

A Framework for the Creative Utilization of Generative AI in Higher Education Teaching and Strategies for Associated Risk Mitigation

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Abstract: Against the backdrop of the deepening digital transformation of education, generative AI is injecting new momentum into the reform of higher education instruction, with its powerful capabilities in content generation, personalized adaptation, and interactive feedback. However, current applications of generative AI in universities largely remain at a superficial, instrumental level, lacking a systematic logic for "creative use." This is accompanied by multiple risks, including academic integrity breaches, technological dependence, and data security concerns. Grounded in the Outcome-Based Education (OBE) philosophy and constructivist teaching theory, and considering the characteristics of higher education teaching practices, it defines the core connotations and value dimensions of the "creative use" of generative AI in university instruction. This paper establishes a four dimensional framework integrating "goal orientation, content innovation, implementation pathways, and support mechanisms," it identifies the core risks within the application process and proposes targeted mitigation strategies, offering theoretical support and practical references for universities to standardize and efficiently utilize generative AI to optimize teaching processes and enhance instructional quality.

Keywords: Generative AI; Higher Education Instruction; Creative Use; Framework Construction; Risk Mitigation

1. Introduction

With the rapid iteration and widespread adoption of generative AI tools such as ChatGPT and DeepSeek, their application scenarios in higher education instruction are continuously expanding. From generating course materials and grading assignments to providing

personalized tutoring and research assistance, they are gradually transforming the organizational forms and implementation methods of traditional teaching [1]. Currently, although the application of generative AI in teaching within Chinese universities has begun, numerous challenges persist: First, the application level remains relatively superficial, mostly concentrated on simple content generation, failing to fully leverage the creative value of AI. Second, there is a lack of systematic application frameworks, leading to fragmented and disorganized teaching practices [2]. Third, the risk prevention and control mechanisms are inadequate, with frequent issues such as academic misconduct, technological dependence, and data leakage, hindering the sustainable application of generative AI in higher education [3].

Therefore, this paper focuses on the "creative use" of generative AI in empowering university teaching, aiming to address two core questions: (1) How to construct a scientific and feasible "creative use" framework to achieve deep integration of AI technology and higher education instruction? (2) How to identify and mitigate various risks during the application process to ensure teaching quality and the achievement of educational goals? This research aligns with the contemporary requirements of digital transformation in education and provides new ideas and directions for teaching reform and research in higher education, holding significant theoretical and practical value.

2. Core Concept Definition and Theoretical Basis

2.1 Definition of Core Concepts

Generative AI refers to artificial intelligence technology based on big data and deep learning algorithms that can autonomously generate various types of content, such as text, images,

audio, and video. It possesses capabilities for interactive feedback, personalized adaptation, and autonomous learning [4]. Its core characteristics are "generativity" and "interactivity", with typical examples including ChatGPT and DeepSeek [5].

The "creative use" of generative AI, as distinguished from "instrumental use," primarily focuses on cultivating students' core competencies. It involves integrating generative AI into the entire teaching process — including goal setting, content design, implementation, and evaluation feedback. By innovating teaching models, enriching content, and optimizing the learning experience through AI technology, it aims to achieve a virtuous cycle where "AI empowers teaching innovation, and teaching feeds back into AI application" [6]. Its core lies in "innovation" and "integration," rather than mere "substitution."

2.2 Theoretical Basis

(1) Outcome-based education (OBE) philosophy
The OBE philosophy emphasizes a student learning outcomes orientation, focusing on cultivating students' core abilities and competencies, and valuing the optimization of the teaching process and evaluation of teaching effectiveness [7]. This aligns closely with the core goal of the "creative use" of generative AI—using AI technology to adapt to students' personalized learning needs, helping them achieve predetermined learning outcomes, and providing goal orientation for framework construction.

(2) Constructivist teaching theory

This theory posits that learning is a process where students actively construct knowledge. The teacher's core role is to guide students in active exploration and autonomous learning [8]. The "creative use" of generative AI is precisely based on this theory, utilizing AI tools to provide students with personalized learning resources and interactive scenarios, guiding them to think actively and engage in collaborative inquiry, thus achieving active knowledge construction.

(3) Technology acceptance model (TAM)

TAM emphasizes that users' perceived usefulness and perceived ease of use are key factors influencing technology adoption [9]. This model provides theoretical support for designing implementation pathways and formulating safeguard measures for the "creative use" of generative AI in higher education, ensuring the

framework's feasibility and operability.

3. Realistic Dilemmas in the "Creative Use" of Generative AI in Higher Education Instruction

The creative application of generative AI in higher education teaching has not been without challenges, facing multiple practical obstacles at the application, framework, risk, and teacher levels. These challenges significantly hinder the full realization of its creative potential.

3.1 Application Level: Superficial and Fragmented, Creative Value Underutilized

Current applications of generative AI in university teaching mostly remain at the level of "tool assistance," lacking creative integration [10]. On the one hand, application scenarios are relatively limited, mainly focused on basic tasks like generating course materials, grading assignments, or answering questions on knowledge points. They fail to deeply integrate AI with curriculum system restructuring, teaching method innovation, and evaluation system optimization [11]. On the other hand, applications are fragmented, lacking unified planning and guidance for AI use across different teachers and courses. This prevents the formation of a systematic application model, hindering the full realization of AI's creative value and even leading to superficial applications where AI is used "for the sake of using AI." [12].

3.2 Framework Level: Lack of Systematic Design, Unclear Application Logic

Currently, universities lack a systematic framework for the application of generative AI in teaching. Most teachers lack clear goal orientation and implementation pathways in their application process. First, teaching objectives are disconnected from AI application, with no specific goals set for AI empowerment based on course characteristics and student needs. Second, clear application processes are absent; the role of AI, application scenarios, and implementation steps throughout the entire teaching process are ambiguous. Third, support systems are inadequate, with shortcomings in technical support, teacher training, and resource development, hindering the implementation of "creative use."

3.3 Risk Level: Multiple Prominent Risks,

Inadequate Prevention and Control Mechanisms

The application of generative AI in university teaching faces multiple risks, coupled with a lack of effective prevention and control mechanisms [13]. First, academic integrity risk: Some students use generative AI to ghostwrite papers or complete assignments, violating academic integrity principles and undermining academic atmosphere construction [14]. Second, technological dependence risk: Students may become overly reliant on AI for answers, losing their ability for independent thinking and inquiry, which is detrimental to cultivating core competencies. Third, data security and privacy protection risk: In the process of collecting and processing student learning data, AI tools may pose risks of data leakage or misuse, infringing on student privacy. Fourth, technology alignment risk: The quality of content generated by some AI tools varies, potentially conveying incorrect information and affecting teaching effectiveness.

3.4 Teacher Level: Insufficient AI Application Ability, Teaching Research Awareness Needs Enhancement

Teachers are the core agents in the "creative use" of generative AI. However, the AI application ability and teaching research awareness of some university teachers currently fall short of requirements. On the one hand, some teachers lack in-depth understanding of the technical principles and application scenarios of generative AI, and lack the ability to deeply integrate AI with teaching. On the other hand, teachers' awareness of teaching research is insufficient; they fail to conduct systematic research on AI applications, making it difficult to summarize application experiences and optimize application strategies, thus hindering the continuous advancement and improvement of AI applications.

4. Constructing a Framework for the "Creative Use" of Generative AI in Higher Education Instruction

Addressing the dilemmas mentioned above and grounded in the theoretical basis, this paper constructs a four-in-one framework for the "creative use" of generative AI in university teaching: "Goal Orientation - Content Innovation - Implementation Pathways - Support Systems". It clarifies the core content and logical

relationships of each module to ensure the framework's scientific rigor, feasibility, and innovation.

4.1 Goal Orientation Layer: Anchoring Core Competencies, Defining AI-Empowered Goals

The goal orientation layer is the core of the framework. Based on the OBE philosophy and centered on cultivating students' core competencies, it defines the overall and specific goals for generative AI empowerment in university teaching. The overall goal is to innovate teaching models, optimize teaching processes, and enhance teaching quality through the creative use of generative AI, cultivating contemporary university students with autonomous learning abilities, innovative thinking, practical skills, and digital literacy. Specific goals are divided into three dimensions: (1) Knowledge goals: Utilize AI tools to enrich teaching content and optimize knowledge presentation, helping students quickly grasp core knowledge points and construct systematic knowledge systems. (2) Ability goals: Through scenarios like personalized AI tutoring and interactive inquiry, cultivate students' autonomous learning ability, innovative thinking, critical thinking, and practical application skills. (3) Competency goals: Leverage AI technology to convey correct values, fostering students' awareness of academic integrity, digital literacy, and social responsibility.

4.2 Content Innovation Layer: Integrating AI Technology, Optimizing Teaching Content Design

The content innovation layer serves as the core carrier of the framework, focusing on optimizing and innovating teaching content to achieve deep integration of generative AI and curriculum content [15]. First, personalized content adaptation: Use AI technology to analyze students' learning foundations, interests, and progress, pushing personalized learning resources to meet diverse learning needs. Second, scenario-based content construction: Leverage AI to generate virtual teaching scenarios and case contexts, transforming abstract teaching content into concrete, vivid situations to enhance students' learning experience and comprehension. Third, dynamic content updates: Utilize AI technology to capture industry frontiers and academic hotspots

in real-time, promptly updating teaching content to ensure timeliness and practicality, synchronizing "teaching content with industry demands and academic frontiers."

4.3 Implementation Pathway Layer: Standardizing Application Processes, Enabling Empowerment across the Entire Process

The implementation pathway layer ensures the framework's practical application. It clarifies the application scenarios and implementation steps of generative AI throughout the entire university teaching process, achieving empowerment across the "pre-class, in-class, post-class" continuum [16].

In the pre-class preparation Stage, teachers utilize AI tools to generate course materials, preview materials, and preview tasks. Simultaneously, they analyze students' preview status through AI to accurately identify knowledge weaknesses and optimize classroom teaching plans. Students use AI tools to complete preview tasks and raise questions, preparing for classroom learning.

In the in-class implementation stage, teachers adopt AI tools to deliver teaching content and conduct interactive teaching, innovating classroom teaching forms; students participate in interactions and conduct independent exploration with the help of AI tools to resolve learning doubts and deepen their understanding of knowledge; AI records students' in-class performance in real time and provides teaching feedback for teachers.

In the post-class consolidation stage, AI pushes personalized review materials and homework assignments to students based on their in-class performance and learning status, and meanwhile grades students' assignments, gives feedback, points out existing problems and provides improvement suggestions; teachers analyze students' post-class learning data via AI tools to optimize follow-up teaching plans and realize a closed-loop teaching system.

4.4 Support System Layer: Perfecting Support Systems, Ensuring Framework Implementation

The support and guarantee layer serves as a critical pillar of the framework. A sound support system is constructed from four dimensions: technology, teachers, institutions and resources, so as to ensure the smooth promotion of the

creative use of generative AI [17].

Technological Support: Establish a university platform for generative AI teaching applications, integrating high-quality AI tools and optimizing technical services to ensure the stability and security of AI applications. Create a technology update mechanism to keep pace with AI frontiers, enhancing the platform's functionality and performance.

Teacher Support: Establish a tiered, categorized teacher training system. Conduct AI application training for teachers from different disciplines and with varying years of experience to enhance their AI application ability and teaching research capacity. Form AI teaching research teams, encouraging teachers to conduct research on AI teaching, summarize application experiences, and optimize application strategies.

Institutional Support: Formulate management measures for generative AI teaching applications, clarifying norms and requirements to regulate AI usage behavior by teachers and students. Establish an academic integrity monitoring mechanism to prevent academic misconduct. Improve data security and privacy protection systems to safeguard student learning data.

Resource Support: Integrate high-quality internal and external teaching resources. Collaborate with AI enterprises and research institutions to develop AI teaching resources suitable for higher education. Establish resource-sharing mechanisms to enable sharing across different courses and universities, improving resource utilization efficiency.

5. Risk Mitigation Strategies for the "Creative Use" of Generative AI in Higher Education Instruction

In response to various risks encountered in the creative use of generative AI in higher education teaching, and in combination with the above framework, targeted risk avoidance strategies are proposed from three dimensions: risk identification, prevention and control measures, and long-term mechanisms, so as to ensure the standardized and sustainable development of AI applications.

5.1 Strengthen Risk Identification, Clarify Key Areas for Prevention and Control

Establish a risk identification mechanism for generative AI teaching applications, regularly investigating various risks in the application

process to clarify key areas for prevention and control.

Academic Integrity Risk: Focus on investigating student behaviors such as using AI to ghostwrite assignments or papers.

Technological Dependence Risk: Pay close attention to cultivating students' independent thinking abilities, preventing over-reliance on AI.

Data Security Risk: Focus on investigating the collection, processing, and storage of student learning data to prevent data leakage and misuse.

Content Quality Risk: Focus on reviewing the accuracy and scientific validity of AI-generated content to prevent the dissemination of erroneous information.

5.2 Formulate Targeted Prevention and Control Measures to Address Core Risks

How to Mitigate Academic Integrity Risk?

Strengthen academic integrity education, guiding students to establish correct academic concepts and understand the boundaries of AI use. Establish detection mechanisms for AI-generated assignments and papers, using AI tools to detect AI-generated content and strictly penalize academic misconduct. Innovate assignment and paper design formats, increasing practical and innovative tasks to reduce simple tasks replaceable by AI.

How to Mitigate Technological Dependence Risk?

Clarify AI's role in teaching, emphasizing AI as an "auxiliary tool" rather than a "replacement," guiding students in its proper use. Design inquiry-based and critical learning tasks, encouraging students to think independently and explore, cultivating their core abilities. Teachers should strengthen guidance and supervision of the student learning process, promptly identifying and correcting student behaviors indicating technological dependence.

How to Mitigate Data Security and Privacy Protection Risk?

Improve data security management systems, clarifying the scope of student learning data collection and usage permissions, and standardizing data processing procedures. Select compliant AI tools and platforms to ensure the security of data storage and transmission. Strengthen data security education, guiding teachers and students to cultivate data security awareness and protect personal privacy.

How to Mitigate Content Quality Risk?

Establish a review mechanism for AI-generated content. Teachers should strictly review AI-generated teaching materials and learning resources to ensure accuracy and scientific validity. Choose reliable AI tools with good reputations, avoiding tools with inconsistent content generation quality. Encourage teachers to combine their professional knowledge to optimize and innovate upon AI-generated content, enhancing content quality.

5.3 Establish Long-Term Prevention and Control Mechanisms, Achieve Dynamic Risk Management

How to Establish a Dynamic Risk Monitoring Mechanism?

Utilize AI technology to monitor various risks in real-time during AI teaching applications, issuing timely warnings and taking countermeasures. Conduct regular risk assessments, optimizing risk prevention and control strategies based on the assessment results.

How to Improve Feedback Mechanisms?

Collect opinions and suggestions from teachers and students during the AI application process, promptly identifying and solving problems, and continuously optimizing the AI application framework and risk mitigation measures.

How to Strengthen University-Enterprise Collaboration?

Cooperate with AI enterprises and research institutions to jointly research risk prevention and control technologies and methods for AI teaching applications, enhancing risk mitigation capabilities. Track the development trends of AI technology, promptly addressing new risks brought by new technologies.

6. Conclusion and Outlook

Generative AI presents new opportunities for teaching reform and research in higher education. Its "creative use" can effectively innovate teaching models, optimize teaching processes, and enhance teaching quality. However, current applications face dilemmas such as superficiality, fragmentation, prominent risks, and insufficient teacher capacity. Based on the OBE philosophy and constructivist teaching theory, this paper constructs a four-in-one framework-"Goal Orientation-Content Innovation-Implementation Pathways-Support Systems"-for the "creative use" of generative AI in university teaching, clarifying the core content

and logical relationships of each module. Simultaneously, addressing various risks in the application process, it proposes risk mitigation strategies involving "Risk Identification-Prevention and Control Measures-Long-Term Mechanisms." This provides theoretical support and practical references for universities to standardize and efficiently utilize generative AI for teaching and research.

With the continuous iteration of generative AI technology and the deepening of higher education teaching reform, the "creative use" of generative AI in university teaching will exhibit more diversified and intelligent development trends. Future research can be further deepened in three aspects: First, explore personalized adaptation pathways for the "creative use" framework of generative AI in conjunction with specific disciplines. Second, conduct in-depth research on the deep integration of AI technology with OBE philosophy and curriculum-based ideological and political education to enhance teaching relevance and effectiveness. Third, track the frontiers of AI technology development, study the application of new technologies and tools in higher education teaching, continuously optimize the "creative use" framework and risk mitigation strategies, and promote the continuous improvement of higher education teaching quality.

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