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A Proposal for the Use of Artificial Intelligence as a Teaching Assistant

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Abstract

Artificial intelligence (AI) has demonstrated considerable potential to improve learning through personalised instruction, immediate feedback, and on-demand academic support. However, universities have yet to fully integrate these technologies into institutional teaching platforms, resulting in students relying on external AI tools that may generate hallucinations, provide responses that are not aligned with course content, and offer limited support for instructors. This paper proposes the Teaching Assistant Artificial Intelligence (TAAI) system, an AI-powered teaching assistant integrated directly into lecture capture platforms such as Lecturecast. TAAI leverages lecture recordings, presentation slides, and approved course materials to deliver context-aware explanations, lecture summaries, worked examples, targeted practice questions, and examination preparation based on a structured learning framework comprising introduction, theory acquisition, practice, and improvement. Unlike existing AI learning assistants that primarily support students, TAAI also provides lecturers with a learning analytics dashboard that identifies difficult topics, recurring misconceptions, quiz performance, and slide-level confusion patterns, enabling evidence-based improvements to teaching and formative assessment. To evaluate deployment feasibility, the paper further presents a scalable cost analysis model demonstrating that only AI inference costs increase with student usage, while retrieval infrastructure, content processing, and software development remain largely fixed, making institution-wide deployment increasingly cost-effective as user numbers grow.

The proposed system therefore offers a practical framework for integrating generative AI into higher education while supporting financial sustainability, regulatory compliance, and academic integrity. By combining personalised student support with actionable teaching analytics, TAAI has the potential to improve learning effectiveness, enhance instructional quality, and encourage wider institutional adoption of AI-assisted education.

Keywords: Artificial Intelligence, Teaching Assistant, Generative AI, Learning Analytics, Higher Education, Formative Assessment

Introduction

Efficient learning refers to the process of acquiring knowledge and skills in a manner that maximizes understanding, retention, and practical application while minimizing unnecessary effort and time. Research in cognitive psychology and educational science [1] suggests that successful learning is not simply the result of exposure to information, but rather a structured process involving comprehension, application, feedback, and continuous improvement. Whether learning mathematics, science, languages, or professional skills, effective learning follows a systematic framework that supports deep understanding and long-term mastery.

The first stage of efficient learning is **Introduction**, where learners are introduced to the topic and its relevance. Understanding what a topic is and why it matters helps create motivation and establishes meaningful connections between new knowledge and real-world situations. Studies have shown that learners are more engaged when they recognize the practical value of what they are learning.

The second stage is **Theory Acquisition**, in which learners develop an understanding of the fundamental concepts, principles, and explanations behind the subject matter. New information is learned more effectively when it is connected to familiar experiences or intuitive examples. Worked examples and step-by-step demonstrations further help learners understand how theoretical concepts are applied in practice.

Following theory acquisition is **Practice**, where learners actively apply their knowledge to solve problems or perform tasks independently. Educational research consistently demonstrates that active retrieval and application strengthen memory and deepen understanding. Feedback during this stage is crucial, as it helps learners identify errors and correct misconceptions before they become ingrained.

The fourth stage is **Improvement**, which involves reflecting on mistakes, addressing misunderstandings, and refining problem-solving strategies. Learning from errors is a critical component of expertise development, as it encourages learners to adjust their mental models and improve future performance [2].

Finally, efficient learning is an iterative process. Learners repeatedly cycle through theory acquisition, practice, and improvement. This continuous refinement, often referred to as deliberate practice, enables the gradual development of expertise and long-term retention, ultimately leading to meaningful and effective learning outcomes.

As artificial intelligence (AI), particularly generative AI, continues to become increasingly influential in everyday life and educational environments, numerous studies have demonstrated its potential to enhance student learning through personalized instruction, immediate feedback, and on-demand academic support [3]. According to a survey by Tyton Partners, the proportion of students who regularly used generative AI tools increased from 27% in 2023 to 44% in 2025 [4], demonstrating the rapid adoption of AI technologies in higher education. Recent evidence also indicates that AI-assisted learning can improve academic performance, increase learner engagement, promote higher-order thinking, and reduce cognitive load when appropriately integrated into educational practice [5]. Rather than replacing instructors, generative AI has the potential to complement existing teaching by providing scalable, context-aware assistance that is available whenever students require support.

Motivated by these developments, the objective of this paper is to propose the integration of a generative AI model directly into institutional lecture capture systems, such as Lecturecast, to transform conventional one-way lecture delivery into a bi-directional, on-demand learning platform [6]. By enabling students to interact with lecture content through natural language while grounding responses in course-specific materials, the proposed Teaching Assistant Artificial Intelligence (TAAI) system aims to facilitate more effective, personalized, and continuous learning.

Problem Definition

The rapid advancement of Artificial Intelligence (AI) has transformed numerous industries; however, its integration into formal education remains limited and fragmented. Although a wide range of AI-powered technologies—including large language models, AI chatbots, speech synthesis, and AI-generated avatars (e.g., ChatGPT, ElevenLabs, and HeyGen)—are now widely available [6], most schools and universities have yet to successfully incorporate these technologies into their core teaching and learning workflows. Consequently, students often rely on external AI services independently rather than through institution-supported platforms. This lack of institutional integration has also led to concerns regarding the unsupervised use of AI in educational settings. According to the Walton Family Foundation, 15% of students reported using ChatGPT without their teacher's permission, highlighting the growing gap between students' adoption of AI technologies and their formal integration into classroom instruction [7].

Nevertheless, recent research suggests that AI can significantly enhance teaching and learning outcomes. A systematic review and meta-analysis of 69 experimental studies conducted between 2022 and 2024 found that ChatGPT improved academic performance, increased student motivation and willingness to learn, enhanced higher-order thinking skills, and reduced mental effort during learning tasks [8]. Similarly, a review of generative AI applications in curriculum teaching reported improvements in student understanding, engagement, and practical application ranging from 20% to 60%. Furthermore, AI tools could reduce teacher preparation time by 40% to 60% [9], highlighting their potential to improve both learning effectiveness and educational efficiency. Overall, this shows that AI already plays a meaningful role in improving learning outcomes when used appropriately.

The importance of accessible learning support becomes even more critical during examination periods. At these times, students often require immediate clarification of concepts while access to lecturers, tutors, and consultation sessions becomes increasingly limited due to high demand. Consequently, many students turn to using available AI as their primary source of academic assistance. While AI provides rapid responses, they frequently suffer from hallucinations, generate explanations that are not aligned with specific course materials, and may present information of questionable relevance or accuracy. In addition, many platforms require paid subscriptions to access advanced features, larger document uploads, or extended usage limits.

These limitations reduce the effectiveness of current AI solutions and create barriers to consistent academic support.

A major challenge in modern education is the inefficiency of knowledge acquisition. Students frequently spend significant amounts of time and money seeking clarification from teachers, tutors, online courses, and supplementary learning materials. While teachers and tutors provide valuable guidance, they are constrained by limited availability, class sizes, consultation hours, and financial costs. Consequently, students increasingly turn to AI for immediate answers and personalized assistance, which only have general information reference.

Therefore, there remains a need for a Teaching Assistant Artificial Intelligence (TAAI) system that is directly connected to lecture materials, supports active learning, delivers contextual guidance, and provides instructors with actionable insights into student learning difficulties.

Literature Review

One example of an attempt to integrate generative AI into an educational system is *Generative Lecture*, proposed by Jo *et al.* [6]. This AI-enhanced lecture-video platform transforms recorded lectures into interactive and personalised learning environments. Rather than requiring students to leave the lecture and use external search engines or general-purpose chatbots, the system integrates generative AI directly into the video interface. It processes the lecture recording by segmenting the video, aligning transcripts with slides, and preparing time-linked learning materials such as quizzes, highlights, and interactive diagrams. It also creates an AI clone of the lecturer using video and voice samples, allowing generated explanations to be delivered within the lecture interface. A key advantage of this approach is that it enables personalised, context-aware learning without requiring students to leave the lecture environment, thereby reducing cognitive load and supporting active engagement [10]. However, the effectiveness of such a system depends heavily on the accuracy of transcript alignment and the reliability of the underlying generative AI [11], which may occasionally produce incorrect or misleading explanations (i.e., AI hallucinations [12]). In addition, the creation of AI-generated instructor avatars raises concerns regarding privacy, consent, and the authenticity of teacher–student interactions.

Furthermore, the system provides several student-facing functions. **On-demand clarification** allows students to select a slide region or ask a question and receive a contextual explanation based on the relevant lecture content. **Enhanced visuals** retrieve supporting diagrams or images for abstract concepts, while **interactive examples** allow students to manipulate diagrams or variables to explore concepts more actively. **Personalised explanations** provide step-by-step guidance or analogies based on a student's academic background or interests.

To support knowledge checking and revision, the system includes **adaptive quizzes** with adjustable difficulty and immediate feedback. It also generates a **study summary and interaction map**, which stores students' questions, notes, quiz results, AI responses, and relevant timestamps. This allows students to revisit specific difficulties without rewatching the entire lecture. Finally, **automatic highlighting** synchronises spoken explanations with relevant areas of lecture slides, while **adaptive breaks** provide short personalised content intended to maintain learner focus.

Overall, *Generative Lecture* demonstrates that generative AI can make lecture videos more interactive through contextual questioning, personalised support, formative assessment, and structured revision [13]. However, like many existing AI learning systems, its primary purpose is to support students during individual learning. The proposed TAAI system adopts the most relevant elements of this model, particularly course-contextual clarification, adaptive quizzes, timestamp-linked revision, and interactive learning support. However, TAAI extends this student-centred approach by also supporting lecturers. By aggregating anonymised student questions, recurring misconceptions, difficult lecture timestamps, and quiz-performance patterns, TAAI can help lecturers identify where students struggle and improve future explanations, learning materials, and teaching strategies. This dual student–teacher function [14] provides a stronger institutional value proposition [15] and may make universities more willing to integrate AI into their existing lecture-capture systems.

Main Proposal

To address the identified challenges, this project proposes a built-in Teaching Assistant Artificial Intelligence (TAAI) integrated directly into the Lecturecast platform. The system provides students with instant, context-aware assistance while reviewing recorded lectures. The following figure presents a user interface mockup demonstrating the proposed system using the topic "Materials Science and Failure." [Lecturecast — UCL]

For institutional adoption, TAAI must be user-friendly for students and lecturers, remain relevant to the taught course, and provide lecturers with useful evidence to improve teaching.

These requirements are addressed through the AI Built-In Learning System, AI Content-Explanation and Summary System, and AI Topic Analysis Dashboard.

1. AI Built-In Learning System: UI & UX, AI on Website

TAAI is based on the existing Lecturecast model used at University College London, United Kingdom. Integrating the system into this familiar platform avoids requiring students and lecturers to use a separate external AI service.

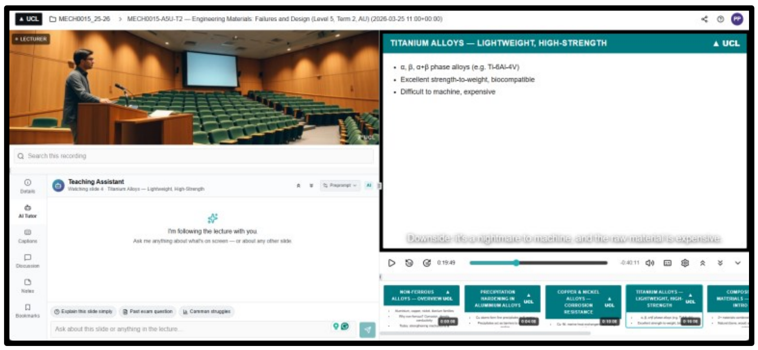

Figure 1

User Interface of the TAAI System

TAAI is connected to lecture recordings, presentation slides, and instructor explanations. Students can ask questions about specific slides, timestamps, or concepts and receive immediate, context-aware responses. To reduce hallucinations and maintain alignment with the taught curriculum, the AI primarily uses lecture recordings, slides, and related approved course materials. Information beyond this scope may be provided, but is clearly labelled "Not taught in the lesson."

TAAI uses existing Lecturecast recordings rather than an AI-cloned lecturer. Since Lecturecast already contains the lecturer's video, voice, slides, and explanations, an AI avatar would add limited educational value while increasing cost, technical complexity, consent requirements, and the risk that students may mistake AI output for the lecturer's own views. TAAI therefore provides clearly labelled written support alongside the original recording.

Automatic highlighting and adaptive breaks are excluded. Highlighting may be unreliable when lecturers explain slides non-linearly or refer to previous content, and may discourage students from independently identifying important information. Adaptive breaks are unnecessary because students can already pause, replay, and revisit Lecturecast recordings at their preferred pace. TAAI instead prioritises contextual explanations, practice, feedback, and teaching analytics.

2. AI Content-Explanation and Summary System

To avoid generic or irrelevant AI responses, TAAI grounds explanations and summaries in the slides, recordings, instructor explanations, and approved course resources for the selected topic. This ensures that support reflects the actual content taught and the course assessment structure.

For a selected subtopic, TAAI follows the proposed learning framework: it introduces the topic and its relevance, explains key concepts in accessible language, and provides worked examples based on lecture materials. Students can request summaries of lectures, slides, timestamps, or subtopics. Students can also access relevant past examination questions and mark schemes, enabling targeted practice, self-assessment, and preparation for the assessment style they are likely to encounter.

3. AI Topic Analysis Dashboard

TAAI also provides lecturers with evidence of student understanding. Rather than relying only on final examination results or low-participation end-of-module surveys, the dashboard supports formative assessment. Research identifies three central questions: "where learners are going," "where learners currently are," and "how to move learners forward." [16]

Within TAAI, these questions are translated into identifying which knowledge, skills, topics, or subtopics students find difficult; identifying why students answer incorrectly, including misconceptions or misunderstandings; and identifying an appropriate teaching response. The proposed dashboard includes the following functions.

a) Topic and Subtopic Difficulty Analysis

TAAI identifies the topics and subtopics students find most difficult or easiest through quantitative and qualitative evidence. Quantitative data include question frequency, clarification requests, quiz performance, and the proportion of students selecting each answer option. Qualitative evidence includes representative anonymised questions, discussion patterns, and recurring requests for explanation.

This enables lecturers to identify learning gaps before high-stakes examinations and target revision sessions, worked examples, and supplementary resources while students still have time to improve.

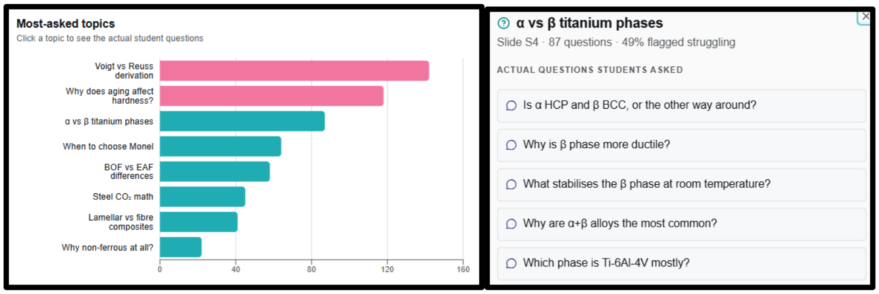

Figure 2

Topic and Subtopic Difficulty Analysis

b) AI-Generated and Institution-Uploaded Quiz System

TAAI provides AI-generated quizzes and allows institutions to upload their own quizzes. Questions are categorised as Easy, Medium, or Hard. The dashboard shows how many students answer each question correctly and, where answers are incorrect, which alternative answer options are selected.

This distinguishes general difficulty from specific patterns of incorrect understanding. It is supported by evidence that "low-stakes quizzing is a particularly powerful approach and that tutor feedback can help" [17]. The results provide lecturers with early evidence of student understanding before high-stakes examinations.

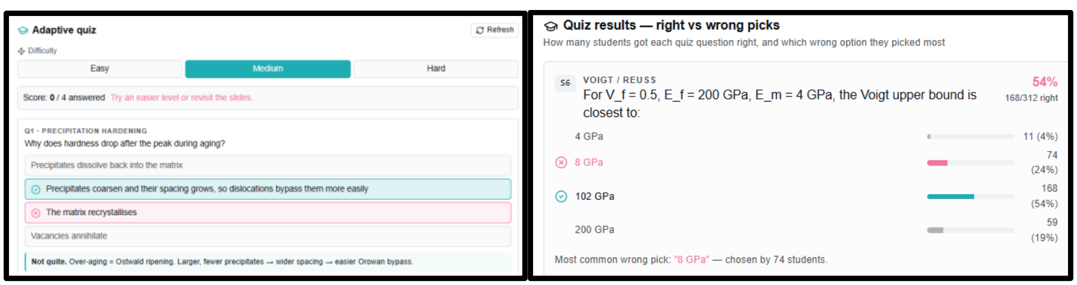

Figure 3

AI-generated quiz and Quiz analysis

c) Common Misconception Identification

Low marks do not show whether students lack prerequisite knowledge, misunderstand a concept, use an incorrect method, or misread a question. TAAI therefore analyses recurring questions, clarification requests, quiz responses, and incorrect reasoning patterns to identify potential misconceptions. Similar patterns are grouped together, and the AI generates proposed corrective explanations that instructors can review, modify, approve, or reject to maintain pedagogical accuracy and alignment with course objectives.

Together, difficulty analysis, quiz analysis, and misconception identification allow lecturers to prioritise topics that are both difficult and associated with recurring misunderstandings. This supports specific rather than vague feedback. A systematic review of 96 empirical studies found that high-quality, tailored, action-oriented feedback positively affects achievement, motivation, and engagement, whereas vague feedback can reduce motivation. [18]

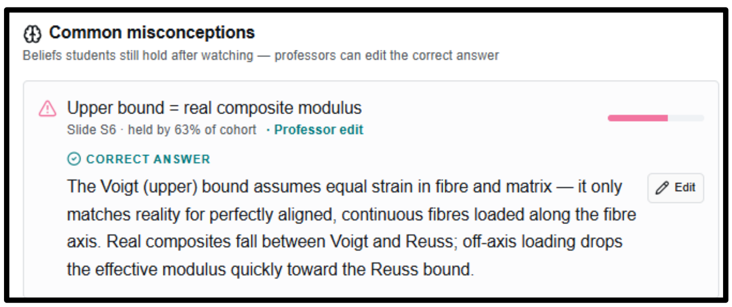

Figure 4

Common Misconception Identification

d) Slide-Level Confusion Heat Map

TAAI identifies where confusion occurs within a lecture so that teaching materials can be improved in future deliveries. The Slide-Level Confusion Heat Map ranks slides according to student confusion and engagement using question frequency, clarification requests, repeated viewing of timestamps, and reported confusion. These patterns are linked to the relevant slide and lecture timestamp.

This enables lecturers to identify sections that may require clearer explanation, slower delivery, an additional diagram, a worked example, or supplementary resources. Rather than only identifying a difficult topic, lecturers can locate the point in the lecture at which confusion may have occurred and revise the material accordingly.

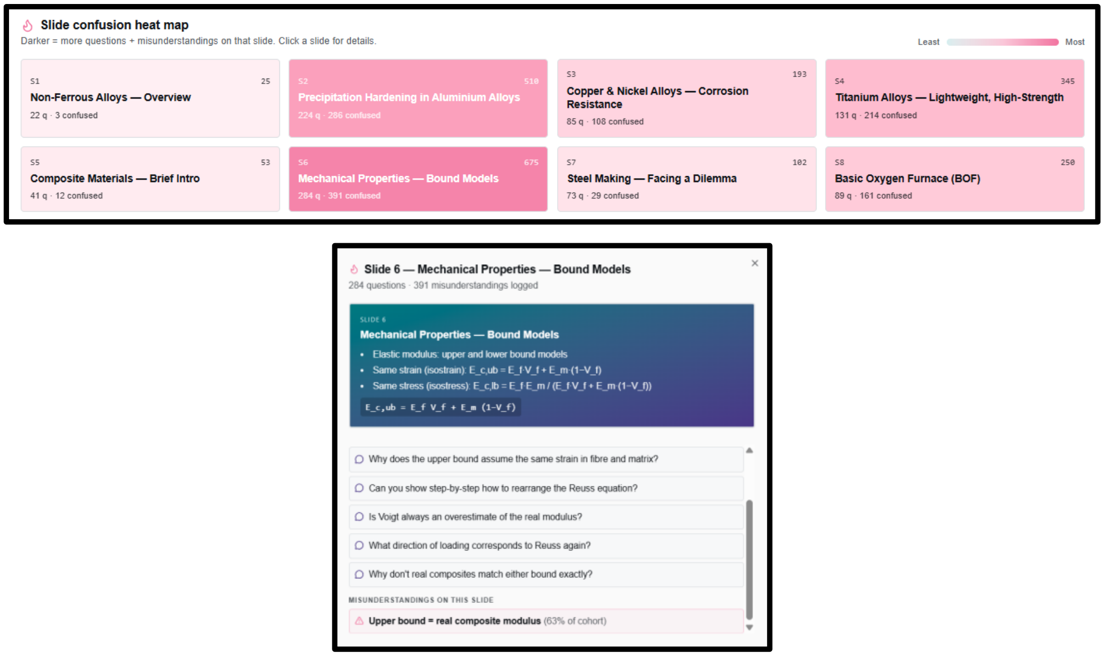

Figure 5

Slide-Level Confusion Heat Map

The anticipated impact of the proposed TAAI system can therefore be summarised across student learning, lecturer support, and institutional feasibility. First, by using existing Lecturecast recordings rather than AI-generated lecturer avatars, cloned voices, and synthetic videos, TAAI reduces development cost, technical complexity, consent requirements, and the risk that students may confuse AI-generated output with the lecturer's own views.

Second, the integrated chatbot provides faster and more accessible support than contacting lecturers, particularly during examination periods when demand for academic assistance is high. Students can ask direct questions about specific slides, timestamps, lecturer explanations, concepts, course structure, and examination style, receiving course-grounded responses rather than broad generic AI information.

In addition, TAAI supports structured learning through explanation, worked examples, practice, and feedback. By retrieving relevant past-paper questions and mark schemes, it enables students to practise question formats likely to appear in assessments and evaluate their own understanding.

Finally, the Topic Analysis Dashboard provides lecturers with specific evidence of difficult topics, recurring misconceptions, and confusing slides, reducing reliance on low-quality or low-participation surveys. This enables more targeted improvements to teaching while helping students identify and correct their own learning difficulties.

Cost Analysis

Implementing the Teaching Assistant Artificial Intelligence (TAAI) system requires consideration of both financial sustainability and regulatory compliance [19]. To evaluate deployment feasibility, we developed an interactive TAAI Cost Analysis Model, which estimates operating costs under different usage scenarios, AI models, and institutional sizes. The model can be accessed here [TAAI Cost Model].

The model divides deployment costs into four categories: AI generation, retrieval and hosting, content processing, and system development. AI generation is the only component that increases with student usage, as it depends on the number of queries and tokens processed by the language model. In contrast, retrieval infrastructure, lecture-content processing (e.g., transcription and slide indexing), and the one-time software development cost remain largely fixed regardless of the number of users. The development cost is amortised over several years to estimate its effective cost per academic term.

In addition to financial considerations, TAAI must comply with institutional data protection and privacy regulations [20]. Student interactions should be anonymised, teaching materials accessed only with appropriate permissions, and AI responses grounded in approved course resources to minimise hallucinations and maintain academic integrity [21].

Conclusions

This paper has proposed the Teaching Assistant Artificial Intelligence (TAAI) system as a practical response to a well-documented problem: students frequently struggle to get timely, course-specific support when reviewing recorded lectures independently, and instructors lack reliable data on where that struggle is concentrated.

The proposed system addresses both sides of this gap. Students gain an AI assistant that knows their specific lecture content, their professor's explanations, their course's exam style, and the structured learning framework applied throughout the module. Instructors gain a dashboard that replaces low-participation surveys with precise, evidence-based insight into student confusion and common misunderstandings. The five features described in Section 4 each target a specific limitation in the current model of university teaching support.

The next step is a controlled pilot deployment within a single module at UCL or Chulalongkorn University, with learning outcomes and system usage measured against a comparable cohort without TAAI access. Findings from this pilot will inform both the refinement of the system and the case for broader institutional adoption.

References

G. E. A. Solomon, J. Youtie, S. Carley, and A. L. Porter, "What people learn about How People Learn: An analysis of citation behavior and the multidisciplinary flow of knowledge" Research Policy, vol. 48, no. 9, Art. no. 103835, Nov. 2019, doi: 10.1016/j.respol.2019.103835.

S. Quinton and T. Smallbone, "Feeding forward: Using feedback to promote student reflection and learning – a teaching model" Assessment & Evaluation in Higher Education, vol. 35, no. 1, pp. 125–135, 2010, doi: 10.1080/14703290903525911.

D. Alshatti Schmidt, B. Alboloushi, A. Thomas, and R. Magalhaes, "Integrating artificial intelligence in higher education: Perceptions, challenges, and strategies for academic innovation" Computers and Education Open, vol. 9, Art. no. 100274, Dec. 2025, doi: 10.1016/j.caeo.2025.100274.

Office of Communications, College of Education, "AI in Schools: Pros and Cons" College of Education, University of Illinois Urbana-Champaign, Oct. 24, 2024. [Online]. Available [here].

Benjamin S. Bloom, "The 2 Sigma Problem: The Search for Methods of Group Instruction as Effective as One-to-One Tutoring" Educational Researcher, vol. 13, no. 6, pp. 4–16, 1984.

H.-Y. Jo, A. Y. Zhao, X. Liu, and R. Suzuki, "Generative Lecture: Making Lecture Videos Interactive with LLMs and AI Clone Instructors" arXiv preprint arXiv:2512.21796, Dec. 2025, doi: 10.48550/arXiv.2512.21796.

Walton Family Foundation, "ChatGPT Used by Teachers More Than Students: New Survey from Walton Family Foundation Finds" Mar. 1, 2023. [Online]. Available [here].

X. Deng, Y. Jiang, Z. Yu, J. Lu, and X. Liu, "Does ChatGPT enhance student learning? A systematic review and meta-analysis of experimental studies" Computers & Education, vol. 227, Art. no. 105267, 2025, doi: 10.1016/j.compedu.2024.105267.

X. Rui, "A Review of the Application of Generative Artificial Intelligence in Curriculum Teaching" in Proceedings of the 2nd International Conference on Intelligent Education and Computer Technology (IECT), New York, NY, USA: Association for Computing Machinery (ACM), 2025, Art. no. 3764243. doi: 10.1145/3764206.3764243.

Sweller, J., van Merriënboer, J. J. G., & Paas, F., "Cognitive Architecture and Instructional Design" Educational Psychology Review, vol. 10, no. 3, pp. 251–296, 1998.

Stefan Feuerriegel, et al., "Generative AI" Business & Information Systems Engineering, vol. 66, no. 1, pp. 111–126, 2024.

Mutlu Cukurova, et al., "Generative AI for Learning: Investigating the Potential of Synthetic Learning Videos" arXiv:2304.03784, 2023.

J. J. G. van Merriënboer, P. A. Kirschner, and J. Frèrejean, Ten Steps to Complex Learning: A Systematic Approach to Four-Component Instructional Design, 4th ed. New York, NY, USA: Routledge, 2024. doi: 10.4324/9781003322481.

Ashok Goel, "AI-Powered Learning: Making Education Accessible, Affordable, and Achievable" arXiv preprint arXiv:2006.01908, 2020.

Chan, C. K. Y., "A Comprehensive AI Policy Education Framework for University Teaching and Learning" arXiv preprint arXiv:2305.00280, 2023

S. Prompiengchai, C. Narreddy, and S. Joordens, "A Practical Guide for Supporting Formative Assessment and Feedback Using Generative AI" arXiv preprint arXiv:2505.23405, May 2025. [Online]. Available: https://arxiv.org/abs/2505.23405.

R. Morris, T. Perry, and L. Wardle, "Formative assessment and feedback for learning in higher education: A systematic review" Review of Education, vol. 9, no. 3, Art. no. e3292, 2021, doi: 10.1002/rev3.3292.

C. Brandmo and S. M. Gamlem, "Students' perceptions and outcome of teacher feedback: A systematic review" Frontiers in Education, vol. 10, Art. no. 1572950, May 2025, doi: 10.3389/feduc.2025.1572950.

H. A. Fauzi, H. Yusoff, and N. S. Jasni, "The role of information technology (IT) for financial sustainability in higher education institutions (HEIs)" International Journal of Modern Education, vol. 7, no. 24, pp. 1125–1138, Mar. 2025, doi: 10.35631/IJMOE.724079.

L. Colonna, "Artificial Intelligence in Education (AIED): Towards More Effective Regulation" European Journal of Risk Regulation, vol. 17, no. 1, pp. 161–181, 2026, doi: 10.1017/err.2025.10039.

K. Bittle and O. El-Gayar, "Generative AI and Academic Integrity in Higher Education: A Systematic Review and Research Agenda" Information, vol. 16, no. 4, Art. no. 296, Apr. 2025, doi: 10.3390/info16040296.