

Collaborative instructional design for integrating generative AI into case-based learning: Faculty guide and student support package in STEM programmes

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Abstract

This paper addresses the challenge of integrating generative AI (GAI) tools into case-based learning in STEM programmes by translating general debates on opportunities and risks into actionable instructional resources. Within an Educational Innovation Project at Universitat Politècnica de València, two complementary tools were collaboratively designed: a faculty guide, including a structured planning template for GAI-mediated case activities, and a student support package consisting of a 10-minute video and written guidelines for responsible GAI use. The results detail legitimate pedagogical uses of GAI, associated risks and mitigation strategies, and a step-by-step workflow that positions AI as a support for exploration, alternative generation and reflective validation rather than as a shortcut to solutions. The conclusions highlight the transferability of these resources across STEM contexts and their potential to safeguard the pedagogical value of the case method while fostering critical, transparent and collaborative AI practices in Higher Education.

Keywords: Generative AI; Case-based learning; Instructional design; Higher education; Collaborative design; Active learning.

1. Introduction

Generative artificial intelligence (GAI) has rapidly moved from experimental technology to a pervasive presence in society, reshaping how information is produced, accessed, and processed (Bommarito et al., 2023). The academic debate has reacted swiftly to examine the impact of GAI (Khosravi et al., 2023), identifying both the benefits and the risks associated with its general use (Sohail et al., 2023) and, more specifically, within the framework of Higher Education (Crompton & Burke, 2023). Recent works have also proposed ethical and

policy-oriented frameworks to guide the use of GAI in higher education, highlighting core principles such as transparency, academic integrity and critical engagement (Nguyen, 2025; Batista et al., 2024). The incorporation of AI into educational processes is set to profoundly transform teaching-learning models by opening new opportunities that enhance both the instructional role and the students' overall formative experience, yet there is still limited guidance on how these principles can be operationalised within specific active learning methodologies such as case-based learning in STEM programmes. In this context, the integration of GAI tools in the classroom emerges as an unavoidable challenge for faculty, who must progressively incorporate them until they are fully embedded within current teaching methods (Walter, 2024).

GAI potential is particularly visible in disciplines within the STEM area, where GAI tools could be increasingly incorporated into knowledge-intensive tasks such as problem-solving, report writing and data analysis. While these tools offer new possibilities for personalizing learning trajectories, providing immediate feedback and fostering digital competencies, they also raise concerns about superficial copying, loss of critical thinking and excessive cognitive delegation to the machine especially when used in active learning environments (Muñoz Martínez et al., 2025) and student assessment (Luckin, 2017). Within case-based learning, a widely used active methodology in STEM education, the tension is especially acute: if students rely on GAI to generate ready-made analyses and solutions, the core pedagogical value of grappling with complex, ambiguous situations may be undermined.

The case method has long been recognized as a powerful pedagogical strategy for fostering transversal competencies central to higher education, including critical thinking, active participation and collaborative learning. By inviting students to analyse realistic situations, discuss alternatives and justify decisions, case-based learning nurtures abilities such as argumentation, judgement, teamwork and communication (Pérez-Escoda & Aneas Álvarez, 2014). Thus, recent advances in GAI introduce a double-edged potential in this context: on the one hand, they can support deeper engagement by offering immediate and personalized feedback, helping students to organize information and explore multiple perspectives. On the other hand, if used uncritically, these tools may erode precisely those competencies the case method seeks to develop, by encouraging unreflective copying, homogenizing responses, weakening group interaction and making it harder to distinguish between students' own contributions and AI-assisted outputs. This tension points to the need for a deliberate, reflective and collaborative approach to instructional design that frames GAI as a tool for analysis and reflection rather than as a shortcut to answers, explicitly addressing both opportunities and threats.

In this context, a two-year (2025 to 2027) Educational Innovation Project at Universitat Politècnica de València (UPV) was conceived to integrate GAI tools into case analysis during classroom practices across several STEM undergraduate and master's programmes, while

preserving and strengthening the pedagogical foundations of the case method. In a previous phase of the project, preliminary qualitative work with lecturers in these programmes identified recurrent concerns about how to guide students towards responsible, critical use of GAI and how to redesign case-based sessions so that AI supports, rather than replaces, dialogic reasoning and collaborative problem-solving. At the same time, lecturers expressed a need for specific, adaptable resources to help them plan and facilitate these redesigned activities, as well as for materials that could convey clear expectations and boundaries to students. Against this backdrop, in the current phase, the project team set out to develop two complementary resources: a faculty guide that articulates pedagogical principles, opportunities, threats and a structured planning template for integrating GAI into case-based learning, and a student-facing support package, including a 10-minute video and written guidelines, aimed at promoting responsible, transparent and reflective use of AI during classroom cases while ensuring effective learning. Thus, the objective of this paper is the presentation of a comprehensive faculty guide and student support package for the ethical integration of GAI into case-based learning environments across higher education. The production of these resources allows the transition towards the integration of GAI tools into the case method to be brought down to the operational level.

2. Methodology

The instructional resources were developed within an Educational Innovation Project at the UPV, involving 8 lecturers from several undergraduate and master's programmes in engineering and related STEM fields.

The collaborative instructional design aligns with relationship-centred instructional design models in higher education, where faculty take an active role as designers while working iteratively with colleagues and other stakeholders to shape learning resources (Drysdale, 2019). Rather than pursuing fully symmetrical co-design, our approach reflects what recent literature describes as collaborative and context-sensitive co-design practices in university settings, in which a smaller group leads the development of artefacts and a wider community contributes through cycles of review, critique and refinement (Zeivots, et al., 2025).

Thus, the methodology applied consisted of the following stages:

Stage 1. INITIAL DESIGN. Two core members of the team, responsible of the Work Package, led the conceptualization and drafting of a faculty guide for integrating GAI into case-based learning, together with a student support package consisting of a 10-minute video structure and written guidelines for responsible AI use in classroom case activities. This stage was grounded in a dual-approach synthesis, combining academic theory with institutional insights: a review of recent research focusing on GAI in higher education, active learning methodologies, and case-based pedagogy was completed with an interpretative diagnosis derived from a focal group

of institutional lecturers, offering concrete qualitative information. The internal research identified the specific opportunities and tensions surrounding GAI integration within the classroom.

Stage 2. ITERATIVE REVIEW AND REFINEMENT. The Educational Innovation Project team participated in iterative validation and refinement cycles. Draft versions of the guide, the planning template for case-based activities and the video script were circulated among colleagues, who provided written comments, suggested clarifications, and contributed discipline-specific examples from their STEM courses. Feedback was discussed in coordination meetings and systematically incorporated into subsequent versions, with particular attention to ensuring that the proposed structures were feasible in diverse classroom formats (large groups, mixed lecture–practice formats) and adaptable to different case types.

The final versions of the guide and student package thus reflect a design collaboratively validated across multiple STEM contexts, ensuring both adaptability to different courses and internal consistency in its educational logic.

3. Results

3.1. Faculty guide: Conceptual framework and structured planning template

The guide is organised into four main sections. First, an introduction situates GAI within broader transformations in higher education and the labour market, emphasising its growing presence in knowledge-intensive work and the need for universities to prepare students for its critical and responsible use. Second, a concise overview revisits the case method as an active learning strategy that promotes transversal competencies such as critical thinking, active participation and collaborative learning, drawing on prior work in higher education pedagogy. Third, a conceptual section examines the specific opportunities and threats that GAI introduces when embedded in case-based activities.

The opportunities section identifies pedagogically valuable uses of GAI that can be aligned with the learning goals of case-based teaching. Table 1 summarises three families of “legitimate uses” emphasised in the guide.

Table 1. Pedagogically legitimate uses of GAI in case-based learning and associated competencies.
Source: own elaboration.

Use	Description	Main competencies developed
Exploration and structuring	Using AI for Clarifying concepts, summarising texts, generating analysis questions, organising and mapping ideas.	Autonomous learning, information management.
Generation of alternatives	Brainstorming solution options, asking AI for counterarguments or weaknesses in a draft analysis.	Critical thinking, creativity.
Reflection and validation	Iteratively questioning AI outputs, identifying assumptions and biases, contrasting with one's own reasoning.	Metacognition, self-regulation, epistemic vigilance.

The guide explicitly encourages lecturers to frame these uses as prompts for deeper thinking so that GAI supports, rather than replaces, students' analytic work. In parallel, the threats section articulates six risks observed in the literature and in local diagnostic work (focus groups): unreflective copy-and-paste of AI output, erosion of analytical and argumentative skills, fragmentation of collaborative learning dynamics, increasing dependence and cognitive passivity, homogenisation of responses and reduced originality, and growing difficulty in distinguishing between students' genuine contribution and AI-assisted text for assessment purposes. For each threat, the guide proposes pedagogical mitigation strategies, such as requiring explicit documentation of AI use, designing open-ended questions that cannot be resolved by factual retrieval alone, and foregrounding peer discussion and justification of positions during case debriefings.

Finally, as last section, the structured planning template constitutes the core practical component of the guide and spans the full cycle of a case-based session with GAI. It first prompts lecturers to define a clear overall objective and a set of specific learning outcomes using action verbs aligned with both disciplinary and transversal competencies (e.g., analyse, justify, argue, evaluate), making explicit how AI will contribute to achieving them. Lecturers are then guided to select and justify the GAI tool to be used (e.g., access conditions, technical requirements, need for prior training) and to outline the temporal structure of the session, typically including: (1) introduction and presentation of the case; (2) identification of key questions or problems to be addressed; (3) joint viewing of the student video on responsible AI use; (4) small-group work in which students iteratively design prompts, consult AI, critically review outputs and refine their reasoning; (5) whole-class sharing and comparison of solutions; and (6) final reflection on both the case and the role of AI in the analysis. The template also requires lecturers to decide how learning will be assessed (e.g., short post-test, rubric-based observation, analysis of artefacts) and how evidence about the experience with AI will be collected for future improvement, in line with the broader evaluation plan of the project. Although the template provides a detailed scaffold, it is explicitly presented as adaptable:

lecturers in different courses are encouraged to modify examples, timing and assessment strategies to fit their disciplinary cases and class formats, while keeping the underlying principles of critical, transparent and collaborative use of GAI intact.

3.2. Student support package: Video and guidelines

This package (available at: <https://grem.upv.es/Grem/index.php?v=5150-8kY9MzyxAzACA74hovIz21>), consists of a 10-minute educational video and a brief set of written instructions, both validated by lecturers from the participating programmes and explicitly aligned with the faculty guide and planning template. The pedagogical rationale for using video is threefold: it provides a homogeneous message for all groups and courses, it is easily reusable across semesters and subjects, and it offers a multimodal format that allows modelling of good and bad practices through concrete examples, which is particularly useful when addressing abstract issues such as ethical use, critical thinking and transparency. The central message of the video is that GAI should be understood as a tool for analysis and reflection, not as a substitute for students' intellectual work or as an automatic solution provider.

The structure of the video follows a sequence intended to balance empowerment and responsibility. In the introductory section, the video demystifies GAI by presenting it as one more tool in students' learning repertoire, clarifying that its value depends on how it is used and that the aim of the course is to help them learn to use it critically rather than to forbid it. The "what you can do" section connects directly with the opportunities identified in the faculty guide, showing concrete examples of how AI can be used to clarify concepts, summarise texts, generate questions and organise ideas, or to brainstorm alternative solutions and obtain constructive critique on draft analyses. The "what you must not do" section makes explicit the main prohibitions and risks highlighted in the diagnostic phase and literature—copying AI outputs without processing them, presenting AI text as one's own, relying on unverified data, or letting AI replace personal reasoning—explaining both the ethical implications (e.g., plagiarism, academic dishonesty, biases) and the pedagogical loss in terms of missed learning opportunities.

Subsequent sections focus on practical technique and process by introducing a simple four-element model for prompts—context, specific task, desired format and validation questions—. The recommended workflow translates this into a reproducible six-step sequence: (1) reading the case completely without AI; (2) formulating initial questions and tentative answers individually or in group; (3) using AI to broaden information or perspectives while applying the four-element prompt model; (4) comparing AI responses with the group's initial reasoning; (5) drafting a personal or group solution in one's own words; and (6) documenting briefly how. The video also highlights situations in which AI should not be used, such as high-stakes ethical dilemmas, unverifiable information or tasks that explicitly require unaided

performance, thereby reinforcing that transparency and academic integrity take precedence over technological convenience.

The written guide accompanying the video is a short document that students can consult before and during case-based sessions, organised around four central ideas: explaining the purpose of using GAI, clearly distinguishing which uses are acceptable and which are not, providing concrete examples of prompts and practices aligned with deep analysis, and reminding students of key principles of academic integrity, source verification and critical reflection. Rather than offering a generic checklist, the guide presents rules such as “you may use AI to...” / “you must not use AI to...”, each accompanied by more appropriate alternatives, proposes a simple formula for transparently documenting how AI has been used in assignments, and repeatedly stresses that the goal is to “think better with AI” rather than “think less thanks to AI”, so that, although it has been built from STEM examples, it applies to common academic practices across disciplines. These student materials are explicitly integrated as one step within the faculty planning template, rather than as stand-alone resources, thereby ensuring coherence between the guidance students receive and the pedagogical structure of the case-based sessions.

4. Conclusions

This paper presents a specific, classroom-ready response to the current transition towards pervasive GAI in higher education, by translating abstract debates on opportunities and risks into an operational faculty guide and a student support package specifically tailored to case-based learning in STEM programmes. In doing so, it helps institutions move beyond generic recommendations and offers lecturers a structured planning template and shared language to orchestrate critical, transparent and collaborative uses of GAI during case activities, rather than leaving its integration to ad-hoc, individual decisions. The proposed resources also contribute to safeguarding the pedagogical value of the case method at a time when cognitive delegation to AI tools is becoming increasingly easy. By explicitly framing GAI as a tool for exploration, generation of alternatives and reflective validation, and by making students’ use of AI visible and discussable in class, the guide and student package support the development of critical thinking, metacognition and collaborative problem-solving instead of their erosion.

From an institutional standpoint, the collaborative design process followed illustrates a scalable model for developing shared resources that are both theoretically grounded and sensitive to local constraints across different STEM subjects and course formats. Rather than prescribing a single way of “doing AI in the classroom”, the guide and template are deliberately adaptable, enabling lecturers to align AI-mediated case practices with their own disciplinary outcomes while maintaining common principles of ethical and responsible use.

The next step within the project will be to measure the impact of the guided integration of GAI into case-based practices on the teaching and learning process through a mixed-methods design.

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References

- Batista, J., Mesquita, A., & Carnaz, G. (2024). Generative AI and higher education: Trends, challenges, and future directions from a systematic literature review. *Information*, 15(11), 676. <https://doi.org/10.3390/info15110676>
- Bommarito, J., Bommarito, M., Katz, D. M., & Katz, J. (2023). *GPT as Knowledge Worker: A Zero-Shot Evaluation of (AI) CPA Capabilities*. arXiv preprint. <https://doi.org/10.48550/arXiv.2301.04408>
- 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), 1-22. <https://doi.org/10.1186/s41239-023-00392-8>
- Drysdale, J. (2019). The collaborative mapping model: Relationship-centered instructional design for higher education. *Online Learning*, 23(3), 56-71. <https://doi.org/10.24059/olj.v23i3.2058>
- Khosravi, H., Shafie, M. R., Hajiabadi, M., Raihan, A. S., & Ahmed, I. (2023). *Chatbots and ChatGPT: A Bibliometric Analysis and Systematic Review of Publications in Web of Science and Scopus Databases*. arXiv preprint. <https://doi.org/10.48550/arXiv.2304.05436>
- Luckin, R. (2017). Towards artificial intelligence-based assessment systems. *Nature Human Behaviour*, 1, 0028. <https://doi.org/10.1038/s41562-016-0028>
- Muñoz Martínez, C., Roger-Monzo, V., & Castelló-Sirvent, F. (2025). Generative AI and critical thinking in online higher education: challenges and opportunities. *RIED-Revista Iberoamericana de Educación a Distancia*, 28(2), 233-273. <https://doi.org/10.5944/ried.28.2.43556>
- Nguyen, K. V. (2025). The use of generative AI tools in higher education: Ethical and pedagogical principles. *Journal of Academic Ethics*, 23, 1435–1455. <https://doi.org/10.1007/s10805-025-09607-1>
- Pérez-Escoda, N., & Aneas Álvarez, A. (2014). La metodología del caso: un poco de historia. En N. Pérez-Escoda (coord.), *Metodología del caso en orientación* (pp. 8-13). Barcelona: Universitat de Barcelona (Institut de Ciències de l'Educació).
- Sohail, S. S., Farhat, F., Himeur, Y., Nadeem, M., Madsen, D. Ø., Singh, Y. & Mansoor, W. (2023). The Future of GPT: A Taxonomy of Existing ChatGPT Research, Current Challenges, and Possible Future Directions. *Journal of King Saud University – Computer and Information Sciences*, 35, 101675. <https://doi.org/10.1016/j.jksuci.2023.101675>
- Walter, Y. (2024). Embracing the future of Artificial Intelligence in the classroom: the relevance of AI literacy, prompt engineering, and critical thinking in modern education. *International*

Journal of Educational Technology in Higher Education, 21, article 15.
<https://doi.org/10.1186/s41239-024-00448-3>

Zeivots, S., Hopwood, N., Wardak, D., & Cram, A. (2025). Co-design practice in higher education: practice theory insights into collaborative curriculum development. *Higher Education Research & Development*, 44(3), 769–783.
<https://doi.org/10.1080/07294360.2024.2410269>

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