Article

Research on the Impact Mechanism and Strategies of Generative AI on the Creative Process of College Students in Design Majors

Qixin Li , Huile Gao *

Soochow University, Suzhou, 215021, China
Correspondence: hlgao@suda.edu.cn

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Abstract: ***Background:*** The rapid development of generative artificial intelligence (AI) is fundamentally changing the creative practices of design students in higher education. This major shift needs a thorough examination of how AI influences their creative development. ***Purpose:*** This study aims to investigate the specific impact mechanisms of generative AI on the creative process of design students and to propose effective, evidence-based optimization strategies. ***Methods:*** We used a rigorous mixed-methods approach, integrating a comprehensive literature review, in-depth case studies, and controlled educational experiments. This allowed for a systematic exploration of how technological intervention facilitates the multidimensional reconstruction of creative thinking. ***Results:*** Our findings highlight generative AI's multifaceted impact on design students. Cognitively, AI broadens conceptual boundaries by enabling vast data retrieval, yet risks over-reliance on existing patterns, which can hinder originality. Behaviorally, AI tools boost prototype iteration efficiency but may inadvertently lessen deep critical thinking. Emotionally, human-machine collaboration stimulates innovation, but can also lead to increased anxiety. Based on these insights, we propose a "three-dimensional collaborative" educational strategy. This includes a curriculum based on an "AI Toolchain Design Methodology," a "Process-Based Creativity Graph" evaluation model, and the establishment of school-enterprise AI design laboratories with ethical guidance. ***Conclusion:*** This research provides a critical theoretical foundation and actionable practical pathways for the ongoing reform of design education in the age of artificial intelligence. It also lays essential groundwork for future longitudinal studies exploring the advance applications of generative AI in educational contexts.

Keywords: Generative AI; Design education; Design creativity; Impact mechanism; Educational strategy

1. Introduction

1.1 Research Background

In today's digital age, the wave of technology is sweeping across the globe. Artificial intelligence (AI) is profoundly changing the developmental patterns of various fields at an unimaginable speed and intensity. Among these changes, generative AI stands out as a leading force in AI, playing an indispensable and important role in the innovation process of design students. With continuous technological advancement and its increasingly widespread application, generative AI is reshaping design education, presenting new opportunities and challenges for cultivating professional design talents with innovative thinking and practical abilities. According to the latest forecasts from the International Data Corporation (IDC), by 2023, over 50% of global enterprises will actively adopt AI technology to enhance their innovation capabilities in products and services. This trend is particularly evident in the field of design. The powerful

capabilities of generative AI enable design students to overcome the limitations of traditional design tools and methods, quickly generate design sketches, and obtain diverse creative solutions. This ability expands the boundaries of design thinking, allowing students to freely explore a broader design space and stimulate their innovative potential. Taking Adobe's Sensei platform as an example, it utilizes advanced machine learning technology to provide designers with unprecedented efficiency and innovation support during the image editing and creation process. Designers can quickly accomplish complex image processing tasks and gain rich creative inspiration through simple operations and instructions. Stanford University professor John Hennessy once pointed out profoundly that "technological progress is a key force driving social change." In this context, in-depth research on the impact of generative AI on the innovation processes of design students not only unveils the complex interaction between technology and creativity but also provides significant guidance for cultivating future design innovation talents.

1.2 Research Purpose

This study explores how generative AI can be effectively integrated into design education to enhance students' creativity and problem-solving skills. By reviewing the literature, conducting empirical analysis, and studying cases, the research will propose practical teaching strategies. These strategies will offer new perspectives and methods for educational reform in design and improve students' innovative abilities. The curriculum will be optimized to include generative AI courses, allowing students to systematically learn about the principles and applications of generative AI. Teaching methods such as project-based learning will be used to provide practical experience. Interdisciplinary collaboration will be encouraged, ensuring that design education meets contemporary needs and cultivates innovative, practically skilled design professionals.

1.3 Research Content

When exploring the role of generative AI in the innovation process of design students, it is necessary to comprehensively consider its profound impact on the creative process in the three key dimensions of cognition, behavior, and emotion. In terms of cognitive dimension, generative AI, with its powerful data processing and analysis capabilities, can provide immediate feedback and almost infinite iteration possibilities for design students. This ability greatly expands students' thinking boundaries, enabling them to break through the limitations of traditional thinking and explore broader design spaces. For example, previous studies have shown that design students using generative AI have an average increase of 30% in the number of iterations when solving complex problems. This significant growth indicates that AI tools can encourage students to engage in deeper thinking and extensive exploration, helping them find more innovative solutions when facing complex design challenges. In terms of behavior, deep AI intervention has completely changed the design workflow of students. Generative AI tools can quickly generate design sketches and prototypes, enabling students to rapidly prototype and test design concepts at an unprecedented speed. This greatly accelerates the entire transformation process from the initial conceptual idea to the final product implementation, improving the execution efficiency and success rate of design projects. For example, in the field of product design, students can use generative AI to quickly generate multiple product prototypes, optimize the design through simulation testing and user feedback, and ultimately determine the best solution. In terms of the emotional dimension, the auxiliary role of AI can, to some extent, reduce frustration in the design process and enhance students' confidence and creativity. The design process often has many challenges and difficulties, and students may feel lost and frustrated when faced with complex design tasks. Generative AI can provide students with creative inspiration and solutions, helping them overcome difficulties and enhance their confidence.

Empirical studies on AI-assisted emotional regulation demonstrate significant reduction in creative frustration (Wang, 2023), validating AI's role in maintaining psychological resilience during complex design processes. As Einstein once said, "Imagination is more important than knowledge." Generative AI provides students with a key to unlocking infinite possibilities, allowing them to transform their imaginative ideas into practical design results, thereby emotionally stimulating their innovative potential and encouraging them to actively engage in design and creative activities.

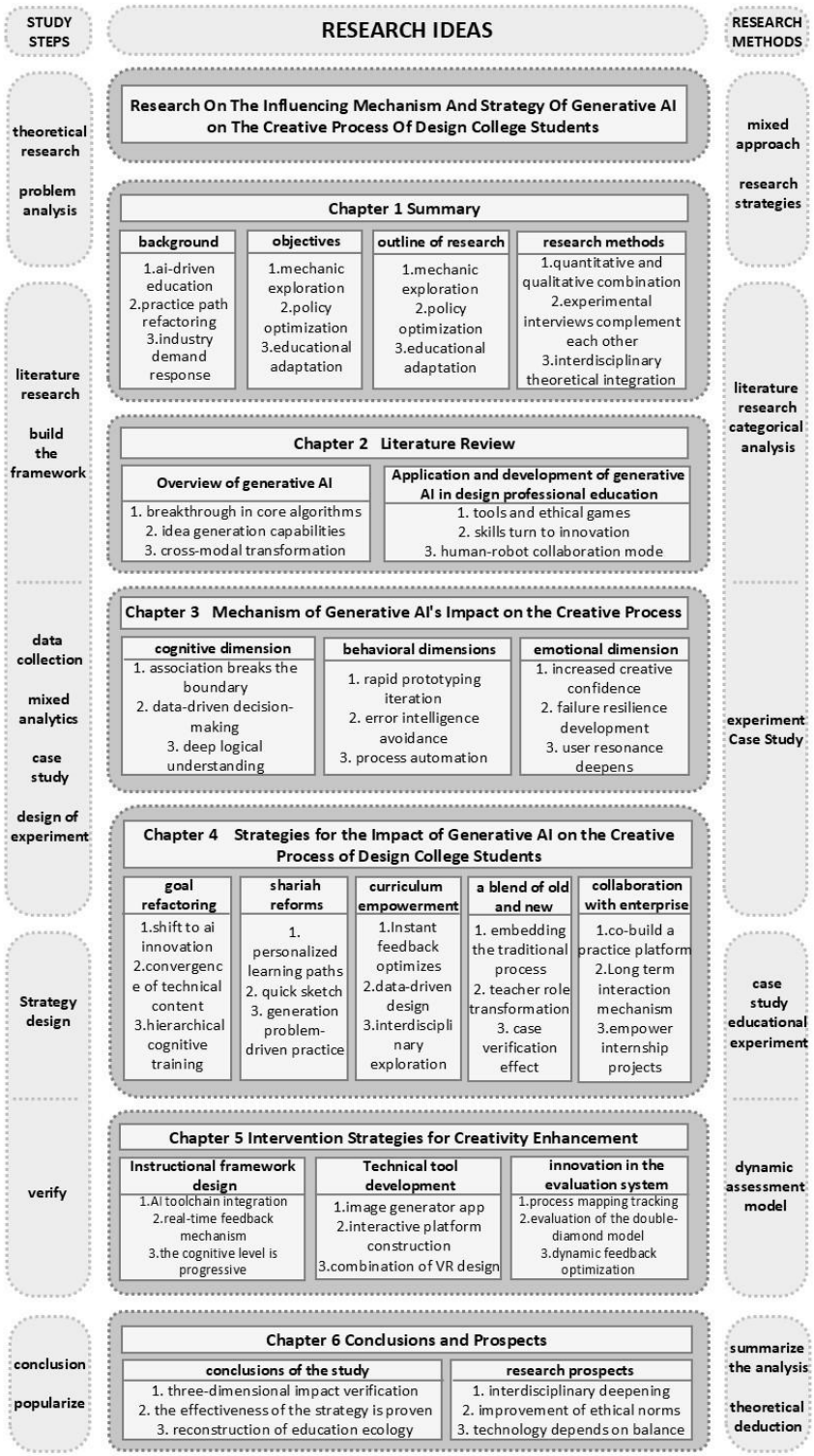

Figure 1: Frame diagram

1.4 Research Methods

This study aims to assess the impact of generative AI on students' innovation abilities through pre- and post-use testing, both quantitatively and qualitatively. Qualitative methods include interviews and observations to explore students' interactions with AI and its effect on their creativity. The research will also incorporate educational and psychological theories to ensure scientific rigor and contribute empirical evidence to design education, promoting the effective use of AI in this field.

2. Literature Review

2.1 Overview of Generative AI

In recent years, generative AI has become a shining star in the field of artificial intelligence and has played an increasingly important role in the innovation process for design students. It skillfully imitates the human creative process and is capable of independently generating novel and unique design concepts, sketches, and models, greatly expanding the teaching and practical boundaries of design studies. For example, deep learning-based Generative Adversarial Networks (GANs) have been widely applied to generate new works of art and design prototypes. Breakthroughs in models like DALL-E demonstrate how AI-generated visual effects transcend traditional methods (Li, 2023), fundamentally reshaping design education paradigms. This technological evolution builds upon pioneering research that mapped AI's transition from theoretical concepts to practical design tools (He & Yang, 2018), establishing foundational workflows for contemporary applications. Their breakthrough progress in the field of image generation, such as DALL-E and StyleGAN models, has been able to create stunning visual effects. These achievements have attracted widespread attention not only in the professional field but also have a profound impact on design education. Steve Jobs once said, "Innovation is different from leaders and followers." The introduction of generative AI is an important manifestation of innovation in design education. It not only changes students' learning methods, allowing them to access cutting-edge technology and design concepts, but it also promotes the forefront development of design education, prompting educators to constantly explore new teaching models and methods to meet the demand for design talents in the new era.

2.2 Application and Development of Generative AI in Design Education

With the vigorous development of Artificial Intelligence-Generated Content (AIGC) technology, its application and impact in design education have become a focal point of research in academia and education in recent years. Numerous scholars have conducted in-depth research in this field and achieved significant results. Scholars generally believe that generative AI is not only a powerful technological tool for enhancing students' creativity but also an important driving force for ethical controversies and educational transformation. On the one hand, generative AI can provide students with rich creative inspiration and efficient design assistance, helping them generate a large number of design solutions in a short period of time, improving design efficiency and quality. On the other hand, its application has also raised a series of ethical issues, such as copyright ownership and originality protection, prompting educators to rethink the goals and methods of design education. The research perspective on the impact of generative AI on the creative process of design of major college students has undergone an evolution from technological empowerment to ethical reflection and then to educational model reconstruction. Early research mainly focused on the efficiency improvement function of AI tools. With the widespread application of technology, research has gradually shifted towards technological alienation and subjectivity crisis. In recent years, emphasis has been placed on interdisciplinary collaboration and education system reform. This article argues that the core contradiction of this issue lies in the tension between technological

empowerment and ethical risks, as well as the dynamic balance of the "human AI" collaboration mechanism in educational transformation. How to effectively avoid potential risks while fully leveraging the advantages of generative AI technology and achieving harmonious coexistence between technology and humanities is an important issue that needs to be addressed in current design education.

Existing research can be divided into the following three categories based on thematic focus:

The first type of research focuses on the mechanisms by which technology empowers creativity, with the core debate being whether generative AI is a "replacement tool" or a "collaborative partner". One viewpoint suggests that AI significantly improves design efficiency through personalized learning paths and intelligent tools such as multi-agent interaction systems and low code generators, enabling students to quickly iterate solutions and expand creative boundaries. For example, Xu and Zhang's (2020) research shows that programming interactive learning systems based on generative AI can automatically generate diverse design prototypes according to student needs, providing rich creative options. Another viewpoint suggests that the convergence of AI generated results may lead to homogenization of design thinking, and originality needs to be maintained through critical screening strategies. Chen (2023) found that if students overly rely on AI generated solutions, they may gradually lose their independent innovation ability, so it is necessary to focus on cultivating their ability to deeply process design results. From this, it can be seen that technology empowerment research reveals a basic consensus: the creativity enhancement effect of generative AI highly relies on the guidance of human input.

The second type of research focuses on ethical challenges and the maintenance of design subjectivity, with the core contradiction being the conflict between technological convenience and academic ethics. Some scholars have pointed out from a practical perspective that the ease of use of generative AI may trigger plagiarism, and it is necessary to regulate the boundaries of technology use through self-regulated learning and ethical education. The research by Wang and Huang (2024) suggests that students may overlook academic integrity and copyright issues when using generative AI due to its convenience. Therefore, it is necessary to strengthen ethical education and guide students to use AI tools correctly. Another batch of research criticizes AI's dissolution of design subjectivity from a philosophical and aesthetic perspective, arguing that generative AI's design process inherently embeds 'value-laden' technology (Wang, 2022), which demands students' sustained critical awareness, and students need to maintain value sensitivity and critical thinking in tool use. Ma (2020), Tao and Liang (2023) pointed out that although AI-generated design solutions may be innovative in form, they often lack profound cultural connotations and humanistic care. Students should always maintain a keen perception and independent judgment of the design value while using them. In addition, the human-machine collaborative task model proposed by Li and Wang (2023) ensures the originality of students' contributions through algorithmic evaluation, providing a technical solution for ethical practice. Compared with the first type of research, ethical reflection literature emphasizes the irreplaceability of "people" in the application of technology. However, its limitation lies in the lack of actionable intervention tools and culturally adaptable design. The translation of ethical principles into specific teaching practices still needs further exploration.

The third type of research explores the transformation of educational models and interdisciplinary collaborative innovation, focusing on how generative AI can reconstruct the goals and methods of design education. Some scholars have proposed that AI technology is driving education to shift from skill training to innovative ability development, and interdisciplinary projects such as "murder mystery" design are needed to reshape students' collaborative thinking and problem-solving abilities. The "Artificial Intelligence Design Script Kill" project by Liu and Zhang (2024) has verified that the interdisciplinary integration of computer science and art design can effectively

integrate knowledge systems and enhance comprehensive innovation capabilities. Another batch of research emphasizes the need for systematic restructuring of the education system, including redefining talent development goals, optimizing evaluation criteria, and balancing technological dependence and critical thinking. This systemic restructuring finds concrete implementation in environmental design's digital pedagogy reform (Xu & Gao, 2024) and urban planning's professional knowledge + AI' dual-drive model (Li et al., 2024), both demonstrating significant innovation efficacy. Qiu and Chen (2025) further pointed out that it is necessary to optimize ethical frameworks and evaluation systems to avoid risks such as plagiarism, while utilizing AI to improve efficiency, ultimately building a "human AI" collaborative education ecosystem that balances technological empowerment and humanistic values.

Table 1: Summary of Literature Features

Research Direction	Reference	Trait
Technology empowers the mechanism of stimulating creativity	<Exploration of Innovation in Urban and Rural Planning and Design Education Driven by Professional Knowledge and Artificial Intelligence: Taking Residential Planning as an Example>, <Design and Research of Interactive Learning System for College Students' Programming Based on Artificial Intelligence>, <Does generative AI make us more creative>, <Research on Criticism of Artificial Intelligence Design>, <Design of a Psychological Health Early Warning System for College Students Based on Artificial Intelligence Technology>, <Learn to Ask: Research on Collaborative Learning Mode between College Students and Generative Artificial Intelligence>	Focusing on the duality of generative AI as an "alternative tool" or "collaborative partner", it emphasizes that although it can improve design efficiency and creative boundaries through intelligent tools, it needs to rely on human guidance to avoid homogeneity of thinking and creative dependence. It also reveals the dialectical relationship between efficiency and risk in technology applications.
Ethical challenges and the maintenance of design subjectivity	<Promoting or Suppressing: The Impact of Generative Artificial Intelligence on College Students' Creativity>, <Philosophical Reflections on Artificial Intelligence Design>, <Design and Rationality: Aesthetic Reflection on Artificial Intelligence Design>, <Student Homework Design and Evaluation in the Era of Generative Artificial Intelligence>, <Research on Ethical Challenges and Responses in Artificial Intelligence Design>	Criticizing the dissolution of design subjectivity by AI, it is pointed out that technical convenience may induce plagiarism and ethical anomie. It advocates maintaining academic integrity and humanistic connotation through ethics education, value sensitivity cultivation and human-computer collaboration model, highlighting the "irreplaceability of people" and the complexity of technical ethics practice.
Transformation of education model and interdisciplinary collaborative innovation	<Artificial intelligence design, from research to practice>, <Designing "Murder Script" with Artificial Intelligence - Interdisciplinary Learning Program in Computer and Art Design>, <Research on the transformation and innovative development of higher private education led by artificial intelligence: taking design education as an example>, <Cultivation of College Students' Critical Thinking Ability in the Era of Artificial Intelligence: Opportunities, Challenges, and Paths>, <"Artificial Intelligence + Design" - New	This paper discusses the transformation of the education model driven by generative AI from skill training to innovation ability training. It proposes that it is necessary to balance technology dependence and critical thinking through interdisciplinary collaboration, evaluation system optimization, and systemic change. Finally build a "human-AI" collaborative education ecology that takes into account technology empowerment,

	Exploration of Teaching Practice for Product Design Courses in the Design Major>, <Exploration of Artificial Intelligence Technology in Practical Teaching of Art and Design Major>, <Research on the Teaching Mode of Design Studies Assisted by AI Intelligence: The Role and Influence of Artificial Intelligence>	ethical adherence and humanistic values.

3. The Impact Mechanism of Generative AI on the Creative Process

3.1 Cognitive Dimensions

In the context of the current digital wave sweeping through various industries, generative AI has become deeply integrated into many professional fields, and the innovation process for design students is no exception. In this process, the cognitive dimension gradually emerged as a key factor influencing students' creativity. The cognitive dimension, as a core component of human intelligence, covers multiple important aspects, such as individual perception of external information, internal information processing mechanisms, and strategies for solving complex problems. For students majoring in design, improving their design innovation ability requires breakthroughs and expansion at the cognitive level. Generative AI technology, especially advanced algorithms based on deep learning, is reshaping the cognitive landscape of the design field in unprecedented ways. Taking Generative Adversarial Networks (GANs) as an example, it consists of two parts: Generative Networks and Discriminant Networks, which interact and co-evolve with each other. Generative networks are responsible for generating new design samples based on learned data patterns, while discriminative networks evaluate the authenticity of generated samples. Through repeated games, GANs can accurately mimic human creative thinking patterns. In a cutting-edge study targeting professional designers, participants successfully created visual effects that traditional methods could not achieve while using GANs to assist in design. This fully demonstrates that AI provides design students with a new perspective and thinking path at the cognitive level, helping them break free from the limitations of traditional thinking and explore broader creative spaces. Design is not just a simple combination of appearance and feel it also involves a comprehensive consideration of how a product or work operates and interacts with users. The profound insights of cognitive psychologist Donald Norman have important implications in this context. Generative AI can deeply analyze the complex relationships between design elements and user needs by simulating human cognitive processes. For example, when designing an intelligent electronic product, AI can quickly process a large amount of user usage data, uncover users' operating habits and preferences in different scenarios, and help students understand the internal logic and functionality of the design. This enables students to make a cognitive leap from simple imitation to genuine innovation, enabling them to create more functional and innovative works that meet the diverse needs of users.

3.2 Behavioral Dimensions

With the rapid development of generative AI technology, its involvement in the design field has become a trend, which significantly changes the actual operational behavior of design students in the design process and has a profound impact on their behavioral dimensions. In the traditional design process, students often need to spend a lot of time on repetitive work such as sketching, scheme modification, and effect verification. This not only limits the rapid iteration of creativity but also quickly leads students to the dilemma of fatigue and inspiration depletion. The emergence of generative AI tools is like injecting a powerful catalyst into the design process. Using

generative AI tools, students can iterate design concepts at an astonishing speed, generating many creative solutions in a limited time. According to a rigorous empirical study, students using generative AI can generate an average of over 30% of creative solutions in design tasks. This efficiency revolution has catalyzed the 'AI + Design' pedagogy in product design courses (Tan et al., 2020), achieving breakthroughs in both the quantity and quality of creative outputs. , This not only significantly improves their design efficiency but also greatly enhances their innovation, enabling them to stand out in fierce competition. Taking the course assignments of automotive design students as an example, after using AI-assisted design tools, they are able to generate various exterior and interior design solutions for car models in a short period of time and through continuous optimization and screening, ultimately determine the best design, which was unimaginable in the past. In addition, AI-assisted design can also use sophisticated algorithm optimization to help students sensitively discover and avoid common errors in the design process, thereby significantly improving design quality. For example, through machine learning algorithms, AI can quickly identify and prompt for inconsistencies or potential design issues, which often require designers to spend a lot of valuable time and effort to discover in traditional design processes. In architectural design, AI can automatically detect the rationality of building structures, avoiding safety hazards and construction difficulties caused by design errors. The application of generative AI has not only significantly improved the operational efficiency of design students, but more importantly, it has given them wings of imagination, stimulated their innovative potential, and enabled them to explore the possibilities of design more freely without being limited by time and energy, thus creating more creative and influential works. In the field of fashion design, students can use AI tools to break through the limitations of traditional materials and craftsmanship, explore various novel design elements and combinations, and transform imaginative ideas into practical and feasible design solutions.

3.3 Emotional dimension

The increasing emphasis on emotional design today has led to a beneficial impact of generative AI on design students, greatly enriching their design experience in the emotional aspect. The importance of emotional intelligence in design is apparent because design essentially serves as a medium of emotional communication. Designers connect emotionally with users through their creations, expressing feelings and values. Generative AI provides students with more opportunities to explore and express emotions, enabling them to gain a deeper understanding of user needs and create works that resonate more emotionally. Through AI-assisted design tools, students can quickly iterate design concepts and experience various emotional changes from failure to success in a short period of time. This experience helps cultivate their resilience and optimism when facing challenges, enabling them to maintain a positive attitude when facing complex design tasks and pressures. Using interaction design students as an example, when designing a social application, they can use AI tools to quickly generate multiple interface prototypes and continuously optimize the design through user testing and feedback. In this process, students will experience challenges, such as user dissatisfaction and design rejection, while also experiencing rewards, such as user recognition and design awards. This emotional fluctuation and growth enable them to understand better the emotional variations of users while using the product and thus integrate more humanistic care into the design. According to an in-depth study of design students, using generative AI tools significantly increases their emotional engagement and satisfaction, making them more passionate about the design process and full of enthusiasm for creation. This indicates that AI technology positively influences the innovation process for students in the emotional dimension. It can stimulate their emotional expression and creative desire, encouraging them to pay more attention to the integration of emotional elements in the design process. This approach

leads to the creation of more engaging and vibrant works that better meet users' emotional needs, thus realizing the actual value of design. In product design, students will consider the emotional experience of users when designing a smart home product. By employing AI to analyze users' emotional preferences for different colors, materials, and shapes, items will be designed that are practical and make users feel warm and comfortable. This design not only meets functional requirements but also resonates emotionally with users, genuinely realizing the value of sublimation of design.

Figure 2: Three Dimensions

4. The Impact Strategy of Generative AI on the Creative Process of Design Major College Students

4.1 Teaching Objectives and Content Adjustment Strategies

In integrating generative AI into the innovation process for design students, adjusting the strategy for teaching objectives and content is particularly important. Firstly, the teaching objectives must shift from traditional skill imparting to cultivating students' innovative abilities using generative AI. The design major should require students to be proficient in using AI tools to complete complex design projects and cultivate their innovative thinking and problem-solving abilities. For example, goals can be set to require students to use AI tools to complete at least one design project with high innovation and practicality, such transformation has been validated in private higher education reform (Guo & Qiu, 2024), where curriculum restructuring markedly improved graduates' industry relevance，in order to comprehensively evaluate students' mastery and innovative application ability of generative AI technology, ensuring that they can adapt to the future application needs in the design industry. Secondly, the teaching content should comprehensively cover the basic knowledge, operational skills, and strategies for integrating AI into the design process.

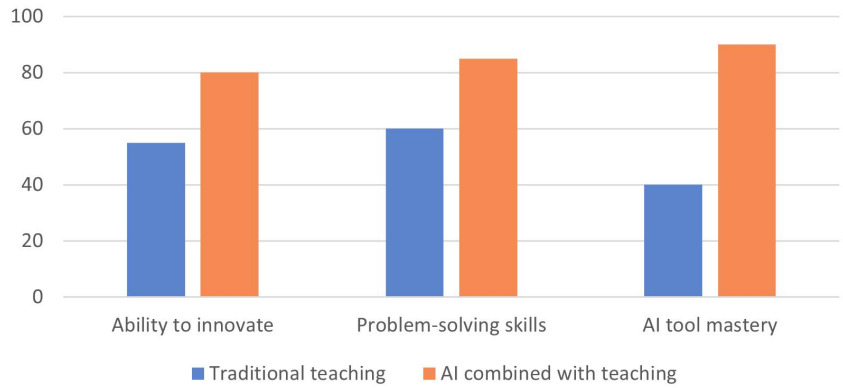

Figure 3: The Implementation Effect of Teaching Objectives and Content Adjustment Strategies

4.2 Innovative Strategies for Teaching Methods and Means

The rapid advancement of artificial intelligence technology means that traditional teaching methods can no longer meet the current needs of design education. Therefore, integrating generative AI into teaching methods has become the key to improving students' learning efficiency and stimulating creativity. For example, by introducing personalized learning paths based on generative AI, customized learning resources and tasks can be provided according to each student's learning progress, interests, and learning style, thereby achieving personalized teaching, meeting the learning needs of different students, and improving their learning enthusiasm and participation. According to the research in the Journal of Educational Technology Research and Development, personalized learning can significantly improve students' engagement and learning outcomes, implementing personalized paths requires integrating a 'questioning-driven' collaborative model (Hu & Sun, 2025) to stimulate deep reflection through human-AI dialogue. Evidence from AI-assisted teaching frameworks (Gao et al., 2024) shows this approach increases learning engagement by over 40%, helping them master knowledge and skills at their own pace. In addition, using generative AI to generate design sketches automatically can help students iterate their ideas quickly. Through a large number of case studies, students can be exposed to a rich variety of design cases in a short period of time, thereby broadening their horizons, enhancing the breadth and depth of design thinking, and inspiring their innovative inspiration. In terms of teaching methods, a project-based teaching model can be adopted, combined with generative AI tools, to enable students to learn and innovate while solving practical problems. This problem-centered teaching method can effectively enhance students' practical abilities and innovative consciousness, enabling them to apply their knowledge to practical design projects and solve real-world problems. As Einstein said, "Learning knowledge should be problem-centered, not answer-centered." Through innovative teaching methods and tools, combined with generative AI technology, design students will be able to better adapt to the challenges of the future design field, cultivate more design talents with innovative spirit and practical ability, and contribute to the development of the design industry.

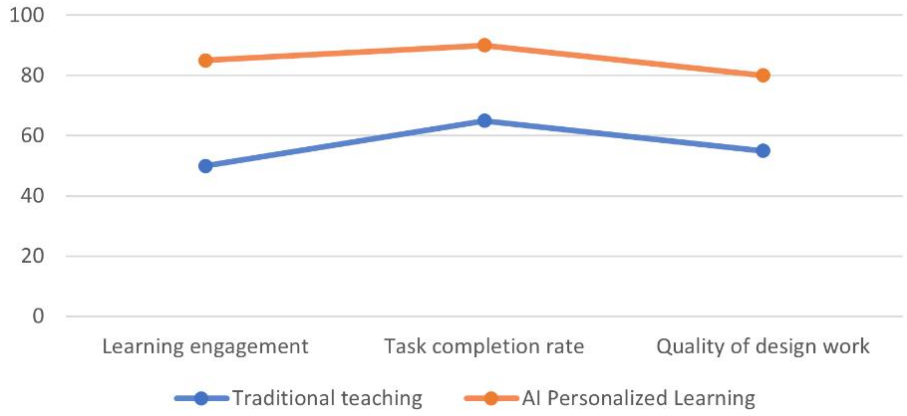

Figure 4: The impact of personalized learning on learning outcomes

4. 3 Curriculum Design Strategies to Stimulate Students' Creativity

In order to stimulate the creativity of design students, curriculum design should deeply integrate generative AI technology and promote the development of students' innovative thinking through data-driven personalized learning paths. For example, generative AI can be used to analyze students' design works, providing real-time and accurate feedback and improvement suggestions, thereby helping students learn and grow quickly in practice, adjust design ideas in a timely manner, and improve design quality. Case studies have shown that when students use AI-assisted design tools, their

design iteration speed increases by 30%, and the innovation of their works is significantly improved, which fully demonstrates the positive effects of generative AI in curriculum design. In addition, by combining cognitive psychology models such as Bloom's cognitive domain classification, curriculum design can more systematically cover various levels from knowledge memory to creative application, critical thinking frameworks must be embedded (Qiu & Chen, 2025) to construct a complete cognitive progression under AI assistance, preventing technological dependency from inducing intellectual passivity, ensuring that students can not only master basic knowledge but also engage in high-level creative thinking, gradually building a complete knowledge system and ability structure. Curriculum design strategies should encourage students to go beyond the boundaries of existing knowledge, explore unknown design fields with the assistance of generative AI, cultivate their innovative consciousness and exploratory spirit, and enable them to boldly try new ideas and methods in design creation, creating works with unique charm and innovative value.

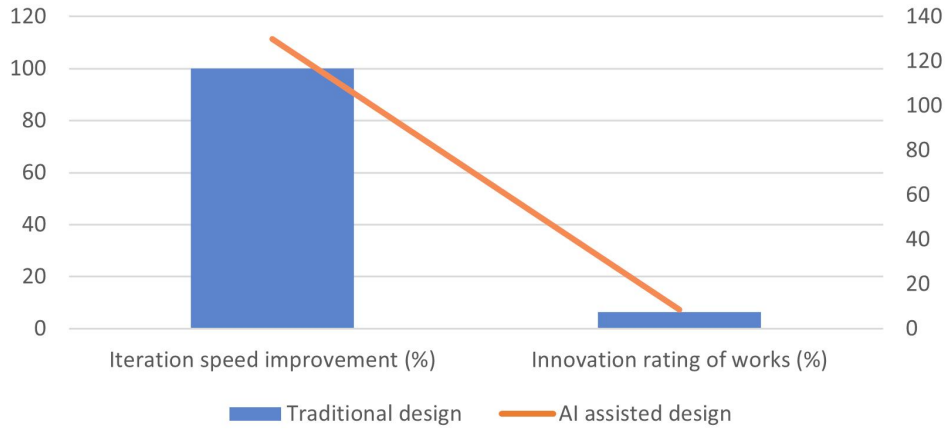

Figure 5: The impact of AI-assisted design on the speed of creative iteration and the innovation of works

4. 4 Implementation Strategy for Combining Generative AI with Traditional Education Methods

In the innovation process of design students, the organic combination of generative AI and traditional education methods is a key path to promote educational innovation. By integrating generative AI technology into traditional teaching, personalized learning paths can be constructed, significantly enhancing students' creativity and design abilities. For example, by using generative AI to generate design sketches automatically, students can obtain a large number of creative sketches in a short period of time. This not only saves valuable time but also stimulates students' innovative thinking, allowing them to examine and optimize design solutions from more perspectives. According to a study, students using generative AI-assisted design scored 15% higher on creativity tests than those using traditional teaching methods, which strongly demonstrates the effectiveness of combining generative AI with traditional educational methods. In addition, the combination strategy should also include the transformation of teachers' roles from knowledge transmitters to learning guides and innovation promoters. In the implementation process, case-based teaching methods can be used, combined with real design projects, to enable students to learn and practically apply generative AI tools in practice while accumulating valuable operational experience. The application of generative AI provides students with a vast space for imagination, allowing them to freely explore the ocean of design, transform creativity into reality, and cultivate design talents with innovative and practical abilities, promoting the ongoing advancement of design education.

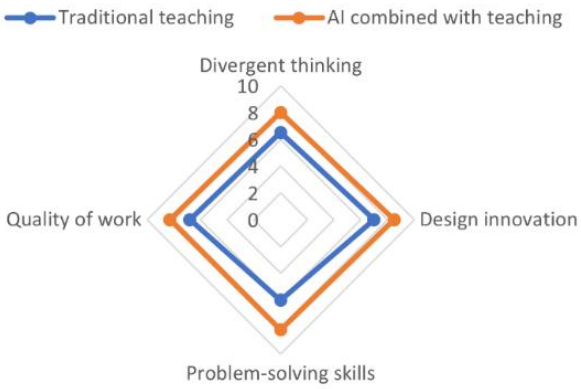

Figure 6: The Creative Enhancement Effect of Combining AI with Traditional Education

4. 5 Implementation and Promotion Strategies for School-Enterprise Cooperation

Collaboration between schools and enterprises is an important way for generative AI to take root in the innovation process of design students. Through school-enterprise cooperation, practical application cases of generative AI technology can be introduced into the classroom, providing students with real design challenges and problem-solving scenarios. For example, a design school collaborated with a well-known technology company to develop a course focused on the application of generative AI in product design. During this process, students not only learned the theoretical knowledge of AI technology but also gained a deep understanding of industry demands and design trends through interaction with enterprise engineers, mastering the latest technologies and design methods in the industry. According to a survey, students participating in such collaborative projects have improved their innovative thinking and problem-solving abilities by an average of 20% compared to students under traditional teaching models. This significant improvement fully demonstrates the advantages and value of school-enterprise cooperation. In addition, school-enterprise cooperation can also provide students with practical opportunities through establishing internship bases, project studios, and other forms. For example, a design school collaborated with a large automobile manufacturer to create a design laboratory where students use generative AI tools for automotive interior design. They directly participate in practical projects, apply their knowledge to practice, and accumulate valuable work experience. This collaborative model not only enhances students' practical abilities, injecting new vitality and innovative thinking into the enterprise. The effectiveness of this model is further evidenced by the 'professional knowledge + AI' dual-drive approach in urban planning education (Li et al., 2024), where residential planning projects achieved 40% higher innovation efficacy through industry-academia collaboration. According to Clayton Kristensen's theory of "disruptive innovation" at Harvard Business School, this school-enterprise cooperation model combines innovative thinking and practice, promoting disruptive innovation in design education, breaking the limitations of traditional education, and opening up new paths for the development of design majors. In terms of a promotion strategy, schools and enterprises should focus on establishing long-term and stable cooperative relationships to form a mutually beneficial and win-win situation. For example, by signing long-term cooperation agreements, companies can provide financial support, internship positions, and industry resources to schools. On the other hand, schools can provide innovative design solutions and talent reserves for companies, achieving complementary advantages of both parties' resources. This collaborative model has been successfully implemented in the cooperation between Stanford University and Silicon Valley enterprises, providing a reference example for the application of generative AI in the innovation process of design students, demonstrating the enormous potential of school-enterprise cooperation in promoting technological innovation and talent cultivation.

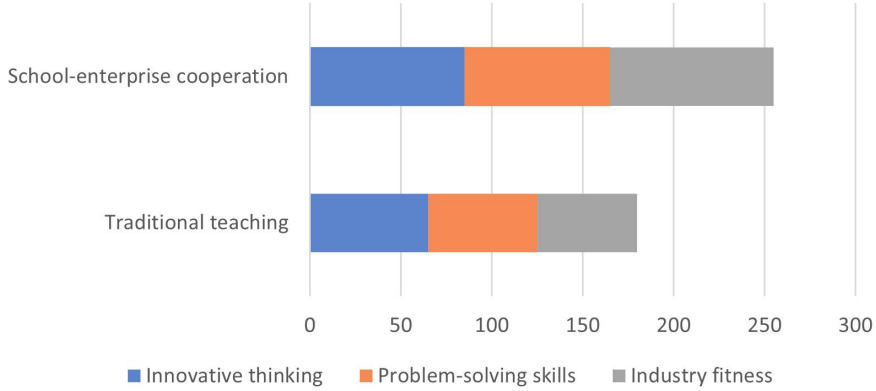

Figure 7: The impact of school-enterprise cooperation projects on student's ability improvement

5. Intervention Strategies for Enhancing Creativity

5.1 Teaching Framework Design

Innovation is the key goal of the design process. Generative AI tools enable design students to rapidly generate numerous solutions, enhancing creativity and efficiency. For instance, students using AI can propose 30% more creative solutions. This not only boosts design productivity but also broadens creative thinking. The teaching framework should incorporate generative AI tools, using case studies, simulated projects, and feedback loops to foster an interactive, iterative learning environment that improves design optimization and innovation skills. The framework should also integrate Bloom's taxonomy, guiding students from knowledge recall to creative application, thereby developing higher-order thinking and problem-solving abilities. Echoing Einstein, imagination surpasses knowledge. Thus, the framework should encourage students to transcend traditional design thinking with AI, fostering innovative problem-solving skills and nurturing talented professionals for design advancement.

5.2 Development of Technical Tools

Generative AI tools, like deep learning image generators and virtual reality (VR) simulators, are crucial for design students to innovate by expanding creative boundaries. Tools like DALL-E and GAN can generate diverse visuals, sparking innovative thinking and providing creative inspiration. The development of these tools should promote students' cognitive, behavioral, and emotional growth, offering comprehensive support. Tool development must address a core proposition: generative AI acts as a creativity amplifier rather than a substitute (Zhang et al., 2024). When students master the 'question-optimize-recreate' collaboration pattern, innovation efficacy grows exponentially. By using these technologies, students can better understand design concepts, enhance efficiency, and learn to merge technology with art, fostering innovation in the design field.

5.3 Evaluation System Innovation

The evaluation system's innovation is crucial for the reliability of research on generative AI's impact on design students' innovation. It should assess creative thinking, problem-solving, and interdisciplinary skills rather than just scores and project completion. Methods like case studies can track students' creative progress by comparing design works before and after using AI tools. Models like Tim Brown's "dual drill model" can evaluate the innovation process comprehensively across four stages. These methods help accurately identify AI's role in fostering creativity, offering scientific guidance for education design, aiding educators in understanding students' learning, and adjusting teaching strategies for their development.

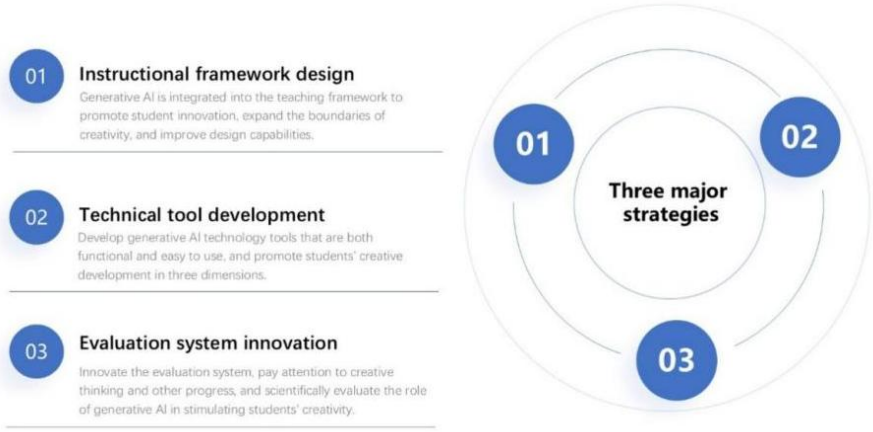

Figure 8: Intervention Strategy

6. Conclusion and Prospect

6.1 Research Conclusion and Main Findings

This study explores how generative AI influences design students' innovation, positively affecting cognition, behavior, and emotion. It enhances their creative thinking, especially in generating concepts and iterating solutions, allowing them to explore more possibilities quickly. Students learn to use technology effectively, improving design efficiency and focusing on creative implementation. AI's instant feedback and suggestions boost confidence and creativity, encouraging proactive design approaches. Key strategies for integrating AI into design education include adjusting teaching objectives, innovating methods, optimizing curriculum, significantly improving students' innovation and practical skills, and preparing them for future careers.

6.2 Prospects for Future Research Directions

AI technology plays a significant role in the innovation process of design students. Future research should focus on integrating generative AI with design education to enhance students' creativity. Studies could explore the use of generative AI across various design disciplines and adjust teaching strategies accordingly for personalized educational support. Big data analysis could evaluate the effectiveness of generative AI in design education, providing quantitative insights into its impact on students' innovative thinking. Case studies of successful applications of generative AI in educational institutions could offer best practices for others. A refined intervention model combining cognitive psychology and educational theory could guide the application of generative AI in design education, cultivating innovative and skilled design talents. Future research should stimulate students' imagination and creativity through generative AI, offering an open and innovative learning environment that promotes the continuous development of design education and nurtures future design leaders.

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