Methods and Practices for Using AI in Education

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Abstract. Generative AI and foundation models are reshaping education through new tools, pedagogical methods, and institutional practices. Based on a structured review of recent literature and policy documents, this paper proposes a taxonomy of AI-based educational systems, outlines supported teaching methods, and identifies near-term trends, indicators, and risks.

Keywords: Education, Generative Ai, Foundation Models, AI Literacy, Education Policies.

1 Introduction

Over the last two years, education has shifted from reacting to chatbots to structured platforms, policies, and targeted AI systems for education. UNESCO published a global guide to generative AI in education and research (UNESCO, 2026). The OECD published Digital Education Outlook, focusing on effective and targeted applications of GenAI for real learning and the need for rigorous assessments and testing (Organisation for Economic Co-operation and Development, 2026). In Europe, the strategic framework is the Digital Education Action Plan 2021-2027 (European Commission, 2025b), and a number of countries are publishing national guidelines for schools and universities.

At the technological level, the key transition is from "chat" to learning systems: personalized assistants, generative tools for differentiating materials, structured evaluators (feedback/marking assistance), and agent workflows (generating learning resources, managing classroom processes). This paper examines these systems as software stacks rather than as models.

This paper addresses the following research questions:

- What specific systems and subsystems are built on foundation models and how are they used in education?
- What pedagogical methods (e.g., Socratic questioning, differentiation, metacognitive strategies) are supported by AI and under what limitations?
- What policy visions and implementation plans exist across developed countries and international organizations for the intensive use of AI, from primary school to PhD level?

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- What are the likely directions of development in 2026-2028 and how can they be measured (indicators)?

2 Methods and Scope

A common approach is to extend the classic architecture of an Intelligent Tutoring System (ITS) with an added Large Language Model (LLM). The classic ITS structure (learner model, expert model, training model, and user interface) is retained, with the large language model being used primarily in the training model to generate explanations and prompts, as well as for motivational feedback, while the other modules remain more structured and controllable. Gaeta et al. (2025) define an ITS-LLM architecture and prototype (with the Llama 3.2 model) for motivational feedback and compare LLM-generated versus expert feedback. Another similar system is GPTutor (GenAI-ITS), which has been studied in real-world use by 880 students. The results show that the effect on engagement is multidimensional – behavioral / emotional / cognitive (Bai et al., 2025).

Another approach combines LLMs with retrieval-augmented generation (RAG), where RAG is used to extract relevant passages from course materials, textbooks, and other educational resources, and LLM generates a response conditioned on the added context. A systematic review of RAG in education synthesizes 51 studies and explicitly points out key issues such as "hallucination" and "outdated knowledge" (Li et al., 2025). Interesting practical examples include the RAG chatbot in an online course on R programming and LPITutor, which combines RAG with prompt engineering (Liu et al., 2025). Reviews of hallucinations in RAG systems systematize methods for detection, correction, and control in the process of logical inference (Zhang & Zhang, 2025).

Multi-agent ITSs offer distribution of the learning system functions among agents: diagnostics, plan/path, exercise generator, checker, motivation coach, metacognitive inference, learning policy agent, and security. GenMentor offers a multi-agent framework for learning based on learning goals: (i) goal→skills, (ii) skill-problem, (iii) learning planning, (iv) learning content selection (Wan et al., 2025). There are also taxonomies and reviews of similar systems (Abou Ali et al., 2026).

Another promising approach uses a learning script instead of free-form chat. This learning script is generated by LLM using learning resources and learning strategies. Ruffle & Riley uses LLM in two roles: to use authorial learning texts; and to implement learning strategies through two agents (teacher and learner). Strong motivation is observed, but without a significant difference in learning outcomes (Schmucker et al., 2024).

Another line of work uses multimodal pipelines to extract knowledge from video, audio, and PDF resources, and to convert it into structured learning materials. Deng & Yuan (2026) describe a system using FFmpeg, Whisper, and OCR to automatically extract knowledge from videos and PDF documents. A similar idea has been implemented using Google's NotebookLM (Reyna, 2025).

The most common LLM-based subsystems include: (a) a learning content generator (worksheets, questions, differentiated versions), (b) feedback generator and rubrics, (c)

assessment and marking assistant for low-risk scenarios, and (d) learning analytics for early detection of difficulties.

Higher education is among the first institutional users of large model platforms. OpenAI positions ChatGPT Edu as an offering designed for universities with tools for campus use and the creation of custom GPTs (OpenAI, 2024). Google offers Gemini for Education (Google for Education, n.d.) as part of Google Workspace for Education, including integrations and models optimized for learning (Google Cloud, 2025). Microsoft is developing Copilot in Education as an AI assistant in Microsoft 365 for teachers, students, and administrators (Microsoft Education, n.d.).

Another approach links LLMs to learning analytics and student performance data, offering personalized interpretations, refining learning questions and intervention plans. The use of learning agents improves students' interpretation of visual statistical information and yields significant post-intervention effects (Yan et al., 2025).

Unlike general chatbots, tutors aim to "teach, not answer." Khan Academy (n.d.) describes Khanmigo as a tutor and assistant for teachers that guides students toward solutions rather than providing ready-made answers, with OpenAI (2023b) citing the use of GPT-4 for Khanmigo. Duolingo Max uses GPT-4 (OpenAI, 2023a) for role-playing dialogues and explaining mistakes ("Explain My Answer") (Duolingo, 2023), and announced the expansion of Explain My Answer to all users (Duolingo, 2026).

3 AI Systems and Architectural Patterns

Based on the analysis of existing use cases and experiments, taking into account both recurrent problems and effective design solutions, we propose the following reference architecture for an AI-based learning system:

- User interface: web/mobile chat and activity player (questions, steps, simulations, tasks) and teacher console (course management, rubrics, interventions)
- Management: dialogue (manages turn-taking, context, session goals), pedagogy (rules for Socratic tutoring, cognitive load, scaffolding strategies, growth mindset - similar to the principles used in effective AI tutor designs), tool / agent router (selects agent or tool: RAG, evaluation, exercise generation, simulations).
- Knowledge: RAG subsystem (indexing → retrieval → generation using learning resources and course data), curriculum (outcomes model: competences, themes, prerequisite graph)
- Learner: student model (knowledge/skills/mistakes/preferences), knowledge tracing and mastery estimation (including dialog knowledge tracing).
- Assessment: generation of exercises with solutions and self-assessment with formative feedback, categories with partially automated assessment (LLM-as-critic only with strict protocol and human validation), structure before chat for complex topics.
- Learning analytics: collection of trace data (LMS logs, xAPI/LRS) and dashboards, GenAI layer for explanations/skeletons for dashboards.

- Safety and governance: guardrails (policies on prohibited/risky topics, academic integrity), privacy (data minimization, execution isolation - code sandbox, audit logs), quality monitoring (hallucination rate, citation coverage, pedagogical score, etc.)

We propose to implement this architecture through a set of AI agents:

- Tutor Agent (Socratic + scaffold) - conducts dialogue, asks questions, manages cognitive load.
- RAG Agent - extracts evidence from the course and provides context.
- Assessment Agent - generates exercises, checks steps, applies headings.
- Learner Agent - updates student model (without changing factual KB).
- Planner Agent – planning learning path (goal→skills→path), following goal-oriented ITS model
- Analytics Agent - interprets dashboards and suggests interventions.

4 AI-Supported Teaching Methods

UNESCO (2026) recommends a human-centered approach, the protection of rights, and careful planning of policies and capacity for the use of GenAI in education and research. The OECD cautions that GenAI is not a panacea but can amplify both good and bad practices; it recommends that tools be created with pedagogical intent and undergo rigorous testing (Organisation for Economic Co-operation and Development, 2026).

The most common AI-supported pedagogical approaches include the following:

- Differentiation and Universal Design for Learning: adapting texts by level, multilingual versions, alternative representations; suitable for early grades under strict supervision.
- Socratic guidance: asking leading questions, level-based prompts, checking for understanding; used by tutors such as Khanmigo (OpenAI, 2023b).
- Error explanation and "micro-feedback": analysis of an incorrect answer and brief explanations of errors and targeted micro-feedback on student responses; example: Explain My Answer (Duolingo, 2023).
- Inquiry-based learning: AI as a research assistant: generates hypotheses, suggests sources, but the student verifies and cites; important for high school and university.
- Metacognitive strategies: self-assessment, explaining in one's own words, error log; AI can ask meta-questions and support reflection.
- Project- and problem-based learning: AI as a partner for ideas, prototyping, coding, simulations; suitable for STEM and PhD programs with reproducibility protocols.

As GenAI becomes more widely used, assessment practices are also changing: more oral defenses, projects with process documentation, in-class assignments, as well as assessment of skills for the critical use of AI. UK guidance emphasizes the need for students to use GenAI with appropriate safeguards and supervision (Department for Education, 2025).

AI integration must be age-appropriate, protect children, and foster learner autonomy. Singapore's Ministry of Education discusses the development of an age-progressive framework and resources for parents/students (Ministry of Education, Singapore, 2025). Japan's Ministry of Education, Culture, Sports, Science and Technology (2025) has published guidelines (Version 2.0) for elementary and secondary education. The Department of Education, Australia (2025) has published a national framework for GenAI in schools, while South Korea is introducing AI-powered digital textbooks starting in 2025 for specific grades and subjects (Korean Ministry of Education, 2025).

In elementary education, emphasis should be on goals such as: developing reading literacy, basic mathematical thinking, and early critical thinking habits. Acceptable uses: text adaptation, exercises with prompts, vocabulary games, and short supervised dialogues. Inappropriate or high-risk uses include: unfiltered chat; evaluation of emotions; replacing writing/reading with ready-made answers (in accordance with UNESCO (2026) and national frameworks (Department of Education, Australia, 2025).

In lower secondary education (grades 5–7), the goals are now: learning through explanation and verification; developing habits of citation, verification, and error detection. Methods: error log, AI as an "editing partner," creating self-assessment tests, mini-projects (e.g., science posters). UNESCO (2024) provides frameworks for students emphasizing values, ethics, and critical understanding.

In secondary education, the focus is on developing systematic AI literacy (how models work, what their limitations are, what deviations and errors we can expect) and on discipline in their use in writing, programming, and research. The EU and OECD are developing an AI literacy framework for primary and secondary education (European Commission & Organisation for Economic Co-operation and Development, 2025), and the EC maintains an initiative/repository for AI literacy practices (European Commission, 2025a, 2025d).

In universities, platforms such as ChatGPT Edu are geared toward institutional use and support for academic and administrative processes (OpenAI, 2024). Best practices: clear rules for acceptable use; requirement for an "AI usage statement"; process evaluation (drafts, versions, justifications); oral defenses.

The master's level allows the use of agents for complex tasks: code generation, experiments, data analysis, and prototyping. Here, the LLMOps discipline (logs, experimental protocols, evaluations) becomes critical. Leading institutions in Canada offer guidelines for GenAI integration and risk management (U15 Canada, 2024).

For PhDs, AI is a tool for: systematic reviews, assistance in formulating hypotheses, coding, and analysis. It is critical to maintain reproducibility: versions of data/code, parameter logs, descriptions of prompts and subsystems (RAG sources), and a clear distinction between human contribution and AI assistance.

5 National Policy Directions

The European Commission is developing the Digital Education Action Plan 2021–2027 as a framework for high-quality and inclusive digital education (European Commission,

2025b). The Commission has published ethical guidelines for educators on the use of AI and data in education (European Commission, 2025c), as well as an initiative on AI skills and literacy (European Commission, 2025a) and a repository of best practices (European Commission, 2025d). The EC and the OECD are working on a framework for AI literacy in primary and secondary education (European Commission & Organisation for Economic Co-operation and Development, 2025).

The OECD Digital Education Outlook 2026 summarizes research on GenAI and proposes principles for effective use, emphasizing pedagogically designed tools and the need for rigorous testing and the avoidance of "false mastery" (Organisation for Economic Co-operation and Development, 2026).

In the United Kingdom, the Department for Education (DfE) published an analysis of opportunities and risks based on interviews and data (Department for Education, 2024a), as well as specific use cases and user studies (Department for Education, 2024b). The DfE also published a policy paper on GenAI in education (Department for Education, 2025), which demonstrates an evolution from observation to practical management and the promotion of safe innovation.

The United States Department of Education published a report titled "Artificial Intelligence and the Future of Teaching and Learning" with recommendations for the ethical and equitable use of AI (U.S. Department of Education, 2023). In 2025, the department published guidelines (Dear Colleague Letter) for the permissible and responsible use of AI in schools and funded programs (U.S. Department of Education, 2025). The White House signed an Executive Order to promote AI literacy and the integration of AI into education and teacher training (White House, 2025).

The Department of Education, Australia (2025) has published a national framework for GenAI in schools, focused on responsible and ethical use and supporting a wide range of stakeholders (teachers, parents, students, policymakers).

In Japan, guidelines were published (Version 2.0) for the use of generative AI in elementary and secondary education (2025), including core principles and specific situations/subjects (Ministry of Education, Culture, Sports, Science and Technology, 2025).

The Ministry of Education, Singapore (2025) has announced an age-progressive framework and resources for parents/students on responsible use, while IMDA is developing programs (e.g., Code for Fun / AI for Fun) for the early introduction of AI concepts in schools (Infocomm Media Development Authority, n.d.).

The Korean Ministry of Education (2025) is introducing AI digital textbooks with approved textbooks and a plan for personalized education for specific grades and subjects.

5.1 Bulgarian Vision for AI in School Education

Ministry of Education and Science (MES) published a Strategy and Proposed Changes to the Curriculum (Grades 3–12). The focus is on general education (grades 3–12) and the cross-curricular integration of AI.

The MES's vision establishes "balance" as a guiding principle: AI should support the cognitive process without replacing cognitive effort, long-term memory, and critical

thinking. The teacher is positioned as the leading factor in the "teacher–AI–student" triad, with an expanded role as an intellectual mentor and navigator in the information environment (Ministerstvo na obrazovanieto i naukata, 2026).

Five key areas (according to the Ministry of Education and Science):

- Knowledge "about" AI (what AI is, how it works; models; prompt engineering; risks).
- Knowledge "from" AI (AI as a source/mediator in subject-specific learning).
- AI in support of students (adaptive exercises, simulations, support for students with special educational needs, etc.).
- AI in support of teachers (planning, differentiation, administrative tasks).
- Skills for using AI as skills for the future (technological, critical, ethical, social).

The vision explicitly identifies risks (hallucinations, algorithmic biases, social engineering, plagiarism, deepfakes), as well as the need for personal data protection and copyright protection. The following are listed as organizational goals: integration of AI into the curricula of all subjects, a national teacher training program, methodological guidelines, and a general AI hub, as well as the adaptation of international tools and the development of Bulgarian platforms (Ministerstvo na obrazovanieto i naukata, 2026).

If approved, these changes will take effect starting in the 2026–2027 school year and will be accompanied by teacher training.

6 Discussion and Forecast

This forecast is tentative and based on current trends in platforms, policies, and pedagogical frameworks. The expected changes can be grouped around the following topics: (i) a shift from chatbots to specialized learning tools, (ii) widespread adoption of AI literacy and teacher training, (iii) the development of AI-resilient assessment, and (iv) stricter privacy and security requirements (especially regarding children).

The following trends are highly likely to emerge:

- Expansion of "purpose-built" AI tutors and integrations into LMS (personalized exercises, error diagnostics).
- Multimodality and voice interfaces in the classroom (especially for language learning and special needs).
- Growth of national frameworks and age-specific guidelines, including AI literacy in curricula.
- Institutional "private" AI environments for schools/universities (data sovereignty; open-source models).
- Shift in assessment: more oral presentations, process-based assessment, and authentic tasks.

The pace of change can be tracked using indicators such as percentage of schools with formal AI policies (high vs. low adoption); availability of AI literacy modules in K-12 curricula (high vs. low coverage); integration of AI into learning management systems (widespread vs. limited use); and changes in assessment practices (substantial uptake vs. institutional resistance).

To have a sustainable impact on actual learning, empirical evaluations and engineering discipline are needed. Key challenges:

- Effectiveness: measuring learning gains (not just satisfaction); randomized trials and replication.
- Equity: digital inequality, linguistic and cultural biases; adaptation for special needs.
- Child safety: minimizing risky outcomes, protection against manipulation and inappropriate content.
- Privacy: minimal data collection, local/sovereign deployments, DLP, and access management.
- Assessment: designing tasks that stimulate thinking and a demonstrable process, rather than final answers.

7 Conclusions

AI-powered learning systems are evolving from generic chatbots into platforms and tutors that combine models, context (RAG), pedagogical rules, and institutional controls. The most successful approaches in 2026–2028 will likely be those that: (i) preserve the learner's cognitive effort, (ii) provide timely and accurate feedback, (iii) undergo empirical testing, and (iv) are implemented with clear safety and privacy policies. The "from first grade to PhD" vision requires age-appropriate progression: from supervised assistive functions in elementary school to instrumental inquiry and reproducibility in graduate school.

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