

Active Learning and Developing Transversal Skills with Artificial Intelligence

How does AI-supported active learning improve critical thinking, collaboration, communication, creativity and learner autonomy?

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Learning Objective

The essence of active learning is that students are not recipients but shapers of the learning process: they ask questions, investigate, experiment, create, argue and reflect. The emergence of generative artificial intelligence (AI) has established a new situation. Experience so far and the first research findings show that AI can be particularly effective in supporting active learning – provided that the teacher integrates it into the teaching process consciously and subordinated to the learning objectives.

In this learning unit, we present how artificial intelligence (AI) can be combined with three proven active learning methods: inquiry-based and research-based learning, the flipped classroom, and project-based learning (PBL¹). After working through the material, teachers will be able to:

- explain why these methods can be more effective with AI than before;
- design AI-supported pre-class activities, research questions, project scenarios and reflection processes;
- use AI in a way that improves students' critical thinking, collaboration and autonomy.

Transversal skills – Why is now the time?

Transversal skills are abilities that are independent of any specific field and are needed in every profession and life situation. The best known of these are the “4Cs” of 21st-century learning: **critical thinking, communication, collaboration** and **creativity**. Closely related to these is **learner autonomy**, i.e. the ability of students to plan, monitor and evaluate their own learning. The European Union's Recommendation on Key Competences (2018) and the LifeComp framework describe the same thing as the competence of “learning to learn”, while DigCompEdu, which describes the digital competences of educators, describes it as supporting collaborative and self-regulated learning and as *empowering learners*.

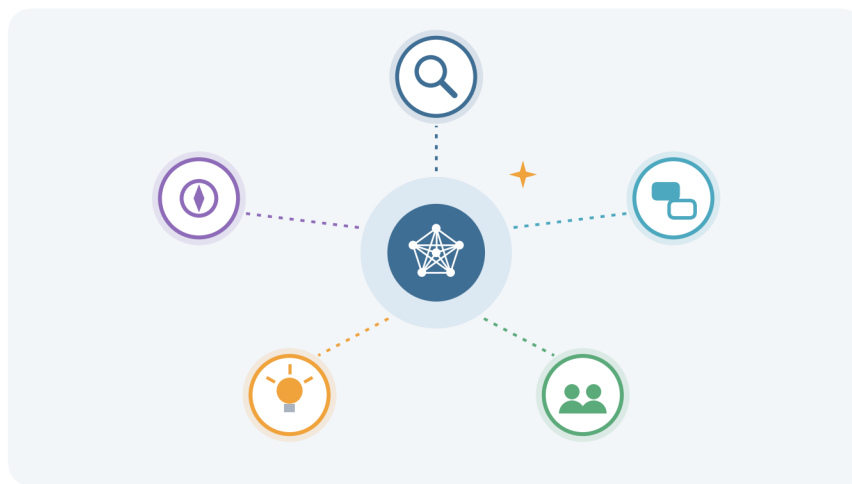
Why does it work better with AI than before?

If a fact, a summary or a piece of program code can be produced in seconds, the value of knowledge shifts: what matters is whether the student can ask a proper question, check the answer, defend position, and create something new together with others. Active learning situations make them practise

¹ Project-based learning is commonly referred to by its abbreviation, PBL.

exactly these skills – and AI helps effectively in planning, designing and managing these situations:

- **as a Socratic partner**, it asks follow-up questions and raises counterarguments – this develops **critical thinking**;
- **as a simulator**, it plays the role of the client, the guest or the expert – this develops **communication**;
- **as an idea generator**, it offers alternatives that the group has to decide on together – this develops **collaboration** and **creativity**;
- **as a tutor and reflection partner**, it adapts to the student's own pace and helps them think through the learning process – this develops **learner autonomy**.



The student at the centre: dialogue with peers and with AI

Though active learning has long been known, yet it appears in everyday teaching practice less often than we would like: it requires a lot of preparation, makes differentiation difficult, and in large groups there is little time for individual feedback. According to international experience, this is exactly where AI helps. In England, teachers using ChatGPT spent nearly a third less time on lesson planning (EEF, 2024). At the same time, the OECD's 2026 report warns that while general-purpose chatbots may improve immediate performance, but not necessarily learning, if students let thinking to them as well.

Pedagogical design determines whether AI strengthens active learning by surging students to think, or works instead of them.

Inquiry-based and research-based learning with AI

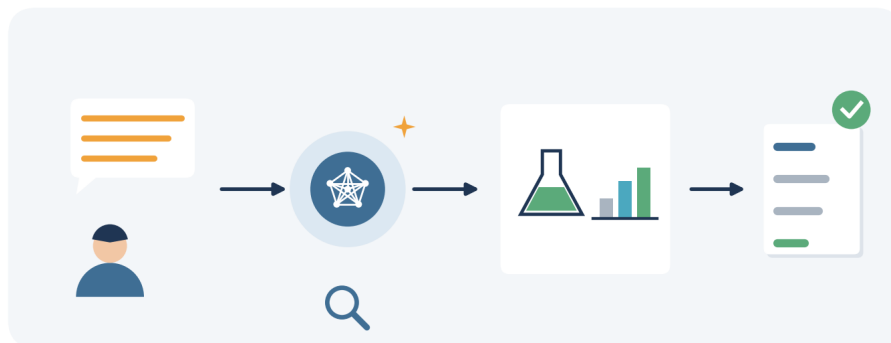
Depending on the role the teacher takes in preparing and conducting the research, and on how independently the students work, the literature uses two terms. In **inquiry-based learning** (*Inquiry Based Learning, IBL*), the questions are typically asked by the teacher, who also guides the discovery, whereas in **research-based learning** (*Research Based Learning, RBL*), students are given more independence and their work follows the steps of scientific research more closely. The phases of the work are the same in both approaches; the difference lies in the role of the teacher and the degree of student independence. AI can support both students and teachers in every

phase – but it can never take over the work of curiosity, questioning and verification.

How can AI help in each research phase?

- **Orientation:** with the help of AI, the teacher can create a realistic case description, a short scenario or provocative questions that arouse students' curiosity. The solution is deliberately left out here.
- **Questions and hypotheses:** students first formulate their own questions and hypotheses, and then ask AI to question them back, look for counterarguments and help them refine the question.
- **Investigation:** AI can review the design of the experiment or survey (What are we measuring? What is the benchmark?), help draft a questionnaire, organise data into tables and create charts. The measurement, the fieldwork and the experiment, however, are carried out by the students.
- **Conclusion:** acting as the “devil's advocate”, AI can offer alternative explanations, and students have to decide, using arguments, which interpretation their data support. Checking sources is also part of the task at this stage.
- **Sharing:** AI can help structure the presentation, make the professional text easier to understand or prepare a summary in a foreign language, but presenting and answering questions remain the students' tasks.

The most important rule: **questioning remains with the student.** If AI formulates the assumption (the hypothesis), the research loses its pedagogical purpose. If, however, students “test” their own hypotheses with AI and have to defend or modify them, critical thinking and reasoning will improve.



Ask, investigate, prove – when AI questions back!

Example: “Why won’t the dough rise?” – inquiry-based learning in baker training

A group of 10th-grade baker students is investigating the proofing process. The teacher does not start with an explanation but with a problem. The students formulate hypotheses (temperature, yeast, salt), carry out an experiment in the training workshop, and, based on their results, write a professional guide for a bakery.

Teacher prompt: write a short, realistic case description for a group of 10th-grade baker students about a small bakery where, over the past week, the bread dough has not been rising properly in the mornings. Include a few telling details (for example cold weather, a new yeast supplier, a new staff member), but do not give the solution! Add five open-ended questions that encourage the students to formulate hypotheses.

Student prompt: our hypothesis is that the dough does not rise because the bakery is too cold. Don't tell us whether we are right! Ask three questions that help us refine our hypothesis, and suggest a simple experiment that we can carry out in the training workshop within two hours. What do we need to measure, and what should the control be?

Skills developed: critical thinking, curiosity, data-based reasoning, joint decision-making.

Flipped classroom with AI

The flipped (or inverted) classroom (*flipped classroom*) is a student-centred method. The “flip” means that working through the learning material does not begin with the teacher’s explanation, but with students studying the digital content provided by the teacher (video, text, interactive task) before class, at their own pace. This leaves more time in class for joint work, problem-solving, discussion and practical application.

According to teachers’ experience, the method has three common obstacles: preparing the pre-class material takes a lot of time, not every student works through it, and the teacher cannot see exactly who has understood what before the lesson. AI offers a solution to all three problems.

Before class – preparatory task with AI

With the help of AI, the teacher can quickly draft the pre-class material: a short explanatory text, a video or interactive learning material, a glossary and/or check questions that can be embedded in the material. The same content can be produced at several levels, which supports differentiation. However, the professional accuracy of the content must always be checked by the teacher.

Students can use AI as a “patient tutor”: if they get stuck, they can ask it questions, but in such a way that it does not give the ready-made answer but helps them with guiding questions. Part of the pre-class task may be for each student to bring two or three questions of their own to class. If the teacher summarises the results of the quiz and the students’ questions with AI – without any personal data – they can already see the typical mistakes before the lesson and can build the lesson on them.

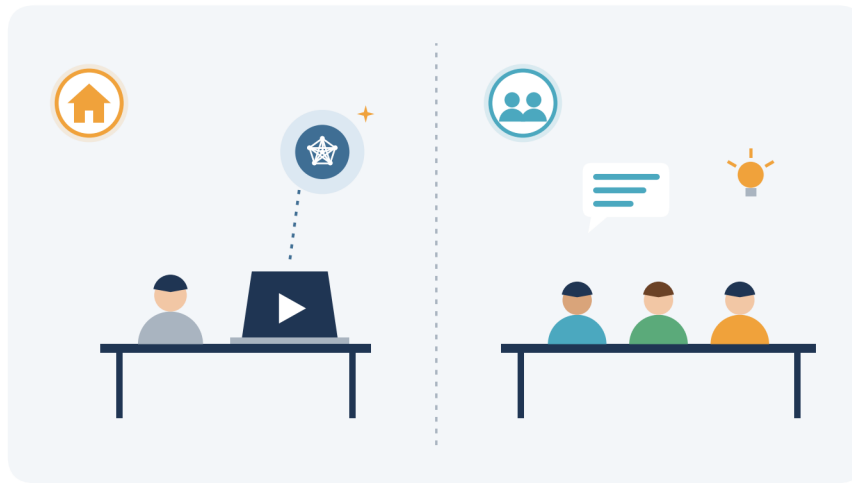
In class – more time for thinking together

Since the basic knowledge has already been acquired before class, in class the students interpret and apply it in groups. Here, AI appears primarily as a simulator and debate partner: it plays the role of a client or guest, formulates opposing views, or gives the group further examples. Meanwhile, the teacher moves between the groups, observes, asks questions and gives immediate feedback – no tool can replace the presence of the teacher.

After class – deepening and reflection

After class, students receive a creative task (for example, they prepare a plan, a guide or a short presentation), on which AI can give formative feedback

based on predefined assessment criteria. The process ends with a short reflection: what did I learn, what was difficult, how did AI help – or where did it mislead me?



Individually at home, together in class

Example: “Allergens in the dining area” – a flipped lesson in hospitality

A group of 11th-grade cook and waiter students is learning about food allergens and how to inform guests. EU regulations define 14 major allergens about which guests must be informed.

- **Before class:** students watch a short video and complete the embedded quiz. Using AI, the teacher also attaches a glossary and a simplified version of the text to the video. Students can practise with AI acting as a tutor and bring two questions to class.
- **Preparation:** from the quiz results, the teacher sees that most mistakes relate to “hidden” allergens (sauces, dressings, coatings), so builds case tasks around these.
- **In class:** the groups receive a real menu and have to decide which dishes contain what allergens. This is followed by a role-play: AI acts as a guest with a peanut allergy, and the students answer as waiters. Another group acts as observers and evaluates the communication: was the answer accurate, polite and safe?
- **After class:** the groups prepare the allergen labelling of the menu and a short information sheet for guests, and then write an individual reflection.

Skills developed: communication, learner autonomy, self-regulation, responsible professional decision-making.

Project-based learning (PBL) with AI

Project-based learning is a teaching and learning method in which the project provides the framework for learning, but every activity is linked to the learning objectives set out in the curriculum. Students work on a real problem related to their own experiences and future profession, plan and decide together, and at the end of the work present a tangible outcome – a product, service, plan

or presentation – preferably also to an audience outside the class. PBL is particularly useful in vocational education and training because it brings school closer to the world of work and enables students from several vocations to work together on a topic. The project consists of well-defined phases, and AI can support both teachers and students in each of them.

- **Driving question and scenario:** a real, open problem linked to the learning objectives.
- **Planning:** roles, tasks, milestones and timeline.
- **Research and creation:** information gathering, experimentation, prototyping, data analysis.
- **Feedback and revision:** peer and self-assessment, teacher and AI feedback, further development of the work.
- **Presentation:** public presentation, preferably also to an audience outside the school.
- **Reflection:** what we learned, how we worked together, how we used AI.

From the teachers' perspective ...

The effectiveness of project-based learning is determined primarily by pedagogical design. In this work, AI can help as a pedagogical assistant to:

- suggest driving questions and realistic project scenarios aligned with the learning objectives;
- break the project down into phases, milestones and tasks, and draw up a timeline;
- develop differentiated roles and tasks for students with different interests and abilities;
- create assessment criteria and assessment tables (rubrics) for peer and self-assessment;
- summarise the groups' interim reports and reflections, and indicate where teacher's intervention is needed.

Teacher prompt

I teach at a vocational school. Design a three-week interdisciplinary project for mixed groups of gardener, electrician and IT students on modernising the irrigation of the school garden. Provide a driving question, the phases and milestones of the project, the roles within the group, and a four-level assessment table (rubric) that, in addition to the professional outcome, also assesses collaboration, communication and creativity. The finished plan is only a starting point, which we will finalise together with the students.

From the students' perspective ...

Working on a project, students learn to interpret the problem together, plan the work, divide the tasks and share responsibility. AI can help them as a conversation partner and a working tool:

- in brainstorming and comparing different solution options;
- in searching for, comparing and verifying information;
- in analysing measurement data and creating tables and charts;
- in writing and debugging program code, with AI also explaining how the code works;

- in structuring the presentation, creating visual elements and writing a summary in a foreign language.



Creating together: the team decides, AI helps

Example (interdisciplinary project): mixed teams of gardener, electrician and IT students investigate how the water consumption of the school garden can be reduced by a third. They design and build irrigation controlled by soil moisture sensors, analyse the measured data, and present the results to the school management and a local horticultural entrepreneur.

Student prompt

These are our three ideas for reducing the garden's water consumption: ... Don't choose for us! Ask two critical questions about each of them, and help us put together a set of criteria (cost, feasibility, impact) on the basis of which we can decide as a team.

Skills developed: collaboration, creativity, problem-solving, taking responsibility, presentation skills.

Feedback and reflection with AI

A common element of all three methods is continuous feedback and reflection. Based on predefined assessment criteria that are also known to the students, AI can give formative feedback during the work, so students can make improvements several times.

- Using AI, the teacher can draft the assessment table (rubric), which they then discuss and finalise together with the students.
- Students can improve the draft of their work with AI feedback based on the assessment criteria before submitting it.
- Before peer assessment, AI can help formulate constructive, specific feedback ("What went well? What could be improved? What do you suggest?").
- AI can summarise the groups' reflections and alert the teacher to recurring difficulties.

In a short "**How did I use AI?**" log, students describe what they used AI for, which suggestions they accepted, which they rejected, and why. Reflection contributes to the development of their digital competences and at the same

time strengthens their autonomy. Responsibility for assessment and grading remains with the teacher.

Student prompt:

We have just finished the project. Ask me five questions, one at a time, about what I learned, what was the most difficult, how we worked together, and what I used AI for. Don't evaluate my answers; just ask follow-up questions if I am too general. At the end, summarise in three sentences what I should do differently next time.

Takeaways for teachers

Applying artificial intelligence in education does not require developing a new, "AI-based teaching method". Introducing AI can make a reality of what progressive pedagogy has been advocating for more than a hundred years: that students ask questions, investigate, create, work together and take responsibility for their own learning.

When digital tools were introduced, many hoped that technology would revolutionise teaching "by its mere presence". It didn't happen so. The interactive whiteboard, the digital textbook or the projector made the traditional, frontal lesson more colourful in most cases, but did not change the logic of learning. One reason for this is that the real obstacle to introducing active learning methods was not a lack of technology, but a shortage of teachers' time and energy. Preparing for a flipped lesson, a project task or differentiated group work requires much more work than traditional explanation. Early digital tools did not reduce this burden; on the contrary, they often added new tasks to it.

This is exactly where AI makes a difference. In a few minutes, the teacher can create tasks of different difficulty levels, guiding questions, debate-starting statements or case studies, which significantly reduces preparation time. In addition, AI can provide something that a teacher in a class of 30 cannot: immediate, personalised feedback and support for every student. Students can ask questions, try things out and make mistakes at their own pace, while the teacher freed of these can support discussion, guide thinking and facilitate joint work in class.

Of course, none of this happens automatically. AI can just as easily serve old, passive learning if students only ask it for ready-made answers. The real value of this opportunity therefore lies not in the tool itself, but in the pedagogical approach with which we use it.

Further reading

- Bastani, H. et al. (2025). Generative AI without guardrails can harm learning: Evidence from high school mathematics. Proceedings of the National Academy of Sciences, 122(26), e2422633122.
- Council of the European Union (2018). Council Recommendation of 22 May 2018 on key competences for lifelong learning (2018/C 189/01).
- Education Endowment Foundation (2024). ChatGPT in lesson preparation – Teacher Choices trial. Evaluation report. London: EEF.
- European Commission (2022). Ethical Guidelines on the Use of Artificial Intelligence (AI) and Data in Teaching and Learning for Educators. Luxembourg: Publications Office of the EU.

- Kestin, G., Miller, K., Klales, A., Milbourne, T., & Ponti, G. (2025). AI tutoring outperforms in-class active learning: An RCT introducing a novel research-based design in an authentic educational setting. *Scientific Reports*, 15, 17458.
- Mollick, E., & Mollick, L. (2023). Assigning AI: Seven Approaches for Students, with Prompts. *The Wharton School Research Paper*. SSRN.
- OECD (2026). *OECD Digital Education Outlook 2026*. Paris: OECD Publishing.
- UNESCO (2023). *Guidance for Generative AI in Education and Research*. Paris: UNESCO.
- UNESCO (2024). *AI Competency Framework for Teachers*. Paris: UNESCO.
- Redecker, C. (2017). *European Framework for the Digital Competence of Educators: DigCompEdu*. Luxembourg: Publications Office of the European Union.

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