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Teaching Practice and Assessment System Construction of Generative AI-enabled Product Design Course

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Abstract: Generative AI technology is reshaping the field of product design, providing designers with new creative tools and promoting the innovation of design education mode. This paper focuses on the teaching practice and assessment system construction of generative AI-enabled product design courses, aiming to explore how to effectively integrate AI technology in design education. By setting three-dimensional course objectives of knowledge, ability and literacy, adopting a modularized course content system, and integrating innovative teaching methods such as case-driven, project practice and collaborative design workshops, the study realizes a progressive learning path from technological cognition to comprehensive design project practice. Through the construction of a multi-dimensional assessment framework and the combination of process and outcome assessment, we ensure that the assessment results are objective and fair, and provide a basis for curriculum optimization and teaching method innovation. The study explores the new teaching path of generative AI-enabled product design courses, providing a useful reference for the innovative development of design education in the AI era.

Keywords: Generative AI, Product Design Course, Teaching Practice, Assessment System, Human-Machine Collaborative Design.

1. Introduction

Generative AI technology is profoundly changing the creation method and education mode of product design. In terms of application features, generative AI technology provides designers with new creative tools through intelligent text-to-image conversion, style migration, etc. This is evident from the original article, which mentions that " based on the pre-training model of VGGNet19, we train the pictures of traditional Chinese decorations and realize the rapid style migration of traditional decorations". The generation and optimization of 3D models and the intelligent generation of interaction design prototypes further expand the creative boundaries of designers [1]. 3D model generation and optimization, as well as the intelligent generation of interactive design prototypes, have further expanded the creative boundaries of designers [1]. This technological change has also brought about a paradigm shift in product design education, as stated in the original article, "design students are generally intimidated by AI technology, and are less likely to adopt new technologies to enhance product creativity", so it is necessary to guide students to shift from traditional design thinking to AI-assisted design thinking, and to reposition the role of designers. Under the teaching demand of human-computer collaborative design, the construction of the curriculum system needs to be based on constructivist learning theory, and realize project-based learning through "problem-oriented case-based teaching method". This teaching mode can not only "stimulate students' innovative thinking and create a relaxed and efficient technology development environment", but also help to cultivate students' human-computer collaborative design ability, which will provide new ideas and directions for the development of design education in the future.

2. Teaching Framework Design for Generative AI-Enabled Product Design Course

2.1. Course Objective Setting

Under the background of the rapid development of generative AI technology, the goal setting of the product design course needs to carry out multi-dimensional integrated planning (Figure 1). The knowledge objective focuses on enabling students to master the basic theories and practical application methods of generative AI, so as to build a solid foundation for their subsequent learning and practice. The competency goal covers two key aspects: on the one hand, it focuses on cultivating students' practical application of AI tools, adopting case-based teaching, starting from AI technology cases that are closely integrated with design and art, and helping students understand the integration path between technology and design; on the other hand, it focuses on fostering students' design and innovation ability, guiding them to enhance product creativity, and realizing the materialization of the scheme and visualization of the idea. The literacy goal emphasizes the cultivation of students' awareness of human-machine collaboration, focusing on shaping their systematic "AI + design" thinking ability, so that they can fully utilize AI tools to expand their innovative thinking and optimize human-machine collaborative design in their future design practice. The three levels of knowledge, ability and literacy are interdependent and progressive, and together they construct a complete and systematic course objective system, which points out the direction for the teaching of product design courses under the background of generative AI technology [2].

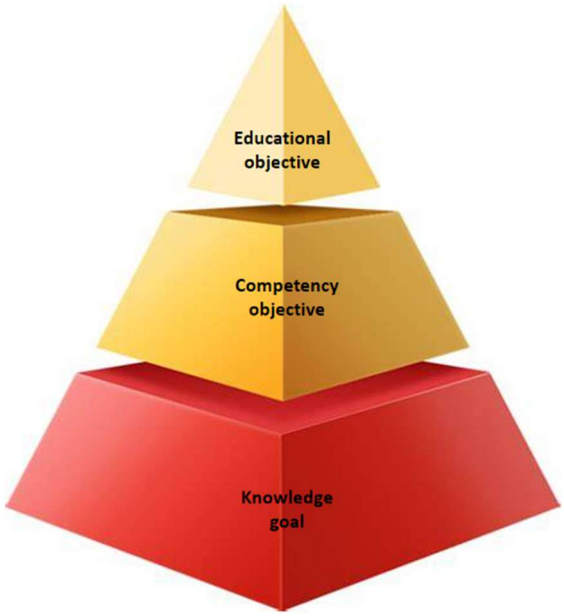


Figure 1. Diagram of the dimensional division of course goal setting

2.2. Course Content System

The course content system is based on modularized design to build a progressive learning path. The basic module is committed to enabling design students to master the principles and tools of generative AI technology, eliminating their fear of AI technology in an easy-to-understand way [3]. The application module focuses on AI-assisted design methods and practices, choosing image recognition, style migration, animation generation, image conversion and other application scenarios that are closely related to design to carry out practical training (see Figure 2). Through the practice of man-machine collaborative design projects, the innovation module guides students to use their extracurricular time to conduct data search and market research, thus cultivating their research and analysis ability, exploring the demand points in the field of "AI+design", and realizing the complete design process from problem discovery to solution implementation. This modularized course content system not only guarantees the systematic learning, but also ensures the practical application of knowledge, providing students with a comprehensive and in-depth learning experience.

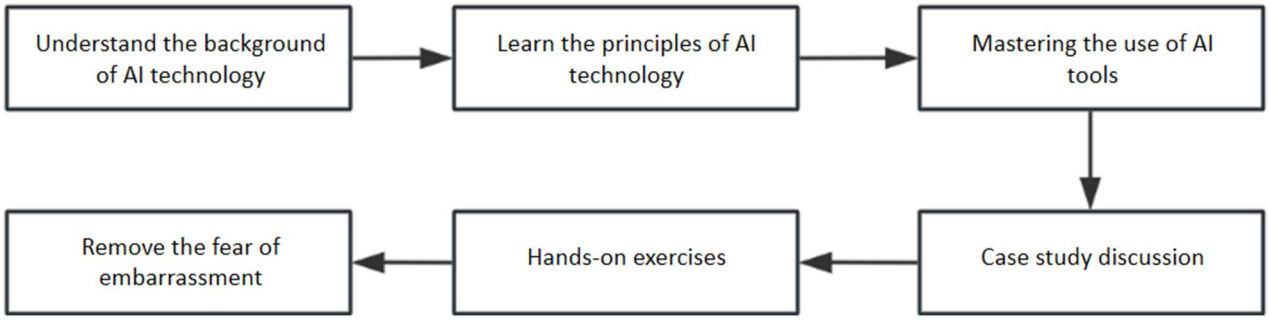


Figure 2. Schematic diagram of the learning path of the foundation module

2.3. Innovation in Teaching Methods

Teaching method innovation is central to the implementation of the course, and it is the key to achieve the expected effect of the course and realize the teaching objectives. In order to achieve ideal teaching results, it is necessary to integrate and flexibly utilize a variety of teaching methods [4,5]. Case-driven teaching method for design students of abstract AI technology concepts cognitive difficulties of outstanding results, through the selection of representative typical cases, guiding students to in-depth analysis and practical exercises, so that the students in the case study intuitive insight into the specific application of AI technology in the field of design and the actual effectiveness of the AI technology, and then build the intuitive cognition of the AI-assisted design to dissolve the unfamiliarity and fear of AI technology. Psychology. Project practice teaching method is problem-oriented, relying on virtual topics or actual projects to carry out teaching, the teacher guides the students to start from the design problems found in real life, thinking about how to integrate AI technology into problem solving and transform it into design opportunities, so that the students can experience the process of applying AI tools in the real design situation, master the operation methods and skills, and enhance the ability to use AI technology to solve actual design problems. [6]. The collaborative design workshop adopts group collaboration mode, encourages students to communicate and discuss, and at the same time sets up simulation roadshow links, invites enterprise designers and technicians to rate and comment on students' works from the perspective of enterprise and market, which is a feedback mechanism that enables students to understand the market feasibility and competitiveness of the design results, and realizes the feedback and optimization of the learning results in a timely manner. This kind of diversified teaching method innovation effectively mobilizes students' interest in learning, promotes students' active learning, and cultivates students' practical innovation ability.

3. Practical Path of Generative AI-Enabled Product Design Course

3.1. Teaching Implementation Process

The teaching implementation adopts a step-by-step three-phase process design. In the stage of technical cognition and tool mastery, the first task is to eliminate the fear of design students of AI technology, through an intuitive and easy-to-understand way to introduce the basic principles of generative AI and commonly used tools, such as text to generate images, image editing and style migration and other basic functions of the operation method. Through demonstration and guidance, the teacher helps students master the basic operation process of mainstream AI design tools and establishes a preliminary knowledge of AI-assisted design. In the AI-assisted design method training stage, the focus shifts to the practical application of the design method, and students are guided to integrate AI tools into the design process through well-

designed practice tasks. This phase emphasizes the combination of technology and design thinking, and helps students form their own AI-assisted design methodology through repeated practice and method summarization (see Figure 3). In the comprehensive design project practice stage, students need to independently complete complete the complete design project, from the demand analysis, program conception to the final presentation, the whole process of using AI tools to assist the design process. This stage focuses on cultivating students' comprehensive application ability and deepening their understanding of human-machine collaborative design through the practice of real projects.

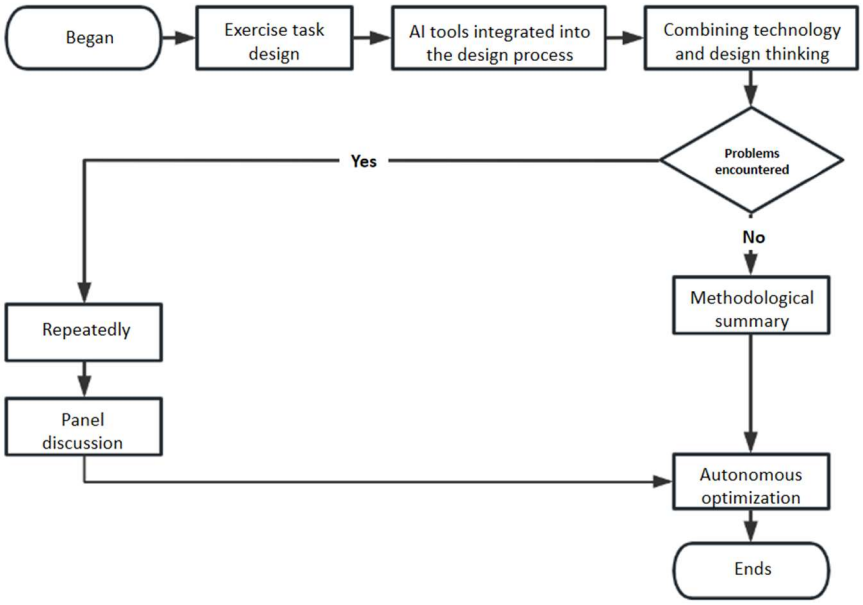


Figure 3. Flowchart of the training phase of AI-assisted design methods

3.2. Teaching Resources Construction

Teaching resource construction is the basic support to ensure the smooth implementation of the course.For the construction of AI tool platform, it is necessary to integrate the mainstream AI design tools and establish a unified learning and practice platform. The platform should contain a variety of functional modules such as text to generate images, image editing, 3D model generation, etc., and be equipped with detailed use tutorials and technical support to ensure that students can conveniently carry out design practice. For the construction of the case library, it focuses on collecting and organizing excellent cases of AI-assisted design, including practical cases in various fields such as product design, interface design, service design and so on. Each case needs to record in detail the design process, technical application methods and final results to provide students with referable learning resources. As for the development of the project library, it is necessary to establish a multi-level design project library, including different types of basic training projects, comprehensive practice projects and innovative exploration projects, and constantly update and improve it according to the actual teaching needs. The systematic construction of these teaching resources provides solid support for the continuous development of the course.

3.3. Analysis of Typical Teaching Cases

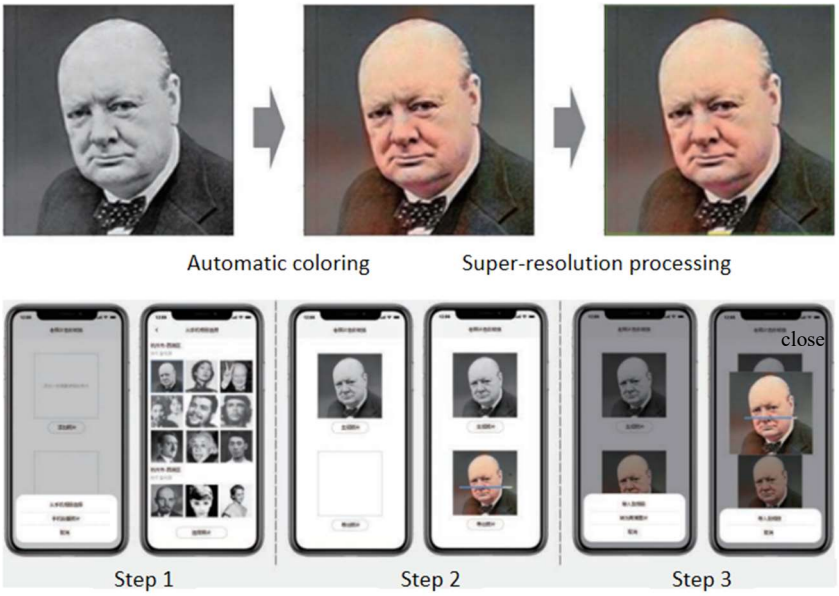


Figure 4. Development diagram of the old photo restoration app

In the teaching practice of generative AI-assisted design, the selection and analysis of typical cases play a key role. Taking the product appearance design based on generative AI as an example, students use deep learning technologies such as generative adversarial network (GAN) to realize the intelligent generation and optimization of product styling [7]. Through AI technology, students can quickly generate multiple design solutions and carry out style migration and feature optimization, greatly improving design efficiency. In terms of AI-assisted interactive interface design, a typical case is the development of old photo restoration app. The case shows how to combine the GAN model and RAISR technology to realize automatic coloring and super-resolution processing of photos. Students formed a clear interaction logic by constructing a complete operation process: from the original grayscale image input, to AI model processing, to the final HD color image output. This case not only demonstrates the students' ability to understand and utilize the AI framework, but also shows how to transform complex technology into user-friendly interface design. In the area of intelligent product service system design, the focus is on how AI technology empowers traditional design work (see Figure 4). Through the construction of intelligent assistive systems, repetitive design tasks can be effectively replaced, providing designers with more space for creative thinking. Although problems such as insufficient technical effects may be encountered in practice (e.g., the super-resolution effect needs to be zoomed in to be observed), this exploratory process of combining AI technology to solve practical design problems precisely reflects the teaching goal of the course: to cultivate students' ability to use new technologies to solve design problems.

4. Construction and Implementation of Course Assessment System

4.1. Design of Assessment Dimensions

The construction of the course assessment system needs to be considered in a multi-dimensional manner to comprehensively evaluate the learning effectiveness of students. In the dimension of technical application ability, the focus is on the students' mastery of generative AI tools, including the ability to understand and utilize various types of AI models, as well as their proficiency in flexibly invoking AI tools in the actual design process [8]. The assessment criteria for this dimension include the accuracy of tool operation, the appropriateness of technology application, and the efficiency of problem solving. In the design innovation ability dimension, it focuses on evaluating students' performance in using AI technology for innovative design, examining whether they can break through the limitations of traditional design thinking and utilize AI tools to open up new design possibilities. The human-computer collaboration capability dimension focuses on how students effectively integrate human creativity and AI's computational power in the design process, and evaluates whether they are able to establish a good human-computer collaboration model. The Project Practice Ability Dimension focuses on students' comprehensive performance in actual projects, including project management ability, teamwork ability, and the ability to transform results.

4.2. Evaluation Methodology System

To build a scientific and complete assessment method system, it is necessary to seek an optimal balance between process and result, qualitative and quantitative evaluation. Process assessment focuses on the dynamic tracking of the whole cycle of learning, and accurately captures the trajectory of students' development of generative AI technology application and design innovation ability through multiple paths, such as classroom observation, quality of homework completion, and staged tests. This kind of continuous assessment can not only timely identify the problems and shortcomings in learning, but also provide teachers with the basis for teaching adjustments and realize tailor-made teaching. Outcome-based assessment focuses on the quantitative assessment of the final learning outcomes, and comprehensively evaluates the completion degree, innovativeness, technical application level and practical value of the project works in multiple dimensions [9]. Through the standardized assessment index system, students' practical achievements and innovative breakthroughs in the field of AI-assisted design can be objectively evaluated. The introduction of the multi-subject assessment mechanism integrates the professional judgment of multiple assessment subjects, such as teacher evaluation, student self-assessment, peer mutual evaluation, and enterprise expert evaluation. Teachers evaluate from the perspective of achieving teaching objectives, students deepen their understanding of the design process through self-assessment and mutual evaluation, and enterprise experts provide professional advice from the perspective of market value and industrialization possibilities. This multi-dimensional assessment system not only ensures the objectivity and fairness of the assessment results, but also provides students with all-round growth feedback, which helps them to make continuous progress and improve their abilities in the field of AI-assisted design. The analysis and application of the assessment results, on the other hand, provides an important basis for curriculum optimization and teaching method innovation, promoting the innovative development of product design education in the AI era.

4.3. Assessment Implementation and Feedback

The assessment implementation and feedback mechanism is the core link to ensure the continuous optimization of the generative AI product design course. In terms of the assessment implementation process, the first step is to establish a semester-based assessment plan matrix, and scientifically distribute the process assessment and outcome assessment in the teaching cycle. Specifically, before each teaching module is carried out, the assessment indexes, assessment methods and assessment focuses are clarified; during the implementation of the module, data on students' performance in the application of AI technology, design innovation and project practice are collected through standardized assessment tools; and at the end of the module, a comprehensive assessment activity involving multiple subjects is organized. The data analysis and diagnosis session adopts a combination of quantitative and qualitative methods, and uses data visualization technology to visually present the development of students' abilities in each dimension. Through data mining technology, the common problems and individualized needs of students in the process of AI-assisted design are identified to provide decision support for tailored teaching. At the same time, a system for analyzing the assessment results is established to regularly summarize the advantages and shortcomings in the construction of the course [10]. In terms of the continuous improvement mechanism, a

closed-loop system of "problem identification - program development - implementation and improvement - effect evaluation" is built. In response to the problems found in the assessment, timely adjustment of teaching strategies, optimization of course content, updating of teaching resources, and upgrading of teaching methods. Through the establishment of course quality continuous improvement files, the implementation of improvement measures can be tracked to ensure the spiral rise of teaching quality. This data-driven dynamic assessment and improvement mechanism effectively guarantees the teaching quality of the generative AI product design course and promotes the continuous innovation and improvement of the course system.

5. Conclusion

This paper focuses on the teaching practice and assessment system construction of generative AI-enabled product design courses. By virtue of text-to-image conversion, style migration and other functions, generative AI technology has revolutionized product design creation and education mode, and driven the transformation of design education paradigm. The objectives of the course are developed from the three dimensions of knowledge, ability and literacy, aiming at consolidating students' basic AI theories, cultivating their ability to apply AI tools and design innovation, and shaping human-machine synergistic thinking. The course content system adopts a modularized design, covering basic, application and innovation modules to ensure systematic learning and effective knowledge application. The teaching methodology integrates case-driven, project practice and collaborative design workshops to stimulate students' interest and sharpen their practical innovation ability. The implementation of the course follows a step-by-step three-phase process, focusing on the in-depth integration of technical knowledge, methodological training and comprehensive project practice. The assessment system builds a multi-dimensional assessment framework, integrating process and outcome assessment to ensure that the assessment results are objective and fair, providing strong support for curriculum optimization and teaching method innovation.

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