rather than implementing universal solutions. Effective responses must be tailored to contextual factors while building on students' existing strengths and abilities.

Desirable difficulties: The value of productive struggle

The phenomenon of metacognitive laziness contrasts sharply with research from the learning sciences on "desirable difficulties" - conditions that make learning more challenging in the short-term but lead to better long-term learning (Bjork & Bjork, 2020).

These productive struggles can include:

- spacing revisions over time rather than massing them together
- mixing different types of problems rather than studying one type at a time
- testing oneself rather than simply reviewing material
- generating answers before receiving explanations.

Each strategy requires greater cognitive effort but typically leads to more durable learning. Yet students often avoid such approaches, assuming that ease signals effectiveness (Bjork et al., 2013). Gen AI may reinforce this misconception: its instant, fluent responses feel satisfying while depriving students of opportunities to practice retrieval and struggle productively with concepts (Fan et al., 2025). Over time, gen AI can become a habitual shortcut that erodes engagement with the effortful cognitive work essential for robust learning (Panadero & Broadbent, 2025).

As higher education adapts to gen AI, it becomes crucial to balance the convenience gen AI tools offer with the necessary cognitive challenges that foster effective learning. This involves finding the 'zone of maximised learning' (Lodge, 2023) that avoids both disengagement from excessive difficulty and overconfidence from too much fluency.

This situation requires a fundamental shift in how learning effort is framed. Rather than positioning struggle as a sign of weakness, institutions must help students understand that effort can, and often does, signal effective learning, and assess learning processes alongside products (as difficult as this is proving to be). Building a durable understanding requires effortful cognitive work that gen AI cannot replace.

Evolving student practices with gen AI

Student learning increasingly occurs across diverse settings beyond traditional institutional boundaries. The integration of digital technologies, such as gen AI, into these practices creates complex networks of regulation involving peers, educators and technological tools (Fawns, 2022). This entanglement raises important questions about agency and the nature of self-regulation in human-gen AI partnerships. As Molenaar

(2022) suggests, these partnerships create a continuum of possible human-machine relationships that influence the learning process.

These evolving practices point toward emerging forms of distributed cognition, or collective intelligence, where students, educators and gen AI systems contribute complementary capabilities to learning processes. Students are already pioneering innovative approaches to human-gen AI collaboration (e.g. de Melo Heredia, 2025). It is therefore critical to build institutional capacity to support these organic developments while helping students develop critical awareness of how these partnerships function.

This capacity building requires recognising students as active agents in shaping the future of learning and providing frameworks that amplify their agency while fostering more intentional, ethical and reflective engagement with these emerging learning ecosystems.

Challenges and opportunities: Persistent barriers transformed

Translating research on adaptive capabilities into educational practice has never been straightforward (e.g. Del Mario & Tran, 2024). The integration of gen AI into learning environments now amplifies these existing difficulties. These challenges reflect systemic limitations rather than inherent weaknesses in students or educators; they are the result of educational systems designed for contexts that no longer exist.

However, this same gen AI integration also creates unprecedented opportunities. Gen AI capabilities can now provide learning support and detailed analytics on students' learning processes that were previously only achievable in research settings (Bond et al., 2024). When designed thoughtfully, these tools can broaden equitable access to sophisticated and personalised learning support. Crucially, they can be configured to promote agency rather than dependency, by scaffolding learners' own strategic and metacognitive development, rather than replacing their judgement or decision-making.

As institutions navigate this transformed environment, understanding how persistent barriers interact with their gen AI-enhanced possibilities becomes essential. While several of the examples of transformation opportunities in Table 1 do not require gen AI per se, gen AI accelerates, scales or meaningfully reshapes the feasibility of these approaches; what gen AI introduces is the ability to enact them at scale, with greater precision, responsiveness and timeliness than was previously possible. The opportunities are therefore intentionally *aspirational*: they illustrate how gen AI-capable systems could enable or expand practices that support adaptive capability development but are not yet fully realised in most institutional contexts.

Table 1. Challenge-opportunity matrix for adaptive capabilities development

Challenge area	Traditional challenge	Gen AI amplification	Potential transformation opportunities
Metacognitive effort, motivation and engagement	Students avoid demanding approaches, favour familiar but less effective strategies, especially under pressure or resource constraints (de Bruin et al., 2025).	Gen AI tools enable cognitive offloading, reducing motivation for effortful learning and critical evaluation.	Personalised and adaptive learning pathways using learning analytics to provide just-in-time interventions; design gen AI scaffolding that gradually builds rather than replaces self-regulation.
Process *vs* product focus	Assessment emphasises outputs over learning processes; limited insight into adaptive capabilities.	Gen AI can generate outputs with minimal human input, making product-based assessment unreliable.	Process-focused assessment capturing learning journeys, portfolios showing development over time, reflective practices demonstrating metacognitive growth.
Curriculum and assessment design	Content knowledge prioritised over learning processes; budget constraints limit innovation.	Gen AI's unprecedented development rate underscores the importance of process-focused approaches to adaptive capabilities development (Lan et al., 2025).	Graduate attribute frameworks explicitly valuing adaptive capabilities and aligned with the national common language of the *National Skills Taxonomy* and *Australian Digital Capability Framework* to ensure capabilities are 'visible' and 'transferable' (Jobs and Skills Australia, 2024b; Future Skills Organisation, 2024).
Evidence and measurement	Internal nature of self-regulation makes measurement difficult (Winne et al., 2001); limited longitudinal evidence (Higgins et al., 2023) and a persistent focus on measuring what has improved rather than what might be lost (Panadero & Broadbent, 2025).	Additional complexity layers from human-gen AI learning networks.	Cross-institutional collaboration and alignment with Jobs and Skills Australia data on emerging skills needs (Jobs and Skills Australia, 2025); innovative data collection approaches; learning analytics at unprecedented scale; detection of skills that are bypassed, tasks that are delegated, or strategies that are abandoned when gen AI is used.

The intersection of these persistent challenges with gen AI capabilities creates unprecedented opportunities (many still emerging) for systematic change. While these opportunities remain aspirational in many cases, the affordances of gen AI can expand the feasibility and scale of approaches that were previously difficult to implement or sustain.

Three areas requiring significant attention are examined below.

1. Reshaping learning environments

Gen AI integration has the potential to enable a fundamental transformation of learning environments through personalised and adaptive pathways that support (when thoughtfully and ethically designed) rather than replace, human regulatory processes. At the same time, gen AI also carries the risk of diminishing students' engagement in productive struggle, especially if it automates decisions that learners should be making themselves or provides overly fluent explanations that obscure underlying complexity.

Recognising this dual potential is essential for responsible innovation. Gen AI-powered learning analytics can provide insights into learning patterns at an unprecedented scale, facilitating just-in-time interventions aligned with students' developmental stages (Li et al., 2025). A promising approach involves implementing solutions that make learning patterns transparent to students themselves through learning analytics, such as open learner models (Hooshyar et al., 2020), gradually transferring autonomy to learners at their own pace.

Such approaches enable students to develop agency over their learning data and regulatory processes, fostering genuine self-regulation rather than dependence. However, deliberate and ethical design remains essential.

> Commercially available gen AI tools are not designed to support metacognition or learning per se, and without scaffolding they can promote overreliance or superficial engagement, effects that disproportionately disadvantage students with less prior experience, confidence or access to high-quality instruction.

Purposefully designed, institutionally provided pedagogical agents can therefore play a complementary role by modelling effective learning processes, offering transparent and educative feedback and, crucially, ensuring equitable access to personalised support for all learners. These systems are most valuable when embedded within intentional learning designs that explicitly cultivate agency and regulation, allowing students to practise the skills needed to monitor, evaluate and adjust their engagement with gen AI.

Higher education has a responsibility to create such purposeful environments, where students can develop and rehearse these capabilities safely, while also revisiting and reimagining prior AI-use habits, before encountering the broader, less structured ecosystem of commercial gen AI tools in the workforce. The aim is not to replace or restrict students' use of general-purpose gen AI systems, but to equip them with transferable regulatory, evaluative and ethical capacities so that, when they do engage with external gen AI in professional or everyday contexts, their agency remains with them rather than being ceded to the tool.

2. Transforming assessment practices

Assessment transformation represents the most immediate opportunity, as process-focused evaluation aligns naturally with adaptive capabilities development.

> Rather than replacing traditional assessment outputs, process-focused evaluation involves rebalancing assessment so that evidence of learning processes sits alongside assessment products, enabling educators to capture how students plan, monitor, evaluate and adapt their thinking over time.

Process-focused evaluation includes approaches that foreground learning journeys, portfolio-based evaluation and reflective practices that make students' regulatory capabilities visible. This approach is strongly supported by the emphasis in *Assessment Reform for the Age of Artificial Intelligence* on evidencing "the process of learning over time and in context" (Lodge et al., 2023, p. 4).

Gen AI tools can facilitate this transformation by automating routine tasks while enabling educators to focus on evaluating distinctly human abilities such as evaluative judgment and critical analysis. This creates opportunities to reimagine feedback as continuous dialogue that actively fosters adaptive capability development. However, these opportunities must be considered in light of the requirements outlined in the Threshold Standards to assure learning through the assessment process. While assessment practices will likely transform in the future, until more sophisticated approaches emerge, there is an imperative to continue to use secure forms of assessment to assure that the required learning has occurred.

3. Institutional leadership opportunities

Strategic institutional leadership emerges through positioning adaptive capability development within broader frameworks for educational excellence. Higher education institutions could demonstrate sector leadership by explicitly embedding the 4 adaptive capabilities defined in this document within graduate attribute frameworks and curriculum design, building on Australia's established reputation for educational innovation. This leadership would also benefit from being supported by embedded professional learning to upskill leaders and educators.

Cross-institutional collaboration offers particular promise for creating efficiencies in research and implementation. By addressing complex challenges associated with developing adaptive capabilities collectively, the sector can leverage shared expertise while building systematic capacity to prepare graduates for gen AI-integrated professional environments.

These interconnected transformation pathways require recognising current challenges as design opportunities. Through coordinated action across learning environments, assessment practices and institutional strategy, Australian higher education can lead in developing graduates equipped for collaborative human-gen AI futures.

Propositions for policy and practice

The following propositions outline aspirational directions for fostering adaptive capabilities in Australian higher education in alignment with the principle: **assessment and learning experiences should equip students to participate ethically, critically and actively in a society where gen AI is ubiquitous.**

These approaches build on established evidence while acknowledging the collaborative innovation required for gen AI-integrated learning environments.

Proposition 1: Establish adaptive capabilities as core graduate attributes

Although the Threshold Standards identifies broad expectations for graduate attributes, including ethical reasoning, communication and the capacity for self-directed learning, it does not offer guidance on how these attributes should be developed or assured in a gen AI-intensive environment. Embedding adaptive capabilities such as the 4 adaptive capabilities defined in this document — digital literacy, distributed cognition, hybrid metacognition, and life-long learning — provide a practical and evidence-informed structure for operationalising these requirements, while allowing disciplines to express, weight and evidence these capabilities in ways that are authentic to their field.

Recognising the complementarity of digital literacy and hybrid metacognition enables curriculum design that supports students to use gen AI tools safely and effectively while retaining the agency, evaluative judgement and regulatory capacity necessary for authentic learning. In this way, the propositions in this paper extend the Threshold Standards high-level intent by offering concrete, implementable mechanisms that strengthen quality assurance and graduate readiness in gen AI-integrated contexts. These capacities integrate essential human-centred skills such as self-regulated learning, co-regulation, and evaluative judgement as core components of hybrid metacognition, rather than treating them as separate or competing concepts.

This adoption requires explicit communication from institutional graduate attributes through to discipline-specific applications (see Hamilton et al., 2025), ensuring capabilities are described in ways that align with national frameworks like the *National Skills Taxonomy* and the *Australian Digital Capability Framework* (Department of Employment and Workplace Relations, 2022; Jobs and Skills Australia, 2024b). This alignment will help make graduate capabilities visible, portable and understood by employers and industry.

Professional learning for educators should focus on facilitating and scaffolding students' adaptive capabilities within human-gen AI learning networks and within disciplines. This includes developing expertise in when and how to intervene in student-gen AI interactions while maintaining student agency and fostering independent regulatory capabilities.

Example

An engineering faculty redesigns its graduate attributes to explicitly include the 4 adaptive capabilities and implements them through a design project in which students build a gen AI-assisted sensor system. Digital literacy is developed as students critically evaluate gen AI generated design suggestions and identify appropriate applications and limitations. Distributed cognition is enacted as teams coordinate human and gen AI contributions to modelling and documentation.

Hybrid metacognition is scaffolded through brief reflective checkpoints requiring students to justify when they relied on or overrode gen AI and to evaluate outputs against engineering standards. Life-long learning is strengthened as students identify knowledge gaps and adapt their approach across project iterations. Staff professional development supports educators to design prompts and feedback that foreground agency and regulation within gen AI-enhanced engineering practice.

Proposition 2: Build institutional infrastructure for learning process evidence

Institutions should consider investing in developing a systematic capacity to collect and analyse data on learning processes. This requires the coordinated development of learning analytics infrastructure and research methodologies, as well as staff technical capabilities to work with data that illuminates *how* students are engaging with tasks over time. Importantly, 'learning process evidence' does not refer solely to outputs such as reflections or journals, but also to the traces students generate as they plan, monitor, seek feedback, revise work, interact with resources and make decisions, including how they engage with gen AI. These traces may include time-stamped edits, patterns of resource use, sequences of problem-solving actions, metacognitive prompts, peer or gen AI interactions, and structured self-assessments. When designed thoughtfully, such data provides *partial windows* into students' regulatory activity without claiming to capture learning in its entirety.

This infrastructure development requires long-term commitment to understanding how students learn rather than simply tracking learning outcomes. Such data collection must prioritise student agency, privacy and transparency through solutions, such as open learner models, that enable students to develop insights that support their regulatory development while institutions build research capacity for evidence-informed innovation. These methods avoid surveillance approaches that undermine the self-regulated learning they aim to foster. Importantly, while these methods provide insight into student learning processes, **they should not be seen as a foolproof method of assuring learning**.

Example

A university develops learning analytics platforms that integrate trace data (such as revision histories, resource use patterns and metacognitive checkpoint responses) into a transparent open learner model. Students view their own learning trajectories through an accessible dashboard that highlights strategy use and engagement patterns, supporting self-assessment and reflection. Educators access an aggregated view that helps them adapt instruction, identify where students are struggling to regulate their learning and evaluate the impact of teaching interventions.

Proposition 3: Design learning environments that promote adaptive capabilities through evidence-informed practices

Learning environments should systematically incorporate desirable difficulties and explicit instruction and modelling of effective self-regulated learning (Russell, et al., 2020) and ethical decision-making. This involves creating structured opportunities for students to practice planning, performing, monitoring and evaluating their learning in an effective, ethical and discipline-appropriate manner. This approach also involves incorporating desirable difficulties: for example, providing retrieval practice (i.e. practice testing) rather than constant information exposure, creating scenarios where students generate solutions before accessing explanations, designing assessment tasks requiring application across varied contexts, and structuring learning sequences that space or revisit material and instruction that interleaves related concepts rather than presenting them in blocks.

Students should be scaffolded in building their metacognitive awareness through reflection activities with prompts that provoke articulating their emotions, judgements of learning and identifying how they will adapt their future strategies. This balance becomes particularly critical in gen AI-enhanced contexts where instant, coherent explanations can undermine beneficial difficulties.

However, as recent research cautions, simply designing learning environments that *contain* desirable difficulties does not guarantee students will develop the hybrid metacognition to deploy these strategies on their own. Molenaar (2022) highlights a critical risk in many adaptive learning systems: while they may be cognitively beneficial, they often outsource the *regulation* of learning from the student to gen AI. This can prevent students from internalising when and how to deploy effortful strategies, ultimately hindering the development of life-long learning capabilities.

Environments must be designed not just to *promote* productive struggle, but to intentionally 'onload' regulation by making students active participants in the process. This involves scaffolding a gradual transfer of control, moving from gen AI-supported regulation to hybrid human-gen AI regulation (Molenaar, 2022). The ultimate goal is for students to internalise these metacognitive skills for independent, self-regulated learning, developing the adaptive capacity to manage their own desirable difficulties when gen AI is not present. Strategies to maintain this balance include:

- incorporating practice testing to reveal gaps between perceived and actual understanding
- using gamified elements to sustain engagement during challenging tasks
- designing activities that require students to struggle productively with concepts before accessing AI-generated explanations.

Particular attention should be given to equity considerations, recognising that adaptive capability development may require different approaches for students from diverse backgrounds while building on existing strengths, a central pillar of the *Australian Universities Accord* (Department of Education, 2023). Centring the student voice through co-design of learning environments enables institutions to understand diverse needs authentically rather than making assumptions, while fostering ownership over learning processes that are fundamental to developing adaptive capabilities.

Example

A first-year science program, co-designed with students, implements spaced retrieval practice (e.g. weekly gamified quizzes that cover new and old content), requires students to generate hypotheses before accessing explanations, teaches students to use gen AI as a study partner for testing their understanding and receiving feedback on their reasoning, and adapts support levels based on student background and progress.

Proposition 4: Transform pedagogical practice toward process-focused assessment

Academic staff should consider rebalancing assessment approaches so that documentation of learning processes meaningfully complement, rather than replace, evaluation of final products. This pedagogical transformation can be supported by the use of learning analytics, which make learning processes visible for assessment. For example, recent research demonstrates that data from learning processes can explain more variance in student performance than data from the final product alone. In a study on multi-text writing, Raković et al. (2023) found that *process features* (such as students' patterns of elaboration, re-reading and planning) were critical predictors of writing quality, in addition to product features.

Adopting such approaches, which are critically dependent on the infrastructure outlined in Proposition 2, allows educators to assess the development of hybrid metacognition in action. This shift aligns with the resource, *Assessment Reform for the Age of Artificial Intelligence's* recognition that learning processes reveal "thinking, competencies and other qualities embodied in learning outcomes" that "AI is less able to simulate" (Lodge et al., 2023, p. 4). This pedagogical transformation involves training educators to design, implement and evaluate learning processes alongside product evaluation, an essential approach when gen AI can generate many traditional assessment products (Gabriel et al., 2025).

Programs should carefully balance providing necessary support with fostering independence, considering how and when to fade scaffolding as students develop greater self-regulated learning capabilities. The transformation of practice requires sustained professional development and departmental culture change to embed process-focused approaches across disciplines, moving beyond isolated task-level changes to systematic curriculum redesign that captures evidence of student regulatory development.

Example

A business faculty retrains teaching staff in portfolio assessment methods, redesigns capstone projects to require learning journey documentation and develops new rubrics that assess both regulatory processes and final outputs.

Proposition 5: Foster collaborative innovation across institutions

Cross-institutional collaboration should address implementation challenges collectively, sharing resources, research findings and innovative approaches to adaptive capability development. This collaborative approach can create efficiencies while building sector-wide

capacity to prepare graduates for gen AI-integrated professional environments. Partnerships between institutions, researchers and technology providers should prioritise human agency and educational effectiveness over technological capability, ensuring that innovation serves pedagogical goals rather than driving them.

Example

A consortium of Australian higher education institutions develops shared professional development resources, assessment rubrics and research protocols for adaptive capability development, creating economies of scale while allowing institutional adaptation.

Conclusion: Adaptive capabilities as the foundation for a gen AI-integrated future

In the age of gen AI, higher education must shift its focus beyond transmitting knowledge to fostering students' ability to regulate their learning and thinking within complex networks of human-gen AI interaction, building on deep disciplinary knowledge. Rather than centering narrowly on technical gen AI capabilities, the 4 broad adaptive capabilities outlined here (including digital literacy) provide a human-centred foundation for navigating an increasingly intertwined and evolving technological environment.

By fostering these capabilities, Australian higher education can prepare graduates who maintain agency in their learning and work, leveraging gen AI as a partner rather than becoming dependent on it. This approach supports the national skills agenda by developing the human capabilities and digital literacies identified as critical by Jobs and Skills Australia (2025) and the OECD (2026) and provides a pathway for delivering the future-ready (Jobs and Skills Australia, 2025), adaptable workforce envisioned by the *Australian Universities Accord* (Department of Education, 2023). Alongside these national priorities, the evidence-informed propositions presented in this paper translate the Threshold Standards' high-level expectations into actionable mechanisms for cultivating the adaptive capabilities required for ethical, critical and authentic learning in a gen AI-integrated future.

Progress will require collaboration across institutions, disciplines and stakeholders. Through strategic investment in research, practice development and policy reform, the sector can position itself as a leader in preparing graduates for a gen AI-integrated future by equipping students to participate ethically and actively in a society where gen AI is ubiquitous.

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