



INTERACTIVE TEACHING METHODS FOR
DEVELOPING ARTIFICIAL INTELLIGENCE
COMPETENCIES OF PROSPECTIVE SCHOOL
TEACHERS IN A DIGITAL LEARNING
ENVIRONMENT

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ABSTRACT

The article develops an interactive instructional system designed to cultivate artificial intelligence (AI) competencies among prospective school teachers within a digital learning environment. The study is grounded in the prototyping stage of educational design research, pedagogical task analysis, mapping against the revised Bloom's taxonomy, and scenario-based instructional design. As a result, didactic profiles (specifications) were formulated for eight distinct methods: problem-based AI cases, the "verify and refute" task, prompt laboratories, debating AI outputs, jigsaw verification, microteaching, project sprints, and reflective portfolios. These methods were integrated into a pedagogical cycle consisting of "problem awareness – collaborative testing – pedagogical product creation – reflective assessment". For each method, the learning objective, student activities, teacher role, AI role, assessment evidence, and safety boundaries were established. The findings demonstrate that the didactic efficacy of interactive methods depends not on the technical novelty of the AI tool itself, but on how effectively it engages the learner's thinking, reasoning, verification, and justification of decisions.



INTRODUCTION

AI competence is an integrative quality manifested through purposeful professional activity. Prospective teachers do not attain professional readiness merely by attending passive lectures on technology, but through testing AI outputs, detecting errors, cross-referencing claims against authoritative evidence, designing pedagogical tasks, and defending their instructional decisions. Consequently, interactive methods serve as one of the primary didactic mechanisms for cultivating this competence.

A digital learning environment does not inherently generate interactivity. Interface buttons, chat modules, or automated quizzes on an LMS platform represent mere technical affordances; authentic pedagogical interactivity emerges only when students actively engage with instructional content, collaborate and debate with peers, make reasoned decisions, and critically revise their work [1–5].

When engaging with AI, interactivity demands a specific stance: epistemic caution. Generative outputs often appear fluent and authoritative, yet they carry substantial risks of being factually inaccurate, biased, or entirely unverified. Interactive methods must therefore discourage the passive retrieval of pre-packaged answers and instead cultivate the habits of refining queries, scrutinizing outputs, and generating independent alternative solutions [8; 9].

The objective of this research is to develop a coherent system of interactive methods aimed at cultivating AI competencies in prospective school teachers and to integrate them into a digital lesson cycle.

MATERIALS AND METHODS

The study was carried out during the prototyping stage of educational design research. This stage entailed analyzing core pedagogical problems, selecting theoretical principles, designing prototypes of learning activities, and verifying their internal didactic coherence against defined criteria. Evaluating longitudinal empirical efficacy was reserved for the subsequent research iteration.

Pedagogical task analysis was employed to delineate observable behavioral indicators of AI competence: problem definition, prompt design, output verification, bias detection, didactic scenario design, safety-critical decision-making, learner facilitation, and metacognitive reflection. A corresponding interactive method was selected for each competency area.

The revised Bloom's taxonomy was utilized to map the cognitive depth of each method. While the lower-order levels of "remembering" and "understanding" were confined to brief initial orientations, the core instructional methods targeted higher-order levels: "applying," "analyzing," "evaluating," and "creating".

In the scenario-based design phase, six constitutive elements were defined for every method: learning objective, baseline scenario, peer collaboration model, constrained assistive role of the AI tool, assessment evidence, and ethical/safety boundaries. The methods were engineered not



as disjointed classroom exercises, but as interconnected components of a four-stage didactic cycle.

Table 1. Design criteria for interactive methods

Unit of Analysis	Guiding Question	Design Outcome	Verification Criterion
Cognitive activity	How does the student think?	Bloom taxonomy level	Evident engagement in analysis, evaluation, or creation
Collaboration	With whom and how do they work?	Pair / small-group role distribution	Reciprocal argumentation and mutual accountability
Role of AI	What does the tool perform?	Bounded assistive function	Retention of human agency and final decision-making
Evidence	How is the outcome demonstrated?	Artifact or observable performance	Direct alignment with assessment rubric
Safety	Which risk is mitigated?	Guidelines and verification checklist	Data privacy, confidentiality, and academic integrity

RESULTS

1. Problem-based AI Cases: Students encounter scenarios reflecting authentic school challenges—for example, a teacher uses a generative AI assistant to draft a classroom rubric, but the generated criteria inadvertently disadvantage specific learner groups. Student teams diagnose the problem, analyze stakeholder impacts, and compare alternative pedagogical solutions.

2. "Verify and Refute" Tasks: An AI-generated text, lesson plan, or commentary is intentionally seeded with factual errors, unreferenced claims, or developmentally inappropriate pedagogical advice. Students locate primary sources, refute discrepancies with evidence, and formulate a corrected version. This method strengthens critical scrutiny and information literacy.

3. Prompt Laboratories: Students design distinct prompts for the identical instructional objective, comparatively assess the outputs against standardized rubrics, and examine how variations in context, constraints, target audience, and output formatting influence the generated results. Assessment does not reward the "longest prompt," but rather the precision of pedagogical instructions and verification constraints.

4. Debating AI Outputs: One group defends the viability of an AI-generated instructional proposal, a second group identifies and argues its pedagogical risks and limitations, and a third group acts as adjudicators evaluating argument validity. Roles rotate in subsequent rounds. This



prevents uncritical techno-optimism or blanket rejection, cultivating balanced pedagogical judgment.

5. Jigsaw Verification: A complex AI deliverable is dissected across distinct dimensions: factual accuracy, instructional methodology, linguistic quality, ethics, and child safety. Expert groups audit their assigned dimension before regrouping into mixed teams to synthesize an integrated appraisal. This distributes the verification load while ensuring final decisions reflect comprehensive evidence.

6. Microteaching: A student delivers a 10–15-minute simulated lesson fragment incorporating AI. Peer observers document performance across specific metrics: objective alignment, pupil engagement, appropriate framing of AI, error checking, ethical guidelines, and feedback. Post-session self-appraisals and peer critiques inform iterative lesson redesign.

7. Project Sprints: Small teams work in rapid development cycles to engineer an AI-supported instructional resource for a specific subject and grade level: problem identification, prototyping, testing, bug/error remediation, and presentation. Sprint evaluations prioritize didactic fitness over superficial technical aesthetics.

8. Reflective Portfolios: Students curate prompt histories, error-analysis logs, lesson blueprints, recorded microteaching excerpts, peer critiques, and self-assessments. The portfolio captures longitudinal developmental trajectories and decision-making logic rather than isolated test scores.

These eight methods are systematically unified into a four-stage instructional progression. Case studies and debates are deployed during "**problem awareness**"; prompt laboratories, "verify and refute" tasks, and jigsaw verification occur during "**collaborative testing**"; project sprints and microteaching are enacted during "**pedagogical product creation**"; and reflective portfolios anchor "**reflective assessment**".

Method selection should align with the discipline, baseline student competency, and allocated class time. Introductory coursework favors short cases and verification drills; intermediate coursework emphasizes prompt laboratories and debates; advanced stages demand project sprints and microteaching.

In a digital environment, the instructor shifts from an evaluator-overseer to an instructional designer and learning facilitator. Rather than dictating answers, the instructor sets evidential standards, manages peer collaboration protocols, curates verification sources, and enforces acceptable-use boundaries.

Ultimately, the mastery of interactive methods is not demonstrated by how many AI software platforms a student can list. The definitive evidence lies in clearly framing pedagogical problems, verifying AI outputs, justifying instructional decisions, creating tasks that stimulate school pupils' critical faculties, and iteratively refining teaching materials through reflective inquiry.



Table 2. Competency mapping of interactive methods

Method	Core Competency	Bloom Taxonomy Level	Primary Deliverable
Problem-based AI case	Ethical and pedagogical decision-making	Analysis – Evaluation	Justified solution brief
Verify and refute	Critical verification	Analysis – Evaluation	Evidence-based correction sheet
Prompt laboratory	Instructional task design	Application – Creation	Optimized prompt specification
AI debate	Balanced pedagogical judgment	Evaluation	Argumentation matrix
Jigsaw verification	Collaborative audit	Analysis – Synthesis	Integrated review report
Microteaching	Practical instructional delivery	Application – Evaluation	Recorded lesson fragment
Project sprint	Methodological artifact innovation	Creation	Functional instructional prototype
Reflective portfolio	Metacognitive self-regulation	Evaluation – Creation	Developmental evidence dossier

Table 3. Didactic cycle of interactive methods

Cycle Stage	Methods	Teacher Role	Assessment Focus
Problem awareness	Case study, debate	Context framing and guided questioning	Stance clarity and argument rigor
Collaborative testing	Prompt lab, verification, jigsaw	Resource provider and criteria consultant	Verification precision and source validity
Product creation	Sprint, microteaching	Instructional design advisor	Pedagogical product rubric
Reflective assessment	Portfolio	Formative feedback and pathway guidance	Individual competency profile

ALGORITHM FOR ORGANIZING AN INTERACTIVE INSTRUCTIONAL SESSION

Selecting an interactive method begins with the target learning outcome. When the goal is factual accuracy, "verify and refute" or jigsaw verification is designated; when targeting ethical reasoning, case studies and debates are chosen; when aiming at instructional product design, project sprints and microteaching are utilized; and when evaluating longitudinal growth, the reflective portfolio is assigned. The decisive factor is not the label of the method, but its capacity to elicit the intended pedagogical behavior.



Explicit role distribution during group assignments ensures equitable, active participation. Distinct roles—such as fact-checker, pedagogical analyst, ethical auditor, scribe of arguments, and presenter—are rotated continuously. A situation where one tech-savvy student operates the AI interface while peers remain passive onlookers defeats the purpose of interactive pedagogy; each team member must contribute unique, traceable evidence to the shared deliverable.

Within prompt laboratories, keeping a structured prompt logbook is standard practice. Students record initial queries, returned outputs, detected flaws, modifications made, and the pedagogical rationale behind each refinement. This exercise demystifies prompt generation, transforming it from a trial-and-error trick into a disciplined pedagogical inquiry and reflective process.

Assessment rubrics must capture both the learning process and the resulting product. Alongside superficial presentation quality, evaluation measures the accuracy of problem framing, the validity of source audits, collaborative reasoning, full disclosure of AI contributions, data protection, and self-evaluation. Consequently, artifacts generated effortlessly via AI without critical examination will not receive high marks.

Academic integrity is established from the outset through clear contractual ground rules. Instructors provide written parameters detailing which phases permit AI assistance, which tasks must be performed autonomously, how prompts and raw AI outputs must be appended, and who bears final accountability for citations. This transparency prevents clandestine tool usage and builds a culture of ethical human-AI co-agency.

To ensure pedagogical inclusivity, methods accommodate diverse modes of engagement. Students who feel inhibited during oral debates can contribute through visual argument mapping, written documentation, or session moderation. In settings with unstable internet connectivity, instructors supply pre-generated AI outputs, allowing students to conduct offline critical audits and contextual analyses.

In hybrid designs, preparatory research and preliminary verification take place asynchronously online, whereas high-leverage peer debates and microteaching occur in the physical classroom. The online phase serves to collect materials and map problems, leaving classroom time free for defending pedagogical choices, cross-examination, and collaborative synthesis.

Instructor scaffolding follows a three-step fading model: first, a clarifying diagnostic question; second, a rubric-oriented prompt; and third, if strictly necessary, modeled reasoning. Providing immediate answers curtails students' critical discovery and decision-making; therefore, external support is systematically withdrawn as student autonomy increases.

An illustrative lesson scenario proceeds as follows: student groups receive an AI-generated narrative intended for a secondary history class; teams audit the text for historiographical accuracy, source credibility, and developmental appropriateness; they then debate whether the material should be integrated into school instruction; finally, each team designs an inquiry-based



task that trains secondary pupils to critically evaluate that very text. This workflow seamlessly connects cognitive, technical, and ethical competencies.

Digital footprints offer rich opportunities for formative assessment: tracking prompt revision counts, group comment logs, and rubric-driven revisions makes the student's learning curve visible. However, learning analytics must remain a diagnostic aid rather than an instrument of surveillance; data collection should be strictly limited to what is pedagogically necessary for guidance and reflection.

Table 4. Sample 90-minute interactive lesson plan

Session Phase	Duration	Activity	Assessment Evidence
Problem framing & guidelines	10 min	Framing the AI case study; establishing integrity requirements	Initial problem statement and preliminary team stance
Collaborative verification	25 min	Jigsaw analysis or "verify and refute" activity	Source list and error/discrepancy map
Prompt / solution iteration	20 min	Hands-on prompt laboratory	Prompt logbook entries showing iterative revisions
Pedagogical product design	25 min	Mini-project sprint or simulated microteaching	Completed classroom assignment and scoring rubric
Reflective debrief	10 min	Portfolio documentation and self-assessment	Explicit goal set for subsequent professional growth

The cognitive demand of interactive methods should be scaled incrementally. It is best to begin with texts containing blatant factual errors, transition to ambiguous pedagogical scenarios with multiple justifiable paths, and culminate in open-ended curriculum design. This progression guarantees that foundational auditing skills are internalized before students confront complex instructional judgments.

Close continuity must link individual classroom methods. For instance, misconceptions exposed during a "verify and refute" task inform prompt construction in the subsequent prompt lab; the lab's outputs feed directly into the project sprint; and observational notes from microteaching provide the basis for portfolio self-reflection. Instructional tasks thus form an unbroken continuum of professional growth.

Peer assessment across teams must be strictly anchored in objective rubrics. Instead of subjective feedback ("good job" or "disliked"), peers must evaluate specific indicators: evidence reliability, thoroughness of AI verification, student active engagement, ethical exposure, and the cognitive challenge of the design. Engaging in structured peer review sharpens students' professional vocabulary and evaluative discernment.



Time management is essential when utilizing generative tools. Open-ended prompting can quickly spiral into unproductive tinkering, crowding out pedagogical discussion. Instructors must institute strict time caps, minimum viable product (MVP) benchmarks, and explicit stopping criteria. Prospective teachers learn to make sound instructional decisions based on sufficient evidence rather than chasing an impossible, "perfect" AI output.

Interdisciplinary collaboration unlocks the full value of these methods. Computer science majors analyze technical parameters and algorithmic limitations, education majors structure instructional delivery and learning theories, while humanities students evaluate content nuance, linguistic tone, and historical sources. This complementary balance reflects the cross-cutting realities of educational AI deployment and models authentic professional collaboration.

Instructors should capitalize on unexpected AI errors as productive teachable moments. When a model hallucinates or an online service goes down, the lesson is not aborted; students evaluate failure modes, pivot to secondary sources or offline strategies, and consider technological resilience. This directly builds professional adaptability and contingency planning.

Finally, longitudinal tracking is necessary to determine whether these habits persist. Whether a student who verified outputs in a micro-task continues to uphold that verification standard during clinical teaching practicums is validated through portfolios and mentor appraisals. Genuine competency mastery is proven by the independent transfer of these skills across new subjects, unfamiliar contexts, and time.

DISCUSSION

The proposed instructional methods align with activity-based and competency-oriented frameworks, elevating the prospective teacher's interaction with AI from mechanical tool usage into reasoned pedagogical decision-making. This methodology harmonizes with established national pedagogical theories regarding problem-based, collaborative, and project-based learning [1–5].

Throughout these interactive methods, AI is not positioned as an autonomous "teacher," but is deliberately restricted to being raw input for critical thought, an alternative-solution generator, or a feedback assistant. Evaluative authority and pedagogical responsibility remain unequivocally with the human educator. This represents a concrete instructional enactment of human-centered and ethical AI frameworks [8; 9].

Instructional designs must actively mitigate the digital divide. Not every prospective teacher has personal subscriptions to premium, high-compute AI models. Consequently, cooperative learning structures, instructor-curated AI sample outputs, offline case analyses, and open-source models must be integrated as standard instructional alternatives.

A limitation of the present study is its focus on the prototyping phase of design-based research. Subsequent research iterations must pilot these methods across diverse academic subject areas, quantitatively assess their impact on student learning outcomes and academic integrity, and capture prospective teachers' lived experiences through qualitative interviews.



CONCLUSION

This study designed a didactic system of eight interactive methods to build AI competencies in prospective school teachers. These methods systematically integrate critical verification, peer collaboration, instructional design, ethical decision-making, and metacognitive reflection.

The methods are structured within an instructional cycle of "problem awareness – collaborative testing – pedagogical product creation – reflective assessment". Across each activity, the functional role of AI is bounded, ensuring that human judgment, evidential reasoning, and didactic purpose remain at the forefront.

The proposed framework is readily applicable to specialized courses, subject-matter teaching methodologies, academic seminars, instructional laboratories, and clinical practicums, providing an operational foundation for subsequent empirical and experimental validation.

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