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From Generation to Autonomy: A Framework for Understanding Generative, Agent, and Agentic AI in Higher Education

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Abstract: The rapid evolution of artificial intelligence (AI) in higher education has moved beyond content generation toward increasingly autonomous systems, necessitating a clearer conceptual understanding of their roles and implications. This paper introduces the Generation-to-Autonomy (GtA) Framework, which positions Generative AI, Agent AI, and Agentic AI along a multidimensional continuum defined by autonomy, control, and intelligence. Drawing on a functional definition of educational intelligence, the framework distinguishes AI systems based on their capacity for content generation, task execution, and self-directed decision-making. The study provides a structured analysis of how Generative AI enhances cognitive support yet raises challenges related to academic integrity and epistemic reliability; how Agent AI enables task-oriented automation and human–AI collaboration while introducing risks of accountability diffusion and task misspecification; and how Agentic AI represents a paradigm shift toward autonomous educational systems, raising complex ethical, governance, and control concerns. By synthesizing these categories into a unified framework, the paper contributes theoretically by clarifying the evolving human–AI relationship—from tool use to partnership and delegation—and practically by offering guidance for curriculum design, assessment transformation, and differentiated governance in higher education. The findings suggest that as AI systems progress toward greater autonomy, educational institutions must adopt nuanced, capability-sensitive strategies that balance innovation with ethical responsibility. The GtA Framework provides a foundation for informed decision-making and future research in AI-integrated education.

Keywords: Generative AI, Agent AI, Agentic AI, AI in higher education, Human-AI collaboration

Introduction

The incorporation of artificial intelligence (AI) in higher education has progressed rapidly, moving from gradual enhancements to significant transformation. Over the years, we have witnessed a series of varying levels of excitement and careful optimism regarding educational technologies. This journey spans from the rule-based computer-assisted instruction of the 1960s to the data-driven learning analytics of the 2010s. Today, we find ourselves in a landscape characterised by large-scale foundation models that not only generate innovative content but also engage in meaningful dialogue and, more recently, take autonomous actions within intricate educational settings (Aguado-García et al., 2025; Crompton & Burke, 2023). Unlike traditional rule-based AI systems that rely on predefined patterns and classification algorithms, Generative AI operates through foundation models capable of producing novel content by predicting statistical patterns, representing a fundamental departure from predictive analytics toward creative synthesis (Israfilzade, 2025a; 2025b). This evolution represents a significant change from viewing AI merely as a responsive tool to recognising it as an active participant in educational processes. This shift raises important questions regarding the limits of human agency, the sharing of knowledge responsibility, and the governance frameworks necessary to align with educational values.

However, this advancement in technology has surpassed our understanding of its concepts (Israfilzade & Sadili, 2024; 2025). The ongoing conversation often merges different categories of AI capabilities—such as content

generation systems, task execution systems, and those that can form self-directed goals—into broad discussions about "AI in education." This blending of concepts masks important distinctions in autonomy, oversight needs, and risk profiles, resulting in governance frameworks that may be overly restrictive for low-risk applications or excessively lenient for high-risk implementations. Existing taxonomies treat AI systems as discrete types rather than as points on a capability continuum, failing to capture the porous boundaries and hybrid characteristics of real-world educational technologies (Sapkota et al., 2025; Kremantzis et al., 2025). As a result, institutions struggle to develop proportionate policies that impact a balance between pedagogical innovation and ethical safeguards, while educators lack diagnostic tools for identifying appropriate human-AI collaboration models across a variety of instructional contexts.

This paper introduces the Generation-to-Autonomy (GtA) Framework, a conceptual tool for navigating this complexity. Using a functional definition of educational intelligence, the framework places Generative AI, Agent AI, and Agentic AI on a multidimensional continuum defined by autonomy, control, and cognitive capability. Rather than treating these categories as isolated technologies, the GtA Framework examines them as anchor points on a continuum of human-AI relationships—from tool use to partnership to delegation—each with its own implications for curriculum design, assessment integrity, and institutional governance. By distinguishing systems based on their ability to generate content, execute tasks, and make self-directed decisions, the framework allows for capability-sensitive strategies that increase oversight requirements proportionally to system autonomy.

The rest of this paper proceeds as follows. The first section lays the groundwork, tracing the evolution of AI in higher education and implementing a functional definition of educational intelligence. The following sections examine each AI category in depth: Generative AI is reactive content creation with implications for academic integrity; Agent AI is task-oriented automation that introduces challenges of accountability and misspecification; and Agentic AI is autonomous systems that raise fundamental questions about control and educational purposes. The framework is then developed as a series of capabilities, culminating in an examination of pedagogical transformations, differentiated governance requirements, and future research directions. Finally, this synthesis contends that as AI systems gain greater autonomy, higher education must abandon one-size-fits-all policies in favour of complex, ethically grounded approaches that protect the irreplaceable human dimensions of teaching and learning.

Conceptual Foundations of AI in Education

Evolution of AI in Higher Education

The history of AI in education is one of recurring cycles of enthusiasm, disappointment, and re-invention. The implementation of AI into higher education has evolved through several distinct phases, each distinguished by unique technological capabilities and pedagogical paradigms (Adamakis & Rachiotis, 2025; Sposato, 2025). Computer-assisted instruction (CAI) and intelligent tutoring systems (ITS) dominated the early phase, which lasted from the 1960s to the 1980s and provided structured learning experiences using rule-based approaches. These systems, while innovative at the time, were limited in their ability to adapt to individual learner needs beyond pre-programmed branching logic.

The second phase, which began in the 1990s and continued into the 2000s, saw the development of more sophisticated adaptive learning systems that used machine learning algorithms to tailor content delivery based on learner performance data. These systems represented a significant advancement in educational technology, allowing for more nuanced differentiation of instruction and the first steps toward data-driven educational decision-making. Their capabilities, however, remained limited due to the limited scope of their training data and the complexity of their underlying models.

The rise of machine learning in the 2000s and 2010s introduced statistical and data-driven approaches to educational AI. Learning analytics, adaptive learning platforms, and early natural language processing (NLP) systems transformed the technological landscape. Platforms such as Knewton, Coursera's adaptive assessments, and intelligent writing assistants demonstrated that AI could be deployed at scale across diverse educational contexts (Coursera, 2025). These systems, however, remained fundamentally reactive: they analysed patterns in student data and generated recommendations, but could not initiate learning experiences, engage in genuine dialogue, or adapt in real time to the complexity of human cognition.

The current phase, which began in the early 2020s, is characterised by the emergence of large-scale foundation models capable of generating novel content, engaging in sophisticated dialogue, and demonstrating emergent capabilities (Aguado-García et al., 2025). This phase has also seen the growth of AI agents capable of performing multi-step tasks (Crompton & Burke, 2023; Pilelienė & Bogoyavlenska, 2025), as well as the recent development of agentic systems capable of operating autonomously in complex environments (Kamalov et al., 2025). Understanding this evolutionary trajectory is critical for contextualising the current state of AI in education and projecting future trends.

Conceptualizing Intelligence in Educational Technologies

The concept of 'intelligence' as applied to educational technologies is still strongly debated, fluctuating between narrow task-specific performance and broader qualities associated with human cognition, such as reasoning and context adaptation. For the purposes of this framework, we use a functional definition of educational intelligence: a system's ability to support, extend, or replace human cognitive activity in educational contexts in ways that are context-sensitive, adaptive to user needs, and capable of producing outputs with legitimate epistemic value (Sritriratanarak & Garcia, 2023). This definition intentionally removes arguments about consciousness in order to focus on functional properties relevant to deployment, presenting intelligence as a multidimensional capability that varies across systems rather than a binary state. This approach allows for a pragmatic assessment of how different AI systems contribute to teaching and learning while avoiding philosophical ambiguities about machine understanding.

Within this functional frame, educational intelligence comprises four interrelated dimensions that serve as organizing principles for the framework. *Cognitive and representational capabilities* encompass pattern recognition, natural language understanding, reasoning, and predictive analytics such as learner modelling. *Generative capacities* refer to the creation of novel, coherent, and contextually appropriate educational content across multiple modalities, including explanations, feedback, and multimodal presentations (Fahimirad & Kotamjani, 2018). *Adaptive and contextual awareness* involves interpreting situational factors—including learner characteristics, task requirements, and environmental constraints—and modifying behaviour based on interaction history and feedback. *Agentic and goal-directed capabilities* denote the capacity to pursue specified objectives through planned sequences of actions, encompassing task decomposition, self-correction, sustained engagement with complex goals, and coordination across multiple operations (Sapkota et al., 2025; Kostopoulos et al., 2025).

These four dimensions of functional intelligence provide the diagnostic foundation for distinguishing the three AI categories examined in this paper. **Generative AI** systems typically excel in cognitive processing and generative capabilities but lack sustained goal-directed behaviour, operating primarily as responsive tools rather than autonomous actors. **Agent AI** systems demonstrate enhanced goal-directed capabilities through task execution and workflow automation yet remain bound to explicit human directives and predefined objectives. **Agentic AI** systems integrate all four dimensions at advanced levels, enabling autonomous operation characterized by self-directed planning, metacognitive monitoring, and collaborative coordination within complex educational environments. By conceptualizing educational intelligence as this continuum of functional capabilities rather than a binary property, the framework enables stakeholders to move beyond simplistic narratives of AI as either threat or panacea, diagnose their specific ecosystemic contexts across micro, meso, and macro levels, and make informed decisions regarding adoption, governance, and pedagogy.

Generative AI in Higher Education

Concept, Capabilities, and Educational Applications

Generative AI refers to systems—typically built on transformer architectures and trained using reinforcement learning from human feedback that generate novel content (text, code, images) by predicting statistical patterns rather than retrieving existing information (Israfilzade & Sadili, 2025). These systems function reactively, responding to prompts within the limitations of their training data and context windows, lacking sustained goals, metacognitive awareness, or genuine understanding (Noviandy et al., 2024). In educational contexts, this translates to powerful but limited capabilities: natural language generation across disciplines, Socratic dialogue simulation, multimodal content creation, code generation and debugging, and real-time translation for accessibility (Francis et al., 2025; Ilieva et al., 2025).

These capabilities enable four primary pedagogical applications. *First*, personalised learning and intelligent tutoring systems use Generative AI to generate adaptive explanations, worked examples of varying complexity levels, and immediate feedback, which promotes self-regulated learning, especially among under-represented students who may avoid seeking human assistance (Francis et al., 2025). *Second*, AI-assisted brainstorming, linguistic refinement, and multilingual support have transformed writing and composition pedagogy, democratising access to high-quality writing assistance that was previously reserved for those with tutoring resources (Oyenuga, 2026). *Third*, in STEM education, Generative AI acts as an on-demand tutor for mathematical problem-solving, code debugging, and generating practice problems, significantly reducing students' "stuck" time (Plate, 2025; Farrelly & Baker, 2023). *Fourth*, instructional design and assessment support allow educators to automate the creation of activities, rubrics, feedback templates, and multimedia resources, reducing administrative burden (Khlaif et al., 2025).

Opportunities, Limitations, and the Academic Integrity Challenge

Generative AI presents significant opportunities for improving academic support at scale, reducing instructor administrative load, improving accessibility for students with disabilities or language barriers, and shifting educator time from lower-order tasks to mentoring and higher-order intellectual engagement. However, there are critical challenges. Generative AI systems exhibit *hallucinations* (confidently generating believable misinformation), and a fundamental disconnect between *competence* and *understanding*—linguistically competent performance does not imply understanding, reasoning, or epistemic reliability (Israfilzade & Sadili, 2024; 2025; Dang & Nguyen, 2025). Furthermore, these systems repeat biases rooted in training data that limit pedagogical transparency, and are unable to verify factual accuracy, necessitating strict human review and AI literacy among users (Yusuf et al., 2024).

The most pressing institutional crisis concerns academic integrity. The ability of LLMs to produce high-quality academic prose undermines traditional assessments—essays, take-home exams, and research papers—while detection tools remain unreliable and vulnerable to false positives. Constructive responses have progressed beyond prohibition to assessment redesign for the AI era, distinguishing between knowledge evaluations (which can be AI-integrated) and developmental skill-building (where AI assistance may undermine learning objectives) (Tariq, 2025). This implies shifting from product-oriented to process-oriented assessment (evaluating drafts, reflections, and demonstrations of thinking) and explicitly incorporating AI use into assignments that require students to criticise or improve on generated content. Finally, this crisis requires a rethinking of higher education's purpose: if Generative AI can replicate standard academic formats, the value of those formats must shift to developing capacities that AI cannot replicate—critical judgement, original synthesis, ethical reasoning. Table 1 illustrates the fundamental paradox of Generative AI in higher education.

Table 1. The paradox of generative AI in higher education

Dimension	*Transformative Potential*	*Critical Risk*
Cognitive Support	Democratization of personalized tutoring and writing assistance	"Cognitive debt" from over-reliance; erosion of independent problem-solving
Content Creation	Automated generation of adaptive learning materials and assessments	Hallucinations and bias amplification; opacity undermining educational trust
Accessibility	Language translation and disability accommodation at scale	Uneven access creating new digital divides; false confidence in AI-mediated communication
Assessment	Efficiency in grading and feedback workflows	Collapse of traditional integrity frameworks; inability to verify authentic learning
Pedagogical Role	Frees educators for high-order mentoring and dialogue	Threat to professional identity; deskilling of instructional expertise

Ultimately, academic integrity in the age of generative AI cannot be enforced through surveillance alone but must be cultivated through pedagogical practices that emphasize authentic learning and the development of capabilities that emerge from genuine intellectual struggle and human interaction.

Agent AI: From Assistance to Action

Agent AI is a significant step forward from generative AI, as it includes autonomous action within defined parameters. While generative AI systems generate outputs in response to prompts, agent AI systems are designed to perform out particular, goal-directed tasks on behalf of users (Bandi et al., 2025). The defining

feature of Agent AI is its focus on task completion through action rather than content generation through response. Technically, these systems typically include a large language model (LLM) as a reasoning core, as well as tool-calling capabilities that enable the model to invoke external functions and APIs such as web searching, database access, and learning management system interaction (Akerkar, 2026).

In educational contexts, Agent AI occupies a different role: it is capable of automating meaningful tasks while remaining limited enough to allow for human monitoring. Agent AI's educational applications span administrative, instructional, and research domains. In administrative settings, agents can automate student communication workflows, identify students at academic risk based on engagement data, schedule office hours, and compile assessment data for reporting, significantly reducing the administrative burden associated with faculty burnout (Schaeffer et al., 2024; Yusuf et al., 2025). Agent AI enables adaptive learning in instructional contexts that go beyond generative AI's responsive dialogue. It can track a student's progress, identify knowledge gaps, curate personalised reading lists, and manage multi-step learning pathways (Kolhatin, 2025; Córdova-Esparza, 2025). In assessment and research, agents equipped with rubric specifications can evaluate student work across multiple dimensions, provide detailed feedback, and act as research assistants (Khlaif et al., 2025).

The most useful uses of Agent AI for education are those that add to human judgement instead of replacing it. This idea is also known as "human-in-the-loop" AI. It is clear that hybrid human–AI workflows work better than fully autonomous systems, especially when it comes to tutoring and testing (Akerkar, 2026; Córdova-Esparza, 2025; Volker & Tilooby 2026; Ilieva et al., 2025). In these workflows, teachers choose prompts, check outputs, and set the pedagogical context, while agents create routines, score them, and get the data. Research on human-AI collaboration suggests several design principles applicable to education: *transparency* (users should understand what the AI is doing), *controllability* (users must be able to override actions), *calibrated trust* (accurate mental models of AI reliability), and *shared accountability* (explicit distribution of responsibility) (Israfilzade, 2025a; Israfilzade & Sadili, 2024; Vössing et al., 2022; Edwards et al., 2025; Dhanasekaran, 2025). Several models of collaboration are emerging, including the *supervision model* (humans set goals, AI executes), the *partnership model* (iterative collaboration), and the *delegation model* (humans entrust specific responsibilities), with the appropriate model depending on the stakes of the task.

However, Agent AI introduces risks that are distinct from those of generative AI, demanding careful governance. The main risk is task misspecification. When a goal is not completely specified, an agent may pursue the stated goal while violating intended values (e.g., maximising engagement by simplifying content to intellectual vacuum) (Dwivedi et al., 2025; Atre, 2026; Schaeffer et al., 2024). Accountability diffusion is a second significant risk; when agents perform tasks previously performed by humans, it is unclear who is responsible for the results. In other words, the instructor, institution, or developer—which is problematic given that accountability for student development is a core ethical responsibility. Other challenges include interpretability and trust (multi-step decisions are more difficult to explain than simple responses), error propagation (planning and tool use can amplify hallucinations) (Israfilzade, 2025a), and dependency risks (over-reliance may result in educator deskilling or student loss of independent learning capabilities).

Agentic AI: Toward Autonomous Educational Systems

Agentic AI is the framework's most advanced and conceptually challenging category, defined by systems capable of sustained autonomous operation in complex, dynamic environments. While 'Agent AI' refers to systems designed to perform defined tasks within bounded parameters, 'Agentic AI' refers to systems with a greater degree of autonomy. This ability to set their own sub-goals, engage in extended multi-step planning, monitor and reflect on their own performance, adapt strategies in response to feedback, and operate over long-time horizons with minimal human intervention (Sapkota et al., 2025; Kamalov et al., 2025). Autonomy in AI is multidimensional, encompassing *operational autonomy* (functioning without constant supervision), *cognitive autonomy* (independent reasoning and judgement), goal autonomy (forming and modifying objectives), and *learning autonomy*.

Agentic AI's ability to make decisions on its own completely changes how it interacts with people and institutions. Thanks to advances in technology like multi-modal perception, meta-learning, long-term memory, and reinforcement learning from human feedback, these systems can look at complicated situations and choose how to handle them based on criteria they create themselves (Hosseini & Seilani, 2025; Xiao & He, 2025). As a learning companion in schools, an agentic system could figure out what a student needs to learn by interacting with them on a regular basis, finding knowledge gaps, making a personalised curriculum, making practice

activities, giving feedback, and updating its model of the student's cognitive state—all without any help from a person (Katsenou et al., 2025). Potential applications span institutional and pedagogical domains: *autonomous learning companions* that track learner trajectories over semesters to support self-regulation and career planning; *multi-agent simulations and serious games* for disciplines like business and law, enabling interaction with complex socio-technical environments; and *autonomous curriculum orchestration* that reorganizes modules and assessments based on predictive analytics and labour market signals.

Agentic AI creates a completely different set of ethical and governance problems than generative or agent AI. The main problem is control: how can institutions make sure that highly autonomous systems stay in line with educational values, respond to human oversight, and are responsible for their actions (Kulaklıoğlu, 2024; Gangavarapu, 2025)? The literature on AI safety has come up with useful frameworks for this problem. These include *corrigibility* (making sure systems can be fixed by humans), *value alignment* (making sure systems pursue human-endorsed values instead of proxy objectives), and *interpretability* (making sure decisions are clear). However, turning these into institutional policy is still a big problem. It gets harder for students and teachers to understand why certain paths or decisions were made as systems become more autonomous and multi-agent (Joshi, 2025) makes them less clear. This makes it harder to be accountable for things like grading, advising, and placement. Governance must specify when and how human educators can override, audit, or constrain agentic decisions, establishing clear lines of human accountability even within automated systems.

Beyond control, Agentic AI intensifies concerns regarding *fairness, bias, and student agency* (Johnsen, 2025). If agentic AI determines educational pathways or allocates resources, any biases in these systems can have systematic and far-reaching effects, necessitating ongoing monitoring and mechanisms for redress (Adamakis & Rachiotis, 2025; Farrelly & Baker, 2023). Moreover, autonomy brings up important questions about the point of education. According to Yang et al. (2024), the educational good includes both the struggle to learn and the practice of intellectual virtue. If agentic AI improves outcomes while skipping these struggles, it may actually hurt the very goals it is meant to achieve. Agentic AI might help people learn to control their own learning, but it could also make people dependent on it in new ways or guide them in ways that go against their goals or values (Francis et al., 2025; Pineda et al., 2025). Lastly, data sovereignty and privacy are particular issues because systems that constantly model students' emotional and mental states create very private data that needs strong rules for who owns it and how it can be utilised that go beyond what FERPA and GDPR require (Chowdhury, 202125). Institutions need to plan carefully to prevent these risks by making sure that AI enhances professional development instead of replacing it and by setting up different governance frameworks that increase the need for oversight as autonomy increases.

From Generation to Autonomy: The Proposed Framework

The Continuum of AI Capabilities

The GtA Framework views AI systems in higher education not as isolated types, but as touchpoints on a multidimensional continuum of capability and autonomy. This conceptualisation recognises that real-world AI systems frequently combine elements from multiple categories, that category boundaries are porous and changing, and that the same system can manifest differently across deployment contexts. Drawing on conceptual taxonomies and educational agentic workflows, AI in higher education is modelled along this continuum to clarify how different systems interact with one another, what capabilities they possess, and what implications they have for educational practice.

On one end of the continuum, we have *Generative AI*, which is known for producing content in response to prompts without any specific objectives or lasting memory (Farrelly & Baker, 2023; Ilieva et al., 2025, Israfilzade 2025a). These systems mainly function as interactive tools, generating responses to human prompts and handing back control after each exchange. On the other end of the continuum is *Agentic AI*, which refers to multi-agent systems that are goal-oriented, adaptable to context, and equipped with persistent memory and self-directed behaviour (Sapkota et al., 2025; Kremantzis et al., 2025; Kamalov et al., 2025; Kostopoulos et al., 2025). These systems run all the time, establish their own objectives, carry out long-term plans, and need very little human involvement. *Agent AI* occupies an intermediate position: it is task-directed (receiving goals from humans) but execution-autonomous (determining its own steps to achieve those goals within defined constraints).

The move from Generative to Agentic is characterised by increasing autonomy, expanding the temporal horizon, increasing the complexity of internal goal structures, reducing the frequency of required human oversight, and

increasing the capacity for self-directed learning and adaptation. This progression emphasises not only increased technical sophistication, but also expanded implications for authorship, responsibility, and institutional control. Understanding where a system fits on this continuum is critical for making informed decisions about educational deployment, governance, and pedagogical integration.

Dimensions of Autonomy, Control, and Intelligence

The GtA Framework organizes the AI continuum along key analytical dimensions, each representing a spectrum rather than a binary distinction. Understanding where systems fall along these dimensions enables nuanced analysis of their educational implications, supporting clearer policy, risk assessment, and pedagogical design (Crompton & Burke, 2023). While systems may occupy different positions on each dimension, the framework primarily distinguishes AI capabilities along axes of autonomy, control, and intelligence, with risk emerging as a correlated outcome.

Autonomy captures the degree to which a system initiates, directs, and sustains goal-directed behaviour without human instruction, encompassing both the level of independence and the *temporal horizon* of engagement (Sposato, 2025; Terziyan et al., 2025). At the low end, Generative AI exhibits prompt-dependent autonomy, operating within single interactions with no persistent goals. Agent AI demonstrates moderate autonomy, where initiative in task specification is human-led but execution is AI-driven within bounded parameters. At the high end, Agentic AI exhibits self-directed autonomy, initiating actions, forming goals, and sustaining longitudinal engagement with learners and curricula over extended periods with minimal intervention.

Control reflects the locus and feasibility of human oversight. At *maximum control* (characteristic of Generative AI), each interaction constitutes a fresh prompt-response cycle allowing immediate direction and termination. *Supervised control* (Agent AI) involves humans defining task parameters and evaluation criteria while ceding execution autonomy over specific steps. *Delegated control* (Agentic AI) permits systems to operate on high-level objectives alone, where practical constraints limit human capacity to monitor, override, or intervene in each decision (Yang et al., 2024; An et al., 2025). This dimension intersects critically with *data and integration depth*: standalone tools permit maximum human command, whereas systems embedded in institutional LMS, student records, and administrative workflows introduce opacity that complicates oversight (Chan, 2023).

Intelligence encompasses the scope and adaptability of cognitive performance, ranging from narrow task performance to broader diagnostic and meta-cognitive cognition (Virdee & Flom, 2025). Generative AI demonstrates broad linguistic intelligence with limited reasoning depth and no meta-cognitive capacity. Agent AI adds planning and tool-use intelligence to linguistic capabilities, enabling multi-step problem solving. Agentic AI integrates meta-cognitive intelligence, including self-monitoring, self-correction, and continuous learning from interaction, allowing for adaptive responses to complex educational situations (Katsenou et al., 2025)

Finally, *Risk* serves as a critical correlated dimension, aggregating potential harms weighted by likelihood and severity (Schaeffer et al., 2024; Giudici et al., 2023). This dimension is positively correlated with autonomy: as systems gain autonomy and intelligence while human control diminishes, the consequences of misalignment, error, and misuse grow, while opportunities for human correction shrink. Positioning specific tools along these dimensions allows institutions to escalate oversight requirements corresponding to increasing autonomy, ensuring that governance frameworks remain aligned with the specific capabilities and risks of each AI category (Adamakis & Rachiotis, 2025; Sposato, 2025).

Comparative Analysis of Generative, Agent, and Agentic AI

The Generation-to-Autonomy Framework allows for a systematic comparison of generative, agent, and agentic AI across multiple dimensions relevant to educational applications. It can reveal both distinguishing features and unique challenges for each category. This comparative analysis helps decision-makers choose appropriate deployment contexts and governance approaches by highlighting how capabilities shift from content creation to autonomous action. Generative AI excels at content creation, information synthesis, and conversational interaction, but it requires human intervention for all significant applications, with the primary challenges being accuracy and academic integrity. Agent AI broadens capabilities to include task execution and sustained goal pursuit, reducing the need for continuous human oversight while operating within defined parameters, but it also introduces risks related to reliability and accountability. Agentic AI represents the highest level of capability and

autonomy, with the potential to transform educational practice through autonomous curriculum design and institutional optimisation, but it also raises significant ethical concerns and governance complexities (Kremantzis et al., 2025; Kostopoulos et al., 2025).

Table 2 systematically compares Generative, Agent, and Agentic AI along the autonomy continuum, mapping their distinctive profiles—from reactive content creation through task-bounded execution to autonomous goal-directed action—across seven dimensions including core function, memory scope, planning capacity, oversight requirements, risk levels, and educational applications.

Table 2. Comparative analysis of AI categories in higher education

Dimension	*Generative AI*	*Agent AI*	*Agentic AI*
Core Function	Content creation and synthesis (text, code, images).	Task execution and automation (tool use, API calls).	Autonomous goal-directed action (planning, reasoning, self-correction).
Autonomy Level	Low — human-initiated prompt-response.	Medium — task-bounded execution.	High — self-directed, open-ended campaigns.
Memory & Temporal Scope	Session-limited; single or short multi-turn exchanges.	Working memory per task; defined task duration.	Persistent, adaptive memory; extended iterative revision.
Planning & Decision-Making	None; probabilistic generation based on patterns.	Short-horizon planning; rule/objective-driven.	Long-horizon multi-step planning; context-driven autonomous.
User Control & Oversight	Full control; human initiates each interaction.	Supervised control; human sets task, monitors exceptions.	Delegated control; human sets goal, manages risk/accountability.
Risk Level	Low–Moderate (accuracy, integrity).	Moderate (task misspecification, accountability diffusion).	Moderate–High (value misalignment, control loss).
Educational Application	Writing, summarizing, tutoring, ideation.	Grading, advising, scheduling, research summarizing.	Curriculum design, mentoring, autonomous research assistance.
Example in HE	ChatGPT for essay drafts; Copilot for code.	Automated grading systems; AI tutoring bots.	Virtual teaching assistant guiding complex analytics projects.

Note: Real-world AI systems may exhibit hybrid characteristics or fall between categories. This framework serves as a heuristic for institutional reasoning rather than a rigid technical taxonomy.

This comparative analysis identifies several critical patterns in the evolution of AI capabilities. First, the transition from Generative to Agentic AI is qualitative rather than quantitative (more capable), shifting the fundamental human-AI relationship from tool use to partnership. Second, the risk dimension does not scale linearly. Agent AI presents qualitatively different risks, such as task misspecification and accountability diffusion. While agentic AI introduces higher-order risks such as value misalignment and control loss. Third, the control dimension is inversely related to the autonomy dimension, posing genuine governance challenges, as the systems with the greatest potential for transformative educational impact are also the most difficult to monitor and correct.

The framework emphasises that as AI systems become more autonomous, the locus of control and responsibility shifts, necessitating transformations in institutional structures. While Generative AI tools necessitate pedagogical strategies centred on source evaluation and proper citation, Agentic AI necessitates a more fundamental transformation of curricula, assessment methods, and institutional governance structures.

Implications for Higher Education

Pedagogical Transformations: Curriculum, Assessment, and AI Literacy

The GtA Framework involves a fundamental reimagining of pedagogy, from simple tool integration to a structural redesign of curriculum and assessment. The increasing number of AI systems across the capability continuum suggests that all students, regardless of discipline, develop foundational AI literacy that goes beyond technical proficiency to include a critical understanding of AI capabilities, limitations, and societal implications (Chan, 2023; Burneo-Arteaga et al., 2025). This literacy must be integrated into the curriculum rather than isolated in specialised courses, addressing key competencies such as evaluating AI outputs for accuracy and

bias, using tools ethically, and recognising boundaries of appropriate use in academic and professional contexts (Chiu, 2024; Tariq, 2025). Furthermore, courses must promote student agency, transforming students from passive users to proactive and reflective collaborators capable of exercising professional judgement about when to rely on AI outputs and when to reject them.

Concurrently, *curriculum design* must shift the emphasis from content recall to particularly human cognitive abilities. If generative AI can easily demonstrate recall, comprehension, and even analysis, learning objectives should prioritise original synthesis, contextual judgement, creative insight, ethical reasoning, and knowledge integration with lived experience (Tariq, 2025; Chiu, 2024). This includes reconsidering frameworks such as Bloom's Taxonomy in an AI-rich environment, as well as ensuring that professional and practical curriculum prepare graduates to work effectively alongside AI systems with varying levels of autonomy. Discipline-specific competencies are essential: technical fields require a deeper understanding of AI development, whereas humanities and social sciences require the ability to critically analyse AI's social and ethical implications.

Assessment and evaluation are the domains where AI's disruption is most noticeable, driving a shift from assessing items to assessing abilities. The appropriate response varies significantly depending on the AI category: for generative AI, challenges include preventing unauthorised submission of AI-generated work through redesigns that prioritise process, oral defence, and real-time performance (Ilieva et al., 2025). For agent and agentic AI, the challenge shifts to ensuring that automation does not negatively impact foundational skill development, creating a difference between formative assessments designed to develop skills and summative assessments that evaluate competency (Kamalov et al., 2025). *Process-oriented assessment* (evaluation of learning trajectories and engagement with feedback), *authentic assessment* (engagement with real-world problems that require situated judgement), and *interactive assessment* (dialogue and demonstration) are all examples of productive reframing. AI systems can help with this transformation by providing immediate feedback on routine aspects of work, allowing human reviewers to focus on higher-order qualities, as long as there are strong human supervision and bias monitoring (Ilieva et al., 2025).

Changing Institutional Roles and Differentiated Governance

The integration of AI systems across the continuum will fundamentally change the roles of educators and the nature of educational institutions, forcing an active professional and institutional response. Educators must transition from being content transmitters to *learning architects*, *mentors*, and *promoters* of human connection (Córdova-Esparza, 2025; Adamakis & Rachiotis, 2025). The unique value of human educators is not in information transmission, which AI does well at, but in mentoring, modelling intellectual virtue, facilitating the social dimensions of learning, exercising contextual pedagogical judgement, and providing the relational foundation for intellectual development (Pineda et al., 2025). To support this evolution, institutions must invest in professional development and capability building for Generative AI and agentic tools, ensuring that educators have the skills to design AI-rich learning environments and guide ethical AI use (Burneo-Arteaga et al., 2025; Sposato, 2025).

Institutions face a similar challenge when redefining their value proposition. If AI can increasingly perform functions that were previously performed by human faculty and staff, universities' unique institutional value must be articulated around dimensions that are inherently social, credentialing, and formative: the experience of intellectual community, the transformation of identity that comes with sustained academic engagement, and the research mission that generates truly new knowledge. Institutions must evolve into managers of AI infrastructures, responsible for protecting academic values while enabling innovation, ensuring equitable access to tools, and protecting student privacy and data rights (Francis et al., 2025; Symeou et al., 2025; An et al., 2025).

To address the diverse challenges presented by AI systems across the capability continuum, *effective governance and policy must differ.* Governance frameworks that treat all AI uniformly risk being either overly restrictive (preventing beneficial uses of lower-risk generative AI) or insufficiently restrictive (failing to protect against higher-risk agentic AI). A differentiated approach involves creating distinct policy frameworks for each category, with increasing autonomy leading to increased oversight requirements (Kulaklıoğlu, 2024). Policies for generative AI emphasise transparency and academic integrity; for agent AI, they include human review of outputs and audit mechanisms; and for agentic AI, governance requires institutional-level ethical review, ongoing monitoring, explicit human override mechanisms, and regular review by multidisciplinary ethics committees (Kostopoulos et al., 2025). Furthermore, governance structures must include diverse perspectives (educators, students, and administrators), establish clear accountability, and be adaptable enough to

accommodate rapid technological change and varying international regulatory environments (Chan, 2023; An et al., 2025). Table 3 shows governance framework that increases control requirements proportionally with AI autonomy, progressing from course-level academic integrity protocols for Generative AI to departmental audit mechanisms for Agent AI, and finally to institutional ethics committees and strategic oversight for Agency AI.

Table 3. Differentiated governance requirements across the AI continuum

Governance Dimension	*Generative AI*	*Agent AI*	*Agentic AI*
Primary Focus	Transparency, Academic Integrity, Disclosure.	Human Review, Audit Mechanisms, Accountability.	Ethical Review, Oversight, Override Mechanisms.
Oversight Level	Course/Faculty Level Guidance.	Departmental/Operational Monitoring.	Institutional/Strategic Ethics Committees.
Risk Management	Bias Monitoring, Output Validation.	Task Misspecification, Error Propagation.	Value Alignment, Control Loss, Data Sovereignty.
Policy Requirement	Acceptable Use Policies, Citation Standards.	Procurement Criteria, Vendor Management.	International Compliance, Data Governance Frameworks.
Human Role	Tool operator and validator	Task supervisor and quality controller	Strategic goal-setter with override authority
Review Mechanism	Faculty guidance and syllabi policies	Periodic audit of automated workflows	Standing ethics committee with multidisciplinary oversight

As systems progress along the continuum from reactive tools to autonomous actors, governance structures must correspondingly evolve from managing transparency and citation standards toward addressing complex risks like value misalignment, control loss, and data sovereignty. This differentiated approach recognizes that blanket AI policies—whether overly permissive or restrictively uniform—fail to address the qualitatively distinct risks each category presents, requiring calibrated oversight where human roles transition from direct operational control to strategic supervision and ethical stewardship with override authority.

Discussion

Interpretation of the Generation-to-Autonomy Framework

The GtA Framework illustrates that the differences among Generative, Agent, and Agentic AI—though often presented as separate categories—actually form a fluid continuum. In practice, real-world systems often display hybrid characteristics and evolve dynamically as architectural capabilities progress. This continuum includes not only technical aspects but also philosophical dimensions. As capabilities evolve from reactive content generation to sustained autonomy, the focus of educational challenges shifts significantly. It moves away from operational issues related to accuracy and academic integrity, leading to deeper enquiries about the purpose of education, the nature of AI-mediated knowledge, and the allocation of accountability in cognitive development.

The framework's multidimensional analysis reveals that autonomy, control, intelligence, and risk interact in a dynamic tension, rather than following a straightforward linear progression. The turning point between Agent and Agentic AI signifies a qualitative transformation rather than a quantitative one. What starts as mere tool use develops into a partnership and the possibility of delegation, ultimately reshaping the epistemic and ethical responsibilities of human educators. The effective use of AI differs across this spectrum: Generative AI works best as a targeted tool for improving productivity, which requires validation protocols. Agent AI takes on a limited responsibility for carrying out tasks, which requires thoughtful supervision and auditing processes. In contrast, Agentic AI calls for intentional and values-based consideration of the essential value of intellectual effort and the crucial role of human judgement in the formation of education.

Synthesis with Existing Literature

The GtA Framework aligns the existing analyses found in the current literature and highlights ongoing gaps that remain unaddressed. This perspective is consistent with the findings of Adamakis & Rachiotis (2025) and Sposato (2025), emphasising the importance of pedagogical integrity and differentiated governance. However, it also critiques the uniform approach to AI systems that has been common in earlier policy frameworks, as noted

by Chan (2023). The framework clarifies the difference between "AI Agents" and "Agentic AI," as discussed by Sapkota et al. (2025) and Kamalov et al. (2025). It translates these technical classifications into categories for educational governance, each with its own unique risk profiles and oversight needs.

There is a shared understanding of the transformative potential of Generative AI for enhancing accessibility and personalised learning (Francis et al., 2025; Córdova-Esparza, 2025), although the literature presents differing views on the limits of autonomy. Kostopoulos et al. (2025) and Kremantzis et al. (2025) highlight the efficiency benefits associated with agentic workflows. In contrast, Yang et al. (2024) and Pineda et al. (2025) raise concerns regarding the potential diminishing of intellectual challenge and student agency due to automation. The GtA Framework addresses this conflict by illustrating that risks increase in a non-linear manner as autonomy expands: Generative AI poses significant challenges to academic integrity, particularly through issues such as hallucinations and plagiarism (Dang & Nguyen, 2025; Yusuf et al., 2024). In contrast, Agentic AI brings forth systemic risks related to value misalignment and accountability diffusion (Dwivedi et al., 2025; Atre, 2026), highlighting the need for robust ethical infrastructure at the institutional level, which is currently lacking in existing faculty guidance models.

The framework effectively tackles an important gap related to the "human-in-the-loop" paradigm. Although the current literature supports the idea of human-AI collaboration (Vössing et al., 2022; Edwards et al., 2025), it often presumes a fixed capacity for human oversight. The GtA Framework suggests that the extended temporal scope and persistent memory of Agentic AI make continuous supervision impractical. This situation calls for a transition from traditional "supervision" to "leadership" models, where humans establish strategic constraints and ethical boundaries instead of overseeing individual decisions (Kulaklıoğlu, 2024; Gangavarapu, 2025).

Theoretical and Practical Implications

This framework invites the field to reconsider its approach to educational technology, encouraging a shift from purely instrumental definitions to relational models that recognise the emergent properties found in autonomous systems. By rethinking educational intelligence as a shared capability within human-AI networks instead of a characteristic of individual actors, this framework indicates that future pedagogical theory should consider epistemic responsibility in tasks that involve delegated cognition. This expands on constructivist learning theory by pinpointing which scaffolding functions—like immediate feedback or content generation—can be automated while still preserving the essential developmental aspects of productive struggle and the formation of intellectual virtues.

The framework requires the restructuring of institutions in a practical sense. The tiered governance model suggests that universities should create specific approval mechanisms. This includes implementing course-level academic integrity protocols for Generative AI, establishing departmental audit systems for Agent AI, and forming standing ethics committees with multidisciplinary oversight for Agentic implementations. This challenges the common approach of centralised IT policies that apply the same standards to all AI, which may be overly restrictive for low-risk Generative tools or too lenient for high-risk Agentic systems.

In the context of curriculum design, it is essential to fundamentally recalibrate the learning objectives within the framework. As Generative AI transforms the landscape of content recall and synthesis, and Agentic AI takes on more complex planning and execution tasks, it becomes essential for educational value to evolve. This evolution should focus on nurturing judgement, ethical reasoning, and contextual adaptation—skills that remain resilient against automation throughout the spectrum. Assessment practices should evolve from a focus on product-oriented evaluation to methods that prioritise process-oriented approaches, highlighting the importance of reflection, oral defence, and demonstrated metacognition.

Limitations of the Study

This conceptual framework is subject to several limitations that may affect its scope and generalisability. To begin with, this framework serves as a synthesis of the existing literature rather than an empirical investigation. It is important to note that validation through longitudinal studies is necessary to examine the actual implementations of Agentic AI across various educational contexts. The swift advancement of AI architectures indicates that the distinctions between categories are becoming increasingly flexible. Systems initially presented as Generative AI may quickly develop Agentic capabilities through the integration of tool use and memory improvements, which could render existing taxonomies outdated.

Secondly, the literature examined primarily demonstrates Western educational settings and English-language research, which may lead to cultural biases concerning acceptable degrees of automation, privacy standards, and the emphasis placed on individual versus collective learning experiences. The framework's focus on autonomy and individual learner agency might need to be adjusted for educational traditions that prioritise collectivism or in contexts where digital infrastructure varies in capacity.

Third, the framework's emphasis on functional capabilities inevitably overlooks more profound philosophical enquiries related to machine consciousness, understanding, and the experiential aspects of AI-mediated learning. Although the functional definition of educational intelligence is useful for practical governance, it may not fully encompass the experiential aspects of human-AI interaction or the nuanced ways in which algorithmic mediation influences our ways of knowing.

In conclusion, the risk assessment aspect, although rooted in the literature on AI safety, still presents uncertainties concerning its long-term effects on the formation of professional identities, the trajectories of cognitive development, and the social aspects of learning communities. The framework highlights potential risks; however, based on the current evidence, it is unable to quantify their likelihood or severity across various disciplinary contexts.

Future Research Directions

To address these limitations, future research should focus on several empirically based agendas. Longitudinal studies that monitor learner autonomy, metacognitive development, and the formation of professional identity in environments enriched by AI are crucial for understanding how ongoing interaction with Generative and Agentic systems influences human capabilities over longer periods. Research of this nature should utilise mixed-methods approaches that integrate quantitative assessments of academic performance alongside qualitative examinations of student epistemic agency and faculty professional experiences.

The empirical evaluation of Agent and Agentic AI within authentic curricula—moving beyond controlled pilot studies—should focus on assessing the real impacts on learning outcomes, educational equity, and the social dynamics of classroom communities. Cross-cultural comparative research ought to explore the diverse institutional and national perceptions surrounding AI autonomy, acceptable governance structures, and integrity standards. It is particularly important to examine how educational traditions, which have varying relationships to authority and automation, adapt these frameworks.

There is a pressing need for design research focused on developing and testing specific models of human-AI co-agency. These models should ensure that meaningful human control is preserved while effectively utilising the capabilities of machines. This involves creating interpretability interfaces for Agentic systems that make long-term planning decisions understandable for educators, as well as developing "graduated autonomy" protocols in which AI systems can earn greater decision-making authority through demonstrated reliability.

From a methodological perspective, the field necessitates the use of validated tools to measure outcomes related to AI literacy, identify instances of algorithmic over-reliance among students and faculty, and evaluate the educational effectiveness of various governance regimes. Ultimately, ongoing theoretical exploration of the normative aspects—particularly regarding what AI ought to do and refrain from in educational settings, the nature of AI-generated knowledge, and the political economy surrounding educational automation—continues to be crucial for ensuring that technological advancements support, rather than undermine, the humanistic goals of higher education.

Conclusion

This paper presents the Generation-to-Autonomy (GtA) Framework as a conceptual tool designed to help navigate the changing landscape of AI in higher education. By placing Generative, Agent, and Agentic AI on a multidimensional continuum characterised by autonomy, control, and intelligence, the framework advances beyond simplistic narratives of threats versus solution, fostering a deeper understanding of the specific risks and opportunities associated with each capability. The analysis shows that as AI systems evolve from generating reactive content to executing specific tasks and eventually engaging in autonomous goal-directed actions, the fundamental relationship between humans and AI changes—from using tools to forming partnerships and

possibly delegating responsibilities. This transformation calls for an evolution in teaching methods, assessment practices, and governance structures.

The continuum model demonstrates that standardised methods of AI governance are inherently insufficient for the context of higher education. Generative AI requires a thoughtful approach to teaching that emphasises academic integrity and focuses on assessing processes. Agent AI requires strong auditing systems and accountability measures to address potential task misalignment. Meanwhile, Agentic AI highlights the need for ethical oversight at the institutional level and clear mechanisms for human intervention to prevent value misalignment and loss of control. Across this spectrum, the invaluable role of human educators' transitions from merely conveying information to embracing mentorship, ethical guidance, and the development of critical judgment—skills that remain resistant to automation due to their foundation in ongoing human interaction and intellectual engagement.

As higher education institutions navigate this technological turning point, the GtA Framework offers a solid basis for decision-making that is sensitive to capabilities, ensuring a thoughtful balance between innovation and ethical responsibility. The shift towards autonomous educational systems is not simply harmful or entirely advantageous; instead, its effects are contingent upon how institutions create varied governance frameworks that adjust oversight according to levels of autonomy, all while maintaining the essential humanistic values of education. Future success will depend not on resisting technological advancement or accepting it without question, but on our ability to define—and defend—the boundaries between suitable enhancement and inappropriate automation in educational development.

Scientific Ethics Declaration

* The author declares that the scientific ethical and legal responsibility of this article published in EPESS journal belongs to the author

Conflict of Interest

* The author declares that there is no conflict of interest.

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References

Adamakis, M., & Rachiotis, T. (2025). Artificial intelligence in higher education: A state-of-the-art overview of pedagogical integrity, artificial intelligence literacy, and policy integration. *Encyclopedia*, *5*(4), 180. https://doi.org/10.3390/encyclopedia5040180

Aguado-García, J., Alonso-Muñoz, S., & De-Pablos-Heredero, C. (2025). Using artificial intelligence for higher education: An overview and future research avenues. *SAGE Open, 15*(2). https://doi.org/10.1177/21582440251340352

Akerkar, R. (2026). AI agents: From perception to action. In *Artificial Intelligence* (pp. 303–355). https://doi.org/10.1007/978-3-031-91084-5_8

An, Y., Yu, J., & James, S. (2025). Investigating the higher education institutions' guidelines and policies regarding the use of generative AI in teaching, learning, research, and administration. *International*

Journal of Educational Technology in Higher Education, 22. https://doi.org/10.1186/s41239-025-00507-3

Atre, S. (2026). Legal challenges of agentic AI systems in education and employment decision-making. *Indian Journal of Computer Science and Technology*, 44–47. https://doi.org/10.59256/indjcst.20260501007

Bandi, A., Kongari, B., Naguru, R., Pasnoor, S., & Vilipala, S. V. (2025). The rise of agentic AI: A review of definitions, frameworks, architectures, applications, evaluation metrics, and challenges. *Future Internet*, *17*(9), 404. https://doi.org/10.3390/fi17090404

Burneo-Arteaga, P., Lira, Y., Murzi, H., Balula, A., & Costa, A. (2025). Capability-based training framework for generative AI in higher education. *Frontiers in Education*. https://doi.org/10.3389/feduc.2025.1594199

Chan, C. (2023). A comprehensive AI policy education framework for university teaching and learning. *International Journal of Educational Technology in Higher Education*, *20.* https://doi.org/10.1186/s41239-023-00408-3

Chan, C., & Hu, W. (2023). Students' voices on generative AI: perceptions, benefits, and challenges in higher education. *International Journal of Educational Technology in Higher Education*, 20. https://doi.org/10.1186/s41239-023-00411-8

Chiu, T. (2024). Future research recommendations for transforming higher education with generative AI. *Comput. Educ. Artif. Intell.*, 6, 100197. https://doi.org/10.1016/j.caeai.2023.100197

Chowdhury, M. S. A. (2025). Student data: Privacy and security challenges. *Enhancing Student Support and Learning Through Conversational AI*, 191.

Córdova-Esparza, D. (2025). AI-powered educational agents: Opportunities, innovations, and ethical challenges. *Inf.*, 16, 469. https://doi.org/10.3390/info16060469

Coursera. (2025). *What is adaptive learning?* Retrieved February 2, 2026, from https://www.coursera.org/articles/adaptive-learning

Crompton, H., & Burke, D. (2023). Artificial intelligence in higher education: the state of the field. *International Journal of Educational Technology in Higher Education*, *20*(1). https://doi.org/10.1186/s41239-023-00392-8

Dang, C. T., & Nguyen, A. (2025). Distinguishing fact from fiction: Student traits, attitudes, and AI hallucination detection in business school assessment. *arXiv preprint arXiv:2506.00050*.

Dhanasekaran, R. (2025). AI revolutionizing education: Technology and human interaction in partnership. *Journal of Computer Science and Technology Studies*, *7*(6), 501-506.

Dwivedi, Y. K., Helal, M. Y. I., Elgendy, I. A., Alahmad, R., Walton, P., Suh, A., Singh, V., & Jeon, I. (2025). Agentic AI systems: What it is and isn't. *Global Business and Organizational Excellence*, *45*(3), 253–263. https://doi.org/10.1002/joe.70018

Edwards, J., Nguyen, A., Lämsä, J., Sobocinski, M., Whitehead, R., Dang, B., ... & Järvelä, S. (2025). Human-AI collaboration: Designing artificial agents to facilitate socially shared regulation among learners. *British Journal of Educational Technology*, *56*(2), 712-733.

Elgeddawy, Y. G. A. (2026). Human–AI collaboration models in supply chain decision-making. *International Journal of Scientific Research in Science Engineering and Technology*, *13*(1), 183–198. https://doi.org/10.32628/ijsrset2613110

Fahimirad, M., & Kotamjani, S. S. (2018). A review on Application of Artificial intelligence in teaching and learning in educational contexts. *International Journal of Learning and Development*, *8*(4), 106. https://doi.org/10.5296/ijld.v8i4.14057

Farrelly, T., & Baker, N. (2023). Generative artificial intelligence: Implications and considerations for higher education practice. *Education Sciences*. https://doi.org/10.3390/educsci13111109

Francis, N. J., Jones, S., & Smith, D. P. (2025). Generative AI in higher education: Balancing innovation and integrity. *British Journal of Biomedical Science*, *81*, 14048. https://doi.org/10.3389/bjbs.2024.14048

Gangavarapu, R. (2025). AI governance: Preparing for the rise of agentic AI. In *Mastering AI Governance* (pp. 111–119). https://doi.org/10.1007/978-3-031-93681-4_12

Giudici, P., Centurelli, M., & Turchetta, S. (2023). Artificial intelligence risk measurement. *Expert Systems With Applications*, *235*, 121220. https://doi.org/10.1016/j.eswa.2023.121220

Hosseini, S., & Seilani, H. (2025). The role of agentic AI in shaping a smart future: A systematic review. *Array*, *26*, 100399. https://doi.org/10.1016/j.array.2025.100399

Ilieva, G., Yankova, T., Ruseva, M., & Kabaivanov, S. (2025). A framework for generative AI-driven assessment in higher education. *Inf.*, *16*, 472. https://doi.org/10.3390/info16060472

Israfilzade, K. (2025a). AI-generated versus human-created advertising: Effects on consumer trust and purchase intent. *Equilibrium Quarterly Journal of Economics and Economic Policy*, *20*(4), 1301–1337. https://doi.org/10.24136/eq.4038

Israfilzade, K. (2025b). Perspective chapter: The impact of generative AI in shaping customer engagement – humanising conversational marketing. In *Business, management and economics*. https://doi.org/10.5772/intechopen.1010894

Israfilzade, K., & Sadili, N. (2024). Beyond interaction: Generative AI in conversational marketing - foundations, developments, and future directions. *Journal of Life Economics*, *11*(1), 13–29. https://doi.org/10.15637/jlecon.2294

Israfilzade, K., & Sadili, N. (2025). Beyond traditional AI: How generative models are transforming E-commerce ecosystems. *2025 IEEE 19th International Conference on Application of Information and Communication Technologies (AICT)*, 1-6. https://doi.org/10.1109/aict67988.2025.11268660

Jayaram, Y., Sundar, D., & Bhat, J. (2024). Generative AI governance & secure content automation in higher education. *International Journal of Artificial Intelligence, Data Science, and Machine Learning*, *5*(4), 163-174.

Johnsen, M. (2025). *Agentic AI*. Maria Johnsen.

Joshi, S. (2025). Framework for government policy on agentic and generative AI: Governance, regulation, and risk management. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.5511060

Kamalov, F., Calonge, D., Smail, L., Azizov, D., Thadani, D., Kwong, T., & Atif, A. (2025). Evolution of AI in education: agentic workflows. *ArXiv*, abs/2504.20082. https://doi.org/10.48550/arxiv.2504.20082

Katsenou, R., Kotsidis, K., Papadopoulou, A., Anastasiadis, P., & Deliyannis, I. (2025). Beyond assistance: Embracing AI as a collaborative Co-Agent in education. *Education Sciences*, *15*(8), 1006. https://doi.org/10.3390/educsci15081006

Khlaif, Z. N., Alkouk, W. A., Salama, N., & Eideh, B. A. (2025). Redesigning assessments for AI-enhanced learning: A framework for educators in the Generative AI era. *Education Sciences*, *15*(2), 174. https://doi.org/10.3390/educsci15020174

Kolhatin, A. O. (2025). From automation to augmentation: a human-centered framework for generative AI in adaptive educational content creation. In *CEUR Workshop Proceedings* (Vol. 4060, pp. 143-195).

Kostopoulos, G., Gkamas, V., Rigou, M., & Kotsiantis, S. (2025). Agentic AI in education: State of the art and future directions. *IEEE Access*, 13, 177467-177491. https://doi.org/10.1109/access.2025.3620473

Kremantzis, M., Essien, A., Pantano, E., & Lythreatis, S. (2025). Uncovering the Generative AI (GenAI) to agentic AI (AgAI) shift for business school education. *Journal of Global Information Management*. https://doi.org/10.4018/jgim.389920

Kulaklıoğlu, D. (2024). Ethical AI in autonomous systems and decision-making. *Human Computer Interaction*. https://doi.org/10.62802/jb2ptt89

Noviandy, T. R., Maulana, A., Idroes, G. M., Zahriah, Z., Paristiowati, M., Emran, T. B., Ilyas, M., & Idroes, R. (2024). Embrace, don't avoid: reimagining higher education with generative artificial intelligence. *Journal of Educational Management and Learning*, *2*(2), 81–90. https://doi.org/10.60084/jeml.v2i2.233

Oyenuga, M. O. (2026). Artificial intelligence and academic-based writing pedagogy. In *Leveraging AI for Future-Ready Writing Education* (pp. 1-30). IGI Global Scientific Publishing.

Pilelienė, L., & Bogoyavlenska, Y. (2025). Artificial intelligence in influencer marketing: Current researchscape, trends and insights from a bibliometric review. *Equilibrium Quarterly Journal of Economics and Economic Policy*, *20*(2), 583–611. https://doi.org/10.24136/eq.3783

Pineda, R., Novillo, B., Villamar, M., Cañizares, J., & Castro, K. (2025). Inteligencia artificial en educación: innovación radical para personalizar el aprendizaje y potenciar la autonomía estudiantil. *Multidisciplinary Journal of Sciences, Discoveries, and Society*. https://doi.org/10.71068/45yja104

Plate, D., & Hutson, J. (2025). *Beyond code: Redefining programming education beyond STEM*. CRC Press.

Sapkota, R., Roumeliotis, K., & Karkee, M. (2025). AI agents vs. agentic AI: A conceptual taxonomy, applications and challenges. *Inf. Fusion*, 126, 103599. https://doi.org/10.1016/j.inffus.2025.103599

Schaeffer, D., Coombs, L., Luckett, J., Marin, M., & Olson, P. (2024). Risks of AI applications used in higher education. *The Electronic Journal of e-Learning*, *22*(6), 60–65. https://doi.org/10.34190/ejel.22.6.3457

Sposato, M. (2025). Artificial intelligence in educational leadership: a comprehensive taxonomy and future directions. *International Journal of Educational Technology in Higher Education*, 22. https://doi.org/10.1186/s41239-025-00517-1

Sritriratanarak, W., & Garcia, P. (2023). On a functional definition of intelligence. *arXiv (Cornell University)*. https://doi.org/10.48550/arxiv.2312.09546

Symeou, L., Louca, L., Kavadella, A., Mackay, J., Danidou, Y., & Raffay, V. (2025). Development of evidence-based guidelines for the integration of generative AI in university education through a multidisciplinary, consensus-based approach. *European Journal of Dental Education*, 29, 285 - 303. https://doi.org/10.1111/eje.13069

Tariq, M. U. (2025). AI-Driven curriculum design in higher education. In *Advances in computational intelligence and robotics book series* (pp. 21–46). https://doi.org/10.4018/979-8-3373-2752-5.ch002

Terziyan, V., Tiihonen, T., Shukla, A. K., Gryshko, S., Golovianko, M., Terziyan, O., & Vitko, O. (2025). Towards ethical evolution: responsible autonomy of artificial intelligence across generations. *AI And Ethics*, *5*(5), 5165–5190. https://doi.org/10.1007/s43681-025-00759-9

Virdee, T., & Flom, A. (2025). AI taxonomies and emergent issues in intelligence. In *Edward Elgar Publishing eBooks* (pp. 834–896). https://doi.org/10.4337/9781035334353.00048

Volker, J., & Tilooby, A. (2026). Generative AI-augmented human judgment: a task-technology fit perspective. *Journal of Information Systems Education*, *37*(1), 151–166. https://doi.org/10.62273/stsp3767

Vössing, M., Kühl, N., Lind, M., & Satzger, G. (2022). Designing transparency for effective Human-AI collaboration. *Information Systems Frontiers*, *24*(3), 877–895. https://doi.org/10.1007/s10796-022-10284-3

Xiao, K., & He, Y. (2025). Adaptive AI agent systems for personalized learning: frameworks, algorithms, and practical applications in education. In *2025 5th International Conference on Artificial Intelligence and Education (ICAIE)* (pp. 108-112). IEEE.

Yang, Y., Luo, J., Yang, M., Yang, R., & Chen, J. (2024). From surface to deep learning approaches with Generative AI in higher education: an analytical framework of student agency. *Studies in Higher Education*, 49, 817 - 830. https://doi.org/10.1080/03075079.2024.2327003

Yusuf, A., Pervin, N., & Román-González, M. (2024). Generative AI and the future of higher education: a threat to academic integrity or reformation? Evidence from multicultural perspectives. *International Journal of Educational Technology in Higher Education*, *21,* 1-29. https://doi.org/10.1186/s41239-024-00453-6

Yusuf, H., Money, A., & Daylamani-Zad, D. (2025). Pedagogical AI conversational agents in higher education: a conceptual framework and survey of the state of the art. *Educational Technology Research and Development*, *73*(2), 815–874. https://doi.org/10.1007/s11423-025-10447-4

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