

# Architectural Teaching Curriculum Reform under the Integration of "AIGC-Emotion Engineering"

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## ABSTRACT

The rapid integration of Generative Artificial Intelligence (AIGC) into contemporary architectural education has revealed students' tendency to rely excessively on intelligent tools while lacking emotional feedback mechanisms within AI-assisted learning. Taking the curriculum reform at Hebei University of Engineering as a case study, this research outlines specific reform measures under the joint application of AIGC and Emotion Engineering, encompassing four stages: site perception, spatial configuration, iterative evolution, and integrated representation. Analysis of post-course student feedback indicates that the reform effectively enhanced students' abilities in site analysis, spatial logic, and emotional expression, while strengthening their critical thinking skills. The study validates the feasibility of architectural pedagogy reform under the integrated framework of "AIGC-Emotion Engineering".

## KEYWORDS

AIGC; Emotion engineering; Architectural education; Curriculum reform

## 1 Introduction

Artificial intelligence, as a productive force that coexists and co-evolves with human beings, is profoundly reshaping the field of education<sup>[1-2]</sup>. By breaking down traditional educational boundaries, AI promotes a shift from "teacher-centered" to "student-centered" pedagogical models, thereby stimulating students' capacity for autonomous inquiry and learning<sup>[3]</sup>, and providing new driving forces for high-quality educational development<sup>[4]</sup>.

From modular design, computer-aided design, and parametric design to artificial intelligence, the tools and methods of architectural design have continuously evolved alongside technological progress<sup>[5]</sup>. The rapid advancement of generative artificial intelligence has propelled architectural design into a new phase, prompting universities to explore its integration into architectural design education. For example, Tsinghua University has restructured the media of expression and modes of thinking in architectural design education by adopting generative AI as a core tool<sup>[6]</sup>. Southeast University has introduced programming techniques into undergraduate courses, encouraging students to explore computational generation of plans and façades<sup>[7]</sup>. Northeastern University has employed generative AI to reshape the "human-machine-human" interaction framework in design education, thereby transforming the teaching process from a linear workflow to an intelligent collaborative model<sup>[8]</sup>. Tongji University has incorporated intelligent design tool platforms into smart construction courses, exploring a collaborative teaching model involving teachers, machines, and students<sup>[9]</sup> (Table 1). These explorations indicate that artificial intelligence is not merely a tool, but a novel cognitive mechanism capable of driving paradigm shifts in architectural education.

Despite these advances, the application of artificial intelligence in architectural design studios still faces several challenges, including limited general applicability and acceptance, insufficient capacity for addressing complex design problems, and high levels of constraint and difficulty in course implementation<sup>[10]</sup>. On the one hand, professional competencies among faculty members in understanding and applying AI technologies remain uneven, limiting their ability to support the restructuring of teaching systems<sup>[11-12]</sup>. On the other hand, students' understanding of architectural design is often at an early stage, and their ability to evaluate spatial experience and emotional responses remains insufficient. Without systematic guidance, students may become overly reliant on intelligent tools, leading to mechanical adoption rather than critical engagement<sup>[10]</sup>. The concept of Emotion Engineering, originally proposed by Japanese design scholars in the 1970s<sup>[13]</sup>, offers a potential approach to addressing this issue by translating subjective human perceptions into quantifiable data. Through the analysis of physiological signals, Emotion Engineering establishes a connection between affective evaluation and spatial design.

Accordingly, this study introduces Emotion Engineering into an AIGC-assisted architectural design course. CAVE immersive systems and VR head-mounted displays are employed to simulate spatial experiences, while electroencephalography (EEG) and eye-tracking devices are used to monitor and analyze participants' emotional

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responses and perceptual differences across design alternatives. In this framework, AI-generated design outputs and human affective feedback form a closed-loop system, providing an instructional pathway that integrates technological rationality with emotional cognition in architectural education.

Table 1 Comparison of College Design Teaching Models

|                        | Tsinghua University   | Southeast University  | Northeastern University  | Tongji University   | Hebei University of Engineering  |
|------------------------|---|---|--|---|--|
| Pedagogical Philosophy | Fostering Interdisciplinary Thinking and Trans-Media Expression | Guided by Digital-Coded Thinking and the Integration of Programming with Design | "Human-Machine-Human" interaction framework to reconfigure the pedagogical model | It cultivates students' empirical design-scientific thinking by utilizing tools as virtual co-instructors | This approach reconstructs design methodology through the fusion of AIGC and Emotion Engineering |
| Instructional Toolkit  | twelve AIGC tools, four auxiliary tools                         | four self-developed modules on the ArchiWeb platform                            | five custom-trained LoRA models  | five independently developed pedagogical tools  | three specialized AIGC tools, and four types of experimental equipment                           |
| Integration Mechanism  | Appropriate intelligent tools are selected at each stage        | self-developed auxiliary modules are integrated throughout the design process   | custom-trained models facilitate scheme generation                               | intelligent tools are employed throughout the entire workflow   | Integrating Emotion Engineering  |
| Faculty Expertise      | Instruction is supported by interdisciplinary expert guidance   | diverse team responsible for platform development and support                   | instructors skilled in self-training AI-aided models                             | a faculty with interdisciplinary backgrounds proficient in AI, robotics, and MR                           | dedicated Emotion Engineering research teams   |

## 2 Course Objectives, Content, and Methodology

Grounded in the educational philosophy of human-machine collaboration, the course is designed to enhance students' autonomous inquiry abilities and overall design competence under conditions of limited teaching resources. It emphasizes the critical use of generative artificial intelligence, guiding students to appropriately engage AI technologies at different design stages, and cultivating their capacity for critical evaluation and logical construction through diversified outputs.

The course aims to strengthen students' ability to address complex site conditions, with a particular focus on integrating human-centered design logic and artificial intelligence. A balance between AI intervention and student agency is emphasized throughout the course. Excessive reliance on AI-generated results may lead students toward mechanical imitation and passive acceptance, thereby constraining the development of design competence. To address this issue, Emotion Engineering is introduced at the mid-stage of the course, where human perceptual feedback is treated as a quantifiable basis for design evaluation and integrated with AI-generated forms to support rational decision-making. The appropriate configuration of human-machine collaboration in alignment with educational objectives constitutes a central concern of the course design. The course is structured into four sequential phases: Site Perception, Spatial Configuration, Iterative Evolution, and Integrated Representation.

In the first phase (Site Perception), artificial intelligence primarily functions as an auxiliary tool for information organization and graphic translation. Through lecture-based instruction, students are introduced to the concept of site perception, including fundamental knowledge of the interaction between place and environment. Canonical cases are analyzed to guide students in understanding site characteristics and place awareness, establishing a theoretical foundation for subsequent field investigations. Students then conduct on-site surveys, observing and recording site

elements, while employing AI technologies for analysis, extraction, and comparison to improve efficiency. During reviews, instructors comment on and refine each group’s analytical outcomes, summarizing the strengths and limitations of AI-generated information. This process enables students to critically assess both human and machine-based analyses, and to develop analytical abilities grounded in environmental conditions and human-centered needs.

In the second phase (Spatial Configuration), AI technologies are primarily applied to conceptual scheme generation and the exploration of design alternatives. The principles and methods of spatial configuration are first introduced, enabling students to understand the mapping logic between space and function, alongside instruction on relevant intelligent tools required at this stage. Based on hand sketches and SketchUp models, students employ ChatGPT to generate multiple design options from key viewpoints, and use the “Doubao” platform to compare the advantages and limitations of different schemes, thereby avoiding fixation on a single design trajectory. Selected schemes are then justified in terms of spatial logic and functional rationality, with instructors providing real-time feedback to prevent excessive dependence on AI and to reinforce students’ design agency.

The third phase (Iterative Evolution) builds upon the outcomes of the previous stage, using AI tools to deepen students’ understanding of design iteration and contextual construction. The iterative process is first clarified to demonstrate its necessity in design development. Instructors then guide students to engage in an “analysis–optimization–feedback–reiteration” cycle based on SketchUp models and ChatGPT, while conducting horizontal comparisons among multiple generated schemes to help students recognize both the capabilities and limitations of AI at this stage. On this basis, Emotion Engineering experiments are introduced. Students experience the generated schemes through CAV-E immersive environments and VR head-mounted displays, while electroencephalography (EEG) and eye-tracking data are collected and analyzed to quantify emotional and physiological responses, providing affective feedback to support design optimization. This phase emphasizes a dual logic of human – machine co-performance and emotion-driven feedback, with final decisions and refinements determined through joint discussion between instructors and students (Figure 1–3).

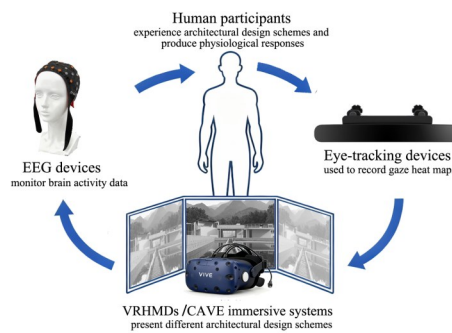


Figure 1 Equipment Utilized in the Emotion Engineering Experiment

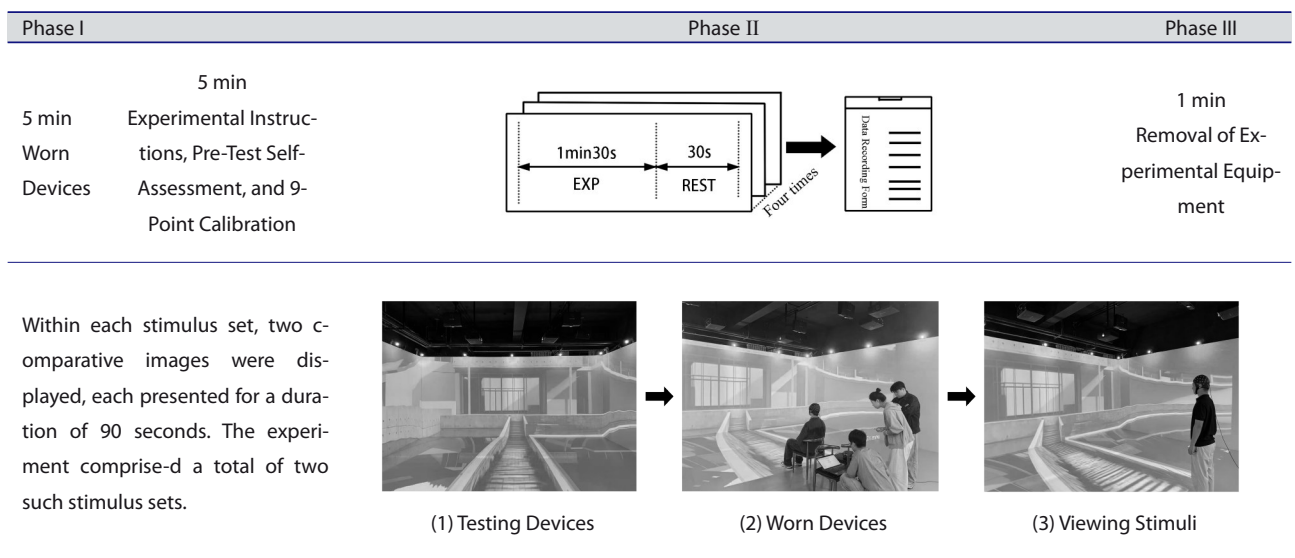


Figure 2 Emotion Engineering Experimental Process

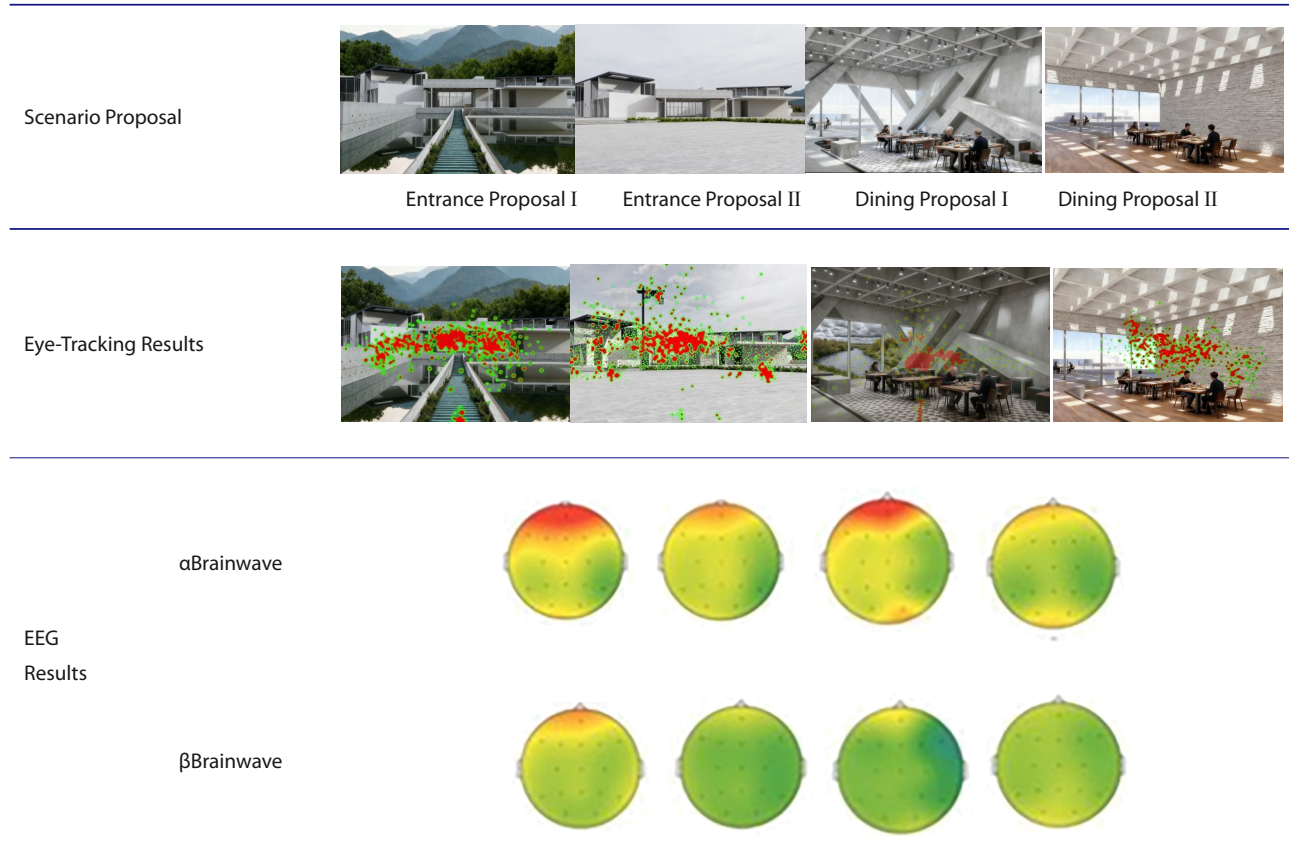


Figure 3 Partial Experimental Analysis Results: Eye-Tracking and EEG

In the fourth stage (Integrated Representation), artificial intelligence is employed primarily for assisted drafting and the optimization of design representation. Students first integrate the analytical outcomes and experiential insights obtained from the previous stages and consolidate AI-generated diagrams produced with ChatGPT to complete formal architectural drawings. Subsequently, through in-class peer review and instructor critique, students are guided to conduct self-evaluation from multiple dimensions, including functional integrity, spatial rationality, environmental adaptability, and technical feasibility. Finally, design proposals are assessed through multi-criteria evaluation jointly conducted by instructors and students, thereby clarifying the supportive role of artificial intelligence as an auxiliary tool in the production and refinement of final design outcomes (Table 2).

Table 2 Course Syllabus

| Course Focus    | Components   | Objectives  | Procedure   | Competencies   | Assessment  |
|-----------------|--|---|---|--|---|
| Site Perception | A. Lecture<br>(4 Credit Hours):<br>① Concept of "Site Perception"<br>② Principles of Place-Making<br>③ Common Smart Technologies       | ① Understanding "Site Perception"<br>② Understanding Principles of Place-Making<br>③ Understanding Smart Technologies | General Education Course  |  |   |
|                 | B. Practice<br>(6 Credit Hours):<br>① On-site Field Research<br>② Intervention of Smart Technologies                                   | ① Mastering Research Methods<br>② Mastering ChatGPT, Kimi, Doubao   | ① Site Survey<br>② Analysis using Doubao<br>③ Instructor-Student Discussion | ① Keyword Extraction via "Doubao"<br>② Text-to-Image Generation with ChatGPT<br>③ Text-to-PPT Generation with Kimi | ① Smart Technology Application (30%)<br>② Rationality of Site and Environmental Analysis (30%)<br>③ Logical Clarity of Drawing Presentation (20%)<br>④ Graphic Richness of Drawing Presentation (20%) |
|                 | C. Presentation<br>(2 Credit Hours + Extracurricular Time):<br>① Site Analysis Diagram Production<br>② "Field Perception" Presentation | ① Mastering Smart Technologies for Analysis Diagram Generation  | ① ChatGPT-Generated Analysis Diagrams<br>② PPT Production using Kimi        |  |   |

Table 2 Course Syllabus(Continued).

| Course Focus              | Components  | Objectives  | Procedure   | Competencies  | Assessment  |
|---------------------------|---|---|---|---|---|
| Spatial Configuration     | A. Lecture<br>(4 Credit Hours):<br>① Principles of Spatial Configuration ② Logic of Function and Massing  | ① Mastering "Spatial Configuration" ② Understanding Technical Constraints   | General Education Course  |   |   |
|                           | B. Practice<br>(6 Credit Hours):<br>① Application of Smart Technologies   | ① Mastering Multi-Scheme Selection<br>② Mastering Smart Technologies  | ① ChatGPT Massing<br>② Doubao Comparison<br>③ Adjustment<br>④ Discussion                | ① ChatGPT Text-to-Image Generation ② "Doubao" Scheme Comparison ③ Kimi Text-to-PPT Generation   | ① Smart Technology Application (30%) ② Rationality of Spatial and Functional Arrangement (30%) ③ Logical Coherence in Drawing Presentation (20%) ④ Graphic Richness in Drawing Presentation (20%) |
|                           | C. Presentation<br>(2 Credit Hours + Extracurricular Time):<br>① Preliminary Scheme Presentation<br>② Final Outcome Presentation                                  | ① Understanding Variant Differences<br>② Mastering Professional Argumentation and Scheme Optimization                     | ① Instructor Feedback ② Drawing Submission  |   |   |
| Iterative Evolution       | A. Lecture<br>(4 Credit Hours):<br>① Iterative- Evolution Process<br>② Advantages and Disadvantages of Smart Technologies<br>③ Materials and Construction Methods | ① Mastering the "Iterative-Evolution" Process<br>② Mastering the Selection of Materials and Construction Methods          | General Education Course  | ① ChatGPT Text-to-Image Generation<br>② Doubao Image-to-Video Conversion<br>③ Immersive System Demonstration<br>④ EEG / Eye-Tracking Data Acquisition | ① Smart Technology Application (30%) ② Rationality of Spatial and Functional Arrangement (30%) ③ Logical Coherence in Drawing Presentation (20%) ④ Graphic Richness in Drawing Presentation (20%) |
|                           | B. Practice<br>(6 Credit Hours):<br>① Scheme Refinement   | ① Mastering ChatGPT Scheme Generation Techniques  | ① Scheme Deepening ② Discussion   |   |   |
|                           | C. Presentation<br>(2 Credit Hours + Extracurricular Time):<br>① Emotion -Assisted Evaluation ② Mid-term Outcome Compilation                                      | ① Understanding "Iterative- Evolution " ② Accurate Outcome Presentation   | ① Integrated Technical Drawings ② Emotion Engineering Integration ③ Instructor Feedback |   |   |
| Integrated Representation | A. Lecture<br>(4 Credit Hours):<br>① Importance of " Integrated Representation " ② Rendering Generation ③ Methods for Logical Evaluation                          | ① Understanding "Integrated Representation" ② Understanding Principles of Place-Making ③ Understanding Smart Technologies | General Education Course  | ① ChatGPT Text-to-Image Generation  | ① Smart Technology Application (20%)<br>② Drawing and Model Presentation (40%)<br>③ Logical Coherence in Drawing Presentation (20%)<br>④ Graphic Richness in Drawing Presentation (20%)           |
|                           | B. Practice<br>(6 Credit Hours):<br>① Final Drawing Production  | ① Mastering Smart Technologies<br>② Mastering the Ability to Evaluate Outcomes  | ① Completion of Final Drawing Production ② Peer Review among Students                   |   |   |
|                           | C. Presentation<br>(2 Credit Hours + Extracurricular Time):<br>① Final Drawing Presentation   | ① Articulating the Value of Smart Technology Integration  | ① Final Drawing Exhibition<br>② Instructor-led Exhibition Review                        |   |   |

### 3 Teaching Conclusions

After the curriculum reform, the overall quality of student work improved significantly. Four student projects from this course were submitted to the 13th Future Designer · National College Digital Art Design Competition, receiving two second prizes and one third prize (Figure 4). Based on student design outputs, questionnaire feedback, and in-depth interviews, the coordinated integration of artificial intelligence and Emotion Engineering was found to substantially enhance students' understanding of complex sites and their design capabilities. Through the four-stage framework—Site Perception, Spatial Configuration, Iterative Evolution, and Integrated Representation—a balance between human-machine collaboration and student agency was achieved, leading to improvements in independent research ability and critical thinking.

Overall, this curriculum reform demonstrates the feasibility and effectiveness of integrating artificial intelligence and Emotion Engineering into architectural design education within resource-limited, non-“Double First-Class” university contexts. However, differentiated feedback across student performance levels was observed. High-performing students reported improved efficiency and a greater focus on design logic and representation. Mid-performing students recognized the value of AI in conceptual development but showed weaknesses in prompt formulation and scheme selection, with a tendency toward tool dependence. Lower-performing students faced higher technical barriers and were more prone to mechanical reliance on AI-generated outputs. These results indicate that while artificial intelligence enhances instructional efficiency and design visualization, insufficient critical guidance may weaken student agency and creativity. Future improvements should therefore emphasize prompt training, affective data interpretation, and faculty development to further enhance teaching quality and student competencies.



Figure 4 Award-Winning Student Projects (Student: Li Jingda; Instructor: Lian Haitao)

### Funding

Natural Science Foundation of Hebei Province (Grant No. E2025402020) and the Special Project for AI-Enabled Teaching Reform in Hebei Higher Education Institutions (No. 2025RGZN008), "Emotion-Oriented Digital Design Teaching Reform,"

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