Available on: https://gjefm.ep-journals.org/ E-ISSN: 3117-6771, P-ISSN: 3117-6763

Global Journal of Education, Finance and Management

Volume: 02 Issue: 11 November 2026

Developing Students' AI Competence through AI-supported Learning Activities

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Published Date: November 25, 2026 **DOI: 10.65150/EP-gjefm/V2E11/2026-07**

ABSTRACT: As artificial intelligence becomes increasingly embedded in higher education, developing students' AI competence is an urgent requirement to enhance learning effectiveness, critical thinking and academic integrity. This paper addresses three key issues: the components of students' AI competence, the design of AI-supported learning activities, and the initial effects of AI integration in learning. The findings identify five components of AI competence, including AI awareness, tool-use skills, prompt-writing skills, critical evaluation and verification, and academic responsibility. Descriptive comparisons from a previously reported institutional experiment show higher cognitive-test scores, on-time task completion and learning interaction in AI-supported lessons, without establishing causal effects or validating the proposed AI competence framework. The paper recommends establishing clear AI-use guidelines, designing controlled AI-supported learning tasks, and strengthening students' academic responsibility in the use of AI.

KEYWORDS: AI competence, AI-supported learning, artificial intelligence in education, higher education, academic integrity.

1. INTRODUCTION

Artificial intelligence (AI) is increasingly used in university learning to summarize documents, suggest outlines, explain concepts, generate revision questions and assist with drafting. AI creates opportunities for personalized learning, greater autonomy and support beyond classroom hours. Nevertheless, without appropriate guidance, students may become dependent on these tools, reproduce outputs uncritically, neglect scholarly sources and weaken their independent reasoning. Research highlights both the potential of AI to support learning and the associated challenges of accuracy, critical thinking, ethics and academic integrity (Holmes et al., 2019; Miao & Holmes, 2023). The central issue is therefore neither an absolute prohibition of AI nor unrestricted access, but rather guidance that enables students to use AI effectively, transparently and responsibly. UNESCO's AI competency framework for students emphasizes a human-centred mindset, AI ethics, technical understanding and the application of AI in learning (Miao et al., 2024). Accordingly, this paper identifies the components of students' AI competence, discusses the design of AI-supported learning activities and examines early evidence on their effectiveness in higher education. An important analytical distinction is that access to AI does not in itself constitute AI competence. The availability of a generative AI application may increase the speed with which students produce text, but competence concerns whether they can formulate a defensible learning purpose, evaluate the system's output and account for the resulting academic work. Consequently, training should address both instrumental skills and the judgement required to use those skills. This distinction is especially relevant to assignments that assess explanation, reasoning, problem-solving and evidence-based argument rather than the presentation quality of a final document.

The present article therefore makes a conceptual and pedagogical contribution, rather than reporting a new intervention undertaken by its author. It develops an operational interpretation of AI competence and connects that interpretation with activity design and observable learning behaviours. Descriptive data from the institutional project reported by Tran (2026) are used as contextual evidence, not as a representative measure of students' AI competence or proof that a particular AI-supported instructional procedure produces better learning outcomes.

2. RESEARCH CONTENT

2.1. Conceptual foundations of students' AI competence

Students' AI competence can be understood as the ability to understand, use, evaluate and regulate the use of artificial intelligence tools in learning appropriately, safely and responsibly. It should not be equated with the ability to program AI or develop AI algorithms. Particularly for students outside computer science, it primarily involves understanding what AI is, how it can support learning, where its outputs may be inaccurate, how these outputs should be verified and how AI assistance must be disclosed in academic work.

This understanding is closely related to AI literacy. Long and Magerko (2020) characterize AI literacy in terms of the ability to understand, use, evaluate and interact meaningfully with AI. In the university context, AI competence extends beyond tool operation to learning effectively in an environment that includes intelligent systems. Students need to formulate better questions, interpret AI outputs with caution, compare them against scholarly materials and take responsibility for their final submissions.

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Crucially, AI should not replace students' thinking. When learners merely submit prompts, copy AI-generated text and present it as their own work, the learning process is severely diminished. Conversely, when AI is used for suggestions, formative feedback, simulated dialogue and checks of understanding, it can create additional opportunities for deeper learning. The distinction lies in task design and the expectation that students reflect on their use of AI.

The five dimensions proposed in this paper should be interpreted as an instructional classification, not as a psychometrically validated scale. Awareness concerns recognizing the capabilities and limits of AI-generated information; tool use concerns choosing and operating an appropriate application; prompting concerns expressing an academic task precisely; verification concerns evaluating claims and sources; and academic responsibility concerns disclosure, data protection and ownership of final decisions. These dimensions can overlap in an authentic task: for example, revising an inaccurate AI explanation may simultaneously require awareness, prompting and verification.

A competence-oriented assessment should observe the process as well as the product. Relevant evidence can include initial and revised prompts, comparison notes against authoritative sources, annotated changes to AI-generated material, brief oral explanations and an AI-use declaration. Such evidence does not guarantee that students possess a stable competence, but it makes their reasoning and decision-making more visible than a final submission alone. Assessment rubrics should distinguish factual accuracy, reasoned justification, appropriateness of assistance and transparent reporting to avoid rewarding superficial prompt complexity.

2.2. Components of students' AI competence

Drawing on UNESCO's competency framework, AI literacy research and the practical context of the institutional research project, five components can be identified: AI awareness; AI tool-use skills; prompt-writing skills; critical evaluation and information verification; and ethics, data safety and academic responsibility.

AI awareness enables students to recognize that AI systems process data, identify patterns, generate content and offer recommendations based on data and trained models. Tool-use skills involve selecting suitable applications, clarifying their intended purpose and limiting dependence on them. Prompt-writing skills involve specifying context, objectives, output criteria and the expected level of detail in a request.

Critical evaluation and verification are essential because AI may produce fluent answers that are not necessarily accurate, adequately sourced or appropriate for a particular course. Students should compare outputs with textbooks, authoritative materials, scholarly publications and lecturers' requirements. They must also recognize that the use of AI entails transparent disclosure, protection of personal data and responsibility for the final academic product.

Table 1. Components of students' AI competence and their manifestations in learning

AI competence component	Manifestation in learning	Illustrative AI-supported activity
AI awareness	Understands that AI supports learning but has limitations and may be inaccurate	Distinguishes AI-generated suggestions from knowledge established in textbooks
AI tool-use skills	Selects appropriate tools for specific learning tasks	Uses chatbots to suggest questions or presentation tools to produce diagrams
Prompt-writing skills	Specifies context, objectives and output criteria in prompts	Prompts AI to explain a concept at different levels
Critical thinking and verification	Cross-checks outputs against textbooks, scholarly sources and official information	Marks accurate statements, inaccuracies and content requiring supplementation
Ethics and academic responsibility	Discloses AI use, avoids uncritical copying and protects data	Submits an account of tools used, their purpose and revisions made

Source: Author's synthesis and proposals based on Long and Magerko (2020) and Miao et al. (2024).

Table 1 indicates that students' AI competence is not limited to operating a tool. It encompasses awareness, tool selection, prompt formulation, verification and academic responsibility. The five-component classification supports more precise task design by requiring lecturers to specify why AI is used, the acceptable extent of assistance and the accountability expected from learners.

2.3. UNESCO AI competency frameworks and the TPACK model

UNESCO's AI competency framework for students covers human-centred thinking, AI ethics, AI techniques and applications, and AI system design. These dimensions progress through levels of understanding, application and creation (Miao et al., 2024). Although broader than an individual learning activity, the framework highlights the need for students to become responsible users capable of assessing AI outputs and progressively regulating their own practices.

UNESCO also provides an AI competency framework for teachers, encompassing human-centred thinking, AI ethics, AI foundations and applications, AI pedagogy and AI for professional development (Miao & Cukurova, 2024). Consequently, students' AI competence cannot be developed independently of lecturers' capacity for pedagogical design.

The Technological Pedagogical Content Knowledge (TPACK) model of Mishra and Koehler (2006) offers an appropriate conceptual basis for AI-supported learning activities. It emphasizes the integration of technological, pedagogical and content knowledge. Applied to AI, lecturers should begin with learning objectives, subject content, student characteristics and instructional methods, rather than selecting an AI tool first and adapting learning activities to it.

The relationship between the UNESCO framework and the five dimensions proposed here is one of instructional alignment rather than equivalence. UNESCO supplies broad reference domains for curriculum development, while this article converts selected domains into learning behaviours that can be practiced in ordinary coursework. For example, a human-centred orientation is operationalized through student control over decisions; ethics through source acknowledgement and data minimization; technical understanding through recognizing model limitations; and

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application through task-specific prompt design. The five dimensions should therefore not be presented as a direct reproduction of the UNESCO framework or as a complete substitute for it.

TPACK also clarifies why a common AI task may be appropriate in one course but inadequate in another. In a production-management module, students may use AI to propose examples of waste and then validate them against established Lean principles and observed process conditions. In a theoretical module, they may compare alternative explanations and justify which is consistent with disciplinary sources. In both cases, the content standard and intended cognitive operation determine the task; the AI tool remains a contingent instructional resource. This approach helps avoid technology-driven task design and allows lecturers to assess the same learning objective through both AI-supported and non-AI pathways.

2.4. Designing AI-supported learning activities to develop AI competence

AI-supported learning activities are those in which students use AI as an aid to the learning process rather than as a substitute for completing the entire task. AI may suggest ideas, pose counter-questions, explain concepts at different levels, provide examples, generate initial drafts, recommend presentation structures or support self-assessment. Nevertheless, the final product must demonstrate the student's understanding, decisions and personal responsibility.

Based on UNESCO's competency framework and the findings reviewed, activities can be designed to transform spontaneous AI use into guided learning practices.

Table 2. AI-supported learning activities designed to develop students' AI competence

AI-supported learning activity	AI competence developed	Implementation considerations
Use AI to generate initial ideas for a learning topic	AI awareness; AI tool-use skills	Record prompts and explain which ideas were selected and why
Write prompts asking AI to explain a concept at several levels	Prompt-writing skills; communication with AI	Do not treat AI responses as final answers; assess how students refine prompts
Compare AI-generated answers with textbooks or scholarly sources	Critical thinking; information verification	Require students to identify accurate, inaccurate and missing elements
Use AI to generate outlines, mind maps or discussion questions	Knowledge organization; learning creativity	Students must revise AI-proposed structures rather than submit them unchanged
Revise AI-suggested products and explain the changes	Academic responsibility; reflective skills	Submit a brief explanation of AI suggestions, student revisions and reasons
Use AI to develop practice questions and self-assess	Independent learning; self-assessment	Check AI-generated questions against learning objectives
Transparently report AI use in academic products	Academic integrity; personal responsibility	Attach an AI-use statement to assignments or essays

Source: Author's synthesis and proposals based on Miao and Holmes (2023), Miao et al. (2024), and Mishra and Koehler (2006).

Table 2 illustrates that the same AI tool can produce very different learning outcomes depending on task organization. Copying generated answers creates little educational value and considerable academic risk; using AI for suggestions, comparison, critique and revision can instead support thinking. Lecturers should require students to verify, revise, explain and take responsibility for their final outputs. Comparing AI responses with textbooks or authoritative scholarly materials is particularly valuable because it returns students to academic sources and encourages close reading for verification, omissions and contextual suitability.

For implementation, lecturers can specify a simple evidence trail alongside each assignment: the original task, the purpose of AI assistance, a selected prompt-response excerpt, sources used for verification, and a short rationale for revisions. These records should be proportionate to the assignment's risk and complexity; extensive logging is not necessary for every low-stakes exercise. Where students do not have equal access to paid tools or reliable connectivity, equivalent non-AI materials and assessment routes should be available. This prevents access conditions from being mistaken for differences in competence.

One illustrative activity asks students to analyse a short production-management scenario. Students first formulate their own interpretation of the problem, then request an alternative explanation from an AI assistant. Next, they label each proposed claim as supported, uncertain or incorrect using the assigned reading and task data. Finally, they submit an independently revised answer with a short explanation of what the AI suggested and why the student accepted or rejected it. The illustration is a proposed activity, not an experiment conducted in the present study. Its purpose is to make critical evaluation, source verification and responsibility assessable within normal coursework.

To foster AI competence, lecturers need a clearly defined procedure. The five-step process below applies the TPACK model and draws on orientations from the institutional research project.

First, the lecturer specifies the task, objectives, expected product, assessment criteria and permitted scope of AI use. Second, students use AI to search, obtain suggestions or create preliminary drafts, while retaining the prompts used. Third, they verify outputs against textbooks, scholarly sources or other authoritative materials. Fourth, they revise, supplement and reorganize their work to produce a final submission. Fifth, students document how AI was used and assess the relative contributions of the tool and their own work.

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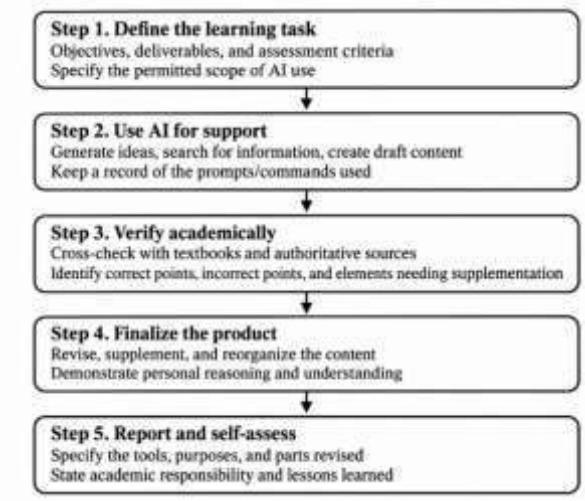

Figure 1. Five-step process for organizing AI-supported learning activities to develop students' AI competence
Source: Proposed by the author.

Figure 1 places AI within a controlled learning cycle. The central concern is not the particular application used, but the associated scholarly practices: retaining prompts, verifying information, revising outputs and reporting AI assistance. In this way, AI moves from an answer-generating tool to a learning-support resource, while lecturers gain additional evidence for assessing both the product and the learning process.

This article combines a focused conceptual synthesis of the works already listed in its references with secondary interpretation of the institutional findings reported by Tran (2026). The literature provides concepts for categorizing AI competence, establishing pedagogical design principles and identifying ethical safeguards. The institutional study supplies descriptive comparisons of AI-supported and non-AI learning activities in a specific course. No new questionnaire, observation, interview or experiment was administered for this article; consequently, no additional sample size or inferential statistic is claimed.

The analytical procedure follows three steps: first, identify competence-related requirements in the cited frameworks; second, translate them into observable behaviours and proposed instructional activities; and third, examine how far the reported institutional outcomes can inform the feasibility of AI-supported learning. The third step is necessarily limited. Cognitive-test performance, worksheet punctuality and interaction frequency are indicators of instructional activity, not direct measures of AI awareness, tool choice, prompting, verification or responsible behaviour. They can motivate further investigation but cannot validate the five-component classification.

The process also creates opportunities for formative assessment at distinct checkpoints. Following the first AI interaction, a lecturer may assess whether the prompt contained a clear objective and sufficient context. After verification, the lecturer can evaluate the correctness of students' comparisons and the quality of their scholarly evidence. At the final stage, the AI-use report indicates whether students can explain the contribution and limitations of the tool. In this sequence, a fluent answer generated by AI is not itself counted as a learning outcome; demonstrated understanding and justified revision remain the primary criteria.

2.5. Preliminary effectiveness and emerging issues

2.5.1. Preliminary evidence

Within the institutional research project "Research on the Application of Selected AI Tools in Teaching at Hanoi Industrial and Trade University," the research team conducted a pedagogical experiment in the course "Production Management Using Lean and JIT" (course code D.QT.0406.3), part of the Textile and Garment Industrial Management programme. This three-credit specialist course combines theoretical and practical components and was selected because it was considered suitable for testing AI applications informed by TPACK (Tran, 2026).

The experiment covered two topics: the theoretical lesson "The Seven Types of Waste in Production" and the practical lesson "Identifying and Eliminating the Seven Types of Waste in a Garment Workshop." It was conducted in class O.D.QT.0406.3.1 with third-year, Cohort 7 students majoring in Industrial Management in the second semester of the 2025–2026 academic year (Tran, 2026).

Table 3. Experimental results for AI-supported student learning activities

Evaluation indicator	Lesson with AI	Lesson without AI	Difference / observation
Mean score on cognitive test	8.15	7.25	+0.90
On-time submission of learning worksheets	93.75%	65.63%	+28.12 percentage points
Mean questions / learning interactions per student per lesson	1.625	0.031	+1.594 interactions

Source: Author's compilation from the pedagogical experiment reported by Tran (2026).

As shown in Table 3, the AI-supported lesson yielded higher values on all three reported indicators. The mean cognitive test score was 0.90 points higher, the on-time submission rate was 28.12 percentage points higher, and the mean number of learning questions or interactions per student was also higher. These descriptive results provide preliminary indications that AI may support more active participation when incorporated

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into a purposeful and controlled instructional sequence. However, they do not establish a causal effect or demonstrate that the five-component competence model itself has been empirically validated.

The difference between a descriptive contrast and a causal estimate is central to interpretation. The reported score difference of 0.90, submission-rate difference of 28.12 percentage points and interaction difference of 1.594 describe the compared lessons under the conditions reported in the source project. The article does not have sufficient information to establish baseline equivalence, control for instructor and task effects, estimate uncertainty or attribute the observed differences uniquely to AI. Differences in content, student preparedness, novelty and lesson organization could also contribute. Therefore, phrases such as 'AI improved learning outcomes' would exceed the available evidence.

Moreover, the measures do not directly test whether students can identify fabricated citations, distinguish suitable from unsuitable tools, revise a vague prompt or disclose AI assistance responsibly. A comprehensive evaluation of the proposed competence model would need performance tasks and analytic rubrics for each dimension, with transparent scoring criteria and evaluation by more than one assessor where feasible. The current results are best viewed as a rationale for designing such a study, rather than as validation of the model or the five-step instructional process.

2.5.2. Issues requiring attention

Despite these encouraging initial observations, the development of students' AI competence presents several risks. First, students may become over-reliant on AI because it produces quick, coherent and apparently plausible answers. If lecturers assess only final products rather than learning processes, students may prioritize an acceptable-looking submission over genuine understanding. Second, large language models may generate inaccurate, unsourced or contextually inappropriate information. Verification should therefore be treated as a core competence rather than an optional supplementary step. Third, the boundary between legitimate AI assistance and the substitution of students' own work is not always clear, making task-specific institutional and instructional rules necessary.

In the related in-depth interviews with ten lecturers, four reported not using AI in teaching, four had used it with limited effectiveness, and two used it relatively frequently with some initial success (Tran, 2026). These findings suggest that students' AI competence cannot develop independently of lecturers' ability to design appropriate AI-supported activities.

These interview data concern lecturers and are useful for identifying the institutional conditions for student-facing activities, but they are not student survey results. They imply that capacity-building for lecturers should cover assignment design, source-based verification, and the evaluation of AI-mediated work in addition to basic tool operation. The reported groups of four non-users, four limited-effectiveness users and two relatively frequent users are small qualitative categories; their proportions should not be generalized to all university lecturers.

Responsible implementation also requires attention to the handling of prompts and student records. Assignments should avoid uploading identifiable student information, unpublished assessments or confidential institutional materials to services without suitable protections. Lecturers should explain the difference between allowable assistance and unauthorized substitution, set expectations for citation or disclosure, and use assessment designs that make understanding observable. The risk is not removed by disclosure alone: even a transparently acknowledged AI answer requires subject-matter verification before being treated as academic evidence.

2.6. Recommendations for higher education institutions

Universities should establish clear, feasible and educationally grounded guidance on AI use in learning and teaching. Such guidance should specify where AI is permitted, disclosure requirements, tasks in which AI use is prohibited, data that must not be uploaded to public services and students' accountability for final submissions. Institutions should also provide training in AI literacy, prompt writing, information verification, AI ethics and data security.

Lecturers should move beyond merely allowing AI and instead design controlled learning tasks. Effective tasks distinguish activities for which AI assistance is appropriate from those students must complete independently; specify sources for verification; and establish assessment criteria. For essays, case analyses and group projects, students may be asked to submit prompts, AI-use statements and lists of materials used to verify the outputs.

Students should regard AI as a learning aid rather than a substitute for their academic work. They should begin with a learning objective, whether to understand a concept, structure an outline, generate practice questions or obtain draft feedback. AI-generated material must then be checked against textbooks, lectures, academic publications or other reliable sources. Where disclosure is required, students should identify the tools used, the purpose of use and the content they revised.

A future evaluation could adopt a staged design. During preparation, the research team would develop tasks and rubrics corresponding to all five competence components and test their clarity with a small group before collecting outcome data. During implementation, comparable course sections or repeated learning activities could receive defined AI-supported and non-AI conditions, while researchers document tool access, prior experience, assignment requirements and lecturer support. Outcomes could include rubric-based competence performance, accuracy of source verification, the quality of independent explanation, and appropriately defined learning indicators. Analyses should report sample size, uncertainty, possible confounders and limitations rather than relying only on percentage changes.

Institutional leaders may also monitor implementation indicators that are distinct from learning effects: the proportion of courses with written AI-use rules, lecturers trained to review AI-generated materials, students who understand disclosure requirements, and reports of unresolved incorrect outputs. These measures would describe institutional readiness and process quality; they should not be presented as proof that AI increases achievement. A gradual evidence-building approach is more defensible than scaling an untested intervention on the basis of isolated positive comparisons.

3. CONCLUSION AND RECOMMENDATIONS

3.1. Conclusions

Developing students' AI competence is necessary as AI becomes increasingly integrated into university learning, research and professional practice. Beyond operating specific tools, students must use AI knowledgeably, verify its outputs, observe ethical standards and assume academic

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responsibility. Without these capacities, AI may foster dependence, blur the boundaries of academic integrity and encourage uncritical acceptance of information. This paper proposes five components of students' AI competence: AI awareness, tool-use skills, prompt-writing skills, critical evaluation and information verification, and ethics, data safety and academic responsibility. It also outlines learning activities and a five-step instructional process. Preliminary experimental results from Hanoi Industrial and Trade University indicate potentially beneficial differences in learning scores, timely task completion and interaction when AI is used within a purposeful and controlled teaching process. Nevertheless, AI does not automatically improve educational quality. Outcomes depend on lecturers' pedagogical design, institutional rules and students' commitment to independent learning. Developing AI competence should therefore be regarded as part of higher education innovation, with AI used to help students learn more deeply, reason more clearly and assume greater responsibility for their work.

3.2. Recommendations

Higher education institutions should define transparent policies on acceptable AI assistance and provide training in AI literacy, information verification, data protection and academic integrity. Lecturers should make the intended learning outcomes, permitted AI contributions and verification expectations explicit in task instructions and assessment rubrics. Students should retain evidence of their prompts, critically review AI-generated content and disclose the extent of AI assistance. Further studies should examine AI competence with direct measures and broader, appropriately designed empirical evaluations; the descriptive results reused here should not be generalized beyond the original experiment.

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