

DESIGNING AI-CT TEACHER: PEDAGOGICAL PRINCIPLES AND ARCHITECTURE OF A CRITICAL THINKING-ORIENTED AI PLATFORM FOR FUTURE ENGLISH TEACHERS

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Abstract

Future English teachers use generative AI daily, but they often accept its answers without checking. Most available AI tools are designed for speed rather than reflection. This paper reports the first phase of a design-based research project. The project runs at Samarkand State Institute of Foreign Languages. This phase aimed to design a web platform for structured critical thinking with AI. The platform is called AI-CT TEACHER. Its design rests on a six-stage cycle: Context, Consult, Critique, Check, Challenge and Conclude. The paper first shows how the design principles were derived. Their sources are critical thinking theory and research on AI in education. It then presents the pedagogical structure, the learning modules and the technical architecture of the prototype. The platform connects to the Gemini model through a secure server-side function. Students therefore never handle API keys. The paper does not report learning outcomes, because the pilot stage has not yet started. Instead, it offers a transparent design rationale that other teacher educators can examine and adapt.

Keywords: *design-based research, generative AI, critical thinking, pre-service English teachers, educational platform, 6C cycle*

1. Introduction

Generative AI tools have become part of the everyday study routine of language students. They ask chatbots to explain grammar, write sample lessons and correct essays. The answers are fast, fluent and usually confident. This confidence creates a new problem for teacher education. A fluent answer invites trust even when it contains errors.

Research already shows the cost of uncritical trust. Lee and colleagues surveyed 319 knowledge workers about their use of generative AI [Lee et al., 2025]. They collected 936 real examples from different professions. The study found that higher confidence in AI was linked with less critical thinking. In contrast, higher self-confidence was linked with more critical thinking. The authors also observed that critical thinking shifts towards verification and integration of AI output. They concluded that AI tools themselves should be designed

to support such thinking. This last conclusion became the starting point of the present project. If tool design affects thinking, then educational tools can be designed to strengthen it. For future teachers, such a tool should also model good practice for their own classrooms.

A second warning comes from research on cognitive offloading. Gerlich studied 666 participants and measured their critical thinking and AI use [Gerlich, 2025]. He found a significant negative correlation between frequent AI use and critical thinking. Cognitive offloading partly explained this link. The youngest group, aged 17 to 25, showed the strongest dependence on AI tools. Gerlich recommended educational strategies that require active engagement with AI. Most pre-service teachers belong to exactly this age group. Therefore, the risk described by Gerlich is not abstract for teacher education. In my view, the answer is not to forbid AI. It is to place AI inside a demanding structure.

Existing chatbots do not provide such a structure. They respond to any question immediately and do not ask the learner to reason first. General guidelines, such as "check the answer", rarely change behaviour. Students need a visible sequence of steps that becomes a habit through repetition. This need motivated the design of AI-CT TEACHER.

The paper addresses two design questions:

DQ1. Which design principles should guide an AI platform that develops the critical thinking of future English teachers?

DQ2. How can these principles be translated into the pedagogical structure and technical architecture of a working prototype?

2. Methods

2.1. Design-based research as the methodological frame

The project follows design-based research. The Design-Based Research Collective described this approach as a blend of empirical research and theory-driven design [Design-Based Research Collective, 2003]. According to the Collective, design and research proceed in continuous cycles. Each cycle includes design, enactment, analysis and redesign. The approach studies learning in real settings rather than in laboratories. It also aims to produce both practical tools and transferable theory. This dual aim fits the present project well. The platform must work in real classes, but it must also clarify how AI-supported critical thinking develops. For this reason, I see design-based research as the most honest frame for a doctoral methodology study.

Wang and Hannafin defined design-based research in more operational terms [Wang & Hannafin, 2005]. They described it as systematic but flexible, and as iterative, collaborative and contextually sensitive. They listed nine principles for conducting such research. Among them are supporting design with theory, setting practical goals and documenting the process carefully. They also stressed that researchers should explain how context

shapes the design. Their emphasis on documentation is especially important at the first phase. A clear record of early decisions allows later readers to judge the final model. This paper is written in that spirit.

McKenney and Reeves divided educational design research into three main phases [McKenney & Reeves, 2019]. The first phase is analysis and exploration. The second is design and construction. The third is evaluation and reflection. They argued that each phase produces its own outputs, such as design principles or prototypes. They also accepted that early phases can be reported before evaluation. The present paper covers the first two phases. Evaluation through a classroom pilot is planned as the next stage.

2.2. Procedure of the design phase

The design phase consisted of three steps. First, theoretical sources on critical thinking were analysed to identify core skills and dispositions. Second, recent studies on AI in education and language teaching were reviewed to identify risks and opportunities. Third, the resulting requirements were translated into design principles, interface decisions and technical solutions. Each decision was recorded in a design log. Early versions of the prototype were revised several times by the author. For example, a seven-stage version with a separate reflection stage was later reduced to six stages. Reflection was integrated into the final stage to keep the cycle shorter and clearer.

3. Results

3.1. Design principles derived from theory

The first source of design principles was critical thinking theory. Facione led an expert panel that described critical thinking as purposeful and self-regulatory judgement [Facione, 1990]. This judgement includes interpretation, analysis, evaluation and inference. It also includes explanation and self-regulation of one's own reasoning. The panel stressed dispositions as well, such as inquisitiveness and willingness to reconsider. Both parts were essential for the platform. Skills can be trained through tasks, but dispositions require repeated situations of choice. Therefore, the platform creates many small moments of choice. In each one, students decide whether to trust AI.

Paul and Elder provided the second theoretical anchor [Paul & Elder, 2019]. They described intellectual standards such as clarity, accuracy, precision, relevance, depth and logic. They argued that good thinkers apply these standards consistently to their reasoning. They also recommended regular questioning as the main method of training. Their standards are easy to translate into concrete prompts for learners. For this reason, the Critique stage of the platform uses these standards as an evaluation checklist. A student evaluates each AI answer against them before moving forward.

Halpern explained why such structure is necessary [Halpern, 1998]. She argued that critical thinking does not transfer across domains automatically. Learners need

dispositional preparation, skills instruction, structure training and metacognitive monitoring. Structure training helps learners recognise familiar problem types in new situations. Metacognitive monitoring helps them evaluate their own reasoning. This model directly shaped the cyclic form of the platform. The same six stages are repeated across different tasks. In this way, the structure becomes recognisable and, ideally, transferable.

Based on these sources and on the AI research discussed above, five design principles were formulated:

DP1. Think before asking. The learner states the context and criteria before any AI interaction.

DP2. Treat AI as a source, not an authority. Every answer is an object of evaluation.

DP3. Make verification visible. The learner records how and where an answer was checked.

DP4. Seek alternatives. The learner asks for counterarguments or a different perspective.

DP5. Close with a reasoned decision. The learner explains the final choice and reflects on the process.

3.2. The 6C cycle as the pedagogical core

The five principles were translated into a six-stage cycle called the AI-CT 6C cycle. Table 1 shows the stages, the learner's action and the role of AI in each stage. The cycle starts and ends with human reasoning. AI appears only in the middle, as material for critical work. This order is deliberate. It prevents the common habit of starting every task with a chatbot.

Table 1. *Stages of the AI-CT 6C cycle in the platform*

Stage	Learner action	Role of AI	Main critical thinking skill
Context	Defines the task, audience and success criteria	Not used	Interpretation
Consult	Formulates a precise question to the AI	Provides an initial answer	Inquiry, clarity of purpose

Stage	Learner action	Role of AI	Main critical thinking skill
Critique	Evaluates the answer against intellectual standards	Object of analysis	Analysis, evaluation
Check	Verifies facts and examples in reliable sources	Object of verification	Evaluation of evidence
Challenge	Asks for counterarguments or alternative solutions	Provides alternative views	Open-mindedness, inference
Conclude	Makes and explains a final decision; reflects on the process	Not used	Explanation, self-regulation

The Context and Conclude stages are AI-free by design. This decision responds to the risk of cognitive offloading described by Risko and Gilbert [Risko & Gilbert, 2016]. They defined offloading as the use of external tools to reduce cognitive demand. They showed that people often offload even when they can perform the task themselves. Offloading saves effort, but it can also reduce the practice of internal skills. Risko and Gilbert noted that this decision is often guided by beliefs about one's own abilities. In my view, this is why the beginning and the end of the cycle must stay human. The learner must frame the problem and own the conclusion. Only the middle part can safely be shared with the machine.

3.3. Learning modules of the platform

The interface is English-first, with short Uzbek notes for support. The platform is student-focused and does not include a teacher dashboard at this stage. It contains five main modules.

My Progress. The learner sees completed cycles and the stages where they spend most effort.

Task Library. The library offers tasks from English teaching practice. Examples are lesson planning, error correction and essay feedback.

6C Consult. The learner works through all six stages with real AI responses at the Consult and Challenge stages.

Method Challenge. The learner evaluates AI-generated teaching ideas and decides which ones are methodologically sound.

Team Competition. Groups answer sets of 5, 10 or 20 questions on critical AI use in a game format.

A separate AI Chat page is also available for free questions. It is placed outside the 6C modules on purpose. Students can compare free chatting with structured work and notice the difference themselves. The combination of structured modules and a free channel follows the logic of blended learning. In such a design, digital tools extend classroom work rather than replace the teacher [Soleyeva & Suleymanova, 2025].

The choice of tasks follows research on AI in language education. Kohnke, Moorhouse and Zou described ChatGPT as a useful tool for explanation, practice and feedback [Kohnke et al., 2023]. They also warned about inaccurate information and academic dishonesty. They argued that teachers need new digital competences to use such tools well. They emphasised that students must be guided in evaluating chatbot output. Their recommendations shaped the Task Library. Each task requires the learner to judge AI output from a teacher's point of view. In this way, the platform trains both critical thinking and professional judgement.

3.4. Technical architecture

The technical design followed one rule: students must never handle API keys. The front end is a static web application hosted on GitHub Pages. AI requests go to a server-side function deployed on Cloudflare Workers. This function holds the key to the Google Gemini API as a protected secret. It also accepts requests only from the platform's own domain. Therefore, the key never appears in browser code, local storage or the public code repository.

This architecture also has a pedagogical meaning. Students do not need to register with an AI provider or configure anything. They enter the platform and start the cycle immediately. The removal of technical barriers keeps attention on reasoning. At the same time, the institution keeps control over which model is used and how. This control matches the UNESCO recommendation to validate AI tools before educational use [UNESCO, 2023].

4. Discussion

The first design question asked which principles should guide such a platform. The design phase produced five principles grounded in theory and recent evidence. Their common idea is simple. AI should enter the learning process only after the learner has

started thinking. It should also leave before the learner makes the final decision. This idea differs from most commercial tools, which aim at instant answers.

The second design question concerned the translation of principles into a prototype. The 6C cycle, the five modules and the secure architecture form one coherent system. The cycle carries the pedagogy, the modules carry the content and the architecture carries the safety. Each layer supports the same aim of active and critical engagement. This coherence is a key requirement in design-based research.

The design also responds to the UNESCO AI competency framework for teachers [UNESCO, 2024]. The framework describes five dimensions of teacher competence. These are a human-centred mindset, ethics of AI, AI foundations, AI pedagogy and AI for professional development. It presents these dimensions at three levels: acquire, deepen and create. The framework places human agency at the centre of every dimension. The 6C cycle mainly develops the human-centred mindset and AI pedagogy. Future teachers learn not only to use AI but also to design tasks around it. In my opinion, this professional dimension makes the platform different from general AI literacy courses.

The design has clear limitations at this stage. First, all decisions were made by the researcher without student feedback. Second, the effect of the platform on critical thinking is still unknown. Third, the platform depends on an external AI provider whose models may change. These limitations define the next research phase. A pilot study with pre-service English teachers will test usability and learning outcomes. Its results will lead to a revised version of the design principles.

5. Conclusion

This paper presented the first phase of a design-based research project on AI and critical thinking. It described how theory and recent evidence produced five design principles. It showed how these principles became the AI-CT 6C cycle and the AI-CT TEACHER platform. The main idea of the design is that human reasoning should frame AI use from both sides. The platform is now ready for a classroom pilot. The next paper will report how future English teachers use it. It will also show what changes in their thinking.

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