

Empowerment or Stratification? The Dual Impact of Generative Artificial Intelligence on the Competency Structure and Future Development of Design

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Abstract: Generative artificial intelligence (GenAI) is rapidly permeating design education, creative practice, and professional preparation, continuously reshaping the competency structure and developmental trajectories of design students. From the dual perspectives of technological empowerment and educational stratification, this study examines how GenAI reconstructs students' competencies, expands their professional imagination, and simultaneously intensifies developmental disparities.

The findings suggest that, on the one hand, GenAI enhances students' capabilities in creative ideation, information integration, cross-media expression, and human–AI collaboration. On the other hand, disparities in technology access, digital literacy, aesthetic judgment, and educational resources contribute to increasing differentiation within the student population.

In response, this paper argues that design education should systematically incorporate AI literacy, critical thinking, aesthetic judgment, and originality into its curriculum, so as to address the evolving demands of talent cultivation in the age of artificial intelligence.

Keywords: Generative AI; Design Students; Competency Structure; Future Development; Educational Stratification; Design Education

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1. Introduction

In recent years, generative artificial intelligence (GenAI)—represented by large language models, text-to-image systems, and multimodal generative frameworks—has developed rapidly and is increasingly permeating higher education and the creative industries. This transformation is particularly pronounced in design education. As a discipline characterized by practice-oriented learning, openness, and creativity-driven processes, design education requires students to continuously engage in ideation, visual expression, iterative refinement, and design communication. The integration of GenAI into this process not only enables it to function as a tool for inspiration support and visual generation, but also has the potential to reshape students' understanding of “design competence,” “creative agency,” and future career pathways.

However, existing discussions have largely focused on issues such as “efficiency enhancement” or “job displacement risks,” while insufficient attention has been paid to design students as a specific group. In particular, there is a lack of systematic analysis addressing the coexistence of “empowerment” and “stratification” brought about by GenAI.

1.1 Research Questions

This study addresses three primary research questions:

- (1) How does generative artificial intelligence reshape the competency structure of design students?
- (2) How does it influence their future developmental trajectories?
- (3) While empowering design learning, does it simultaneously generate new forms of stratification and developmental inequality?

1.2 Research Significance

From a theoretical perspective, this study contributes to bridging research on generative artificial intelligence with design education and educational stratification. From a practical standpoint, it provides insights for curriculum reform and talent cultivation models in design-related programs in higher education.

2. Literature Review and Theoretical Framework

2.1 Generative AI and Educational Transformation

Existing studies generally suggest that generative artificial intelligence holds significant potential in areas such as instructional support, personalized learning, task generation, and feedback provision. At the same time, it introduces challenges related to accuracy, bias propagation, academic integrity, privacy protection, and learner dependency^{[1][6]}.

Kasneci et al. argue that large language models can play a constructive role in explanation, question answering, and demonstration, yet may also weaken learners' capacity for independent thinking^[2]. Tlili et al. emphasize that the application of GenAI in education must be accompanied by careful consideration of ethical norms and boundaries of use^[3]. UNESCO further highlights the importance of fairness, explainability, privacy protection, and the preservation of human agency in educational applications of generative AI^[1].

2.2 Generative AI and Design Education

The tension between automated efficiency and human creativity remains. Compared with general educational contexts, the integration of GenAI into design education is particularly representative. Research indicates that students widely recognize its value in image ideation, creative stimulation, conceptual visualization, and early-stage communication. However, concerns persist regarding originality, ethical standards, depth of aesthetic thinking, and independent judgment^{[7][8]}.

Studies on AI–design collaboration further demonstrate that GenAI does not simply replace designers; rather, it restructures the design process. Design activity is shifting from “individual production” toward a collaborative process in which humans and intelligent systems jointly generate, evaluate, and refine outcomes^{[9][11]}. Consequently, the core competencies required of design students are evolving—from technical proficiency and formal expression toward problem framing, critical evaluation, iterative refinement, and integrative transformation.

2.3 Digital Divide and Educational Stratification

Research on the digital divide suggests that disparities brought about by new technologies extend beyond access to devices and networks. They also involve differences in digital skills, usage strategies, algorithmic understanding, and the ability to translate usage into tangible benefits^[14].

Studies on online education similarly indicate that students' ability to benefit from digital technologies is closely tied to their level of digital readiness and ICT competence, which are often influenced by family background, institutional resources, and unequal distribution of educational opportunities^[15]. Therefore, although generative AI appears to lower certain technical barriers in design implementation, this does not imply equal access to its benefits for all students^{[8][13][15]}.

3. Research Design

This study adopts a combination of literature review, comparative analysis, and theoretical analysis to systematically examine existing research on the impact of generative artificial intelligence on the competency structure and future development of design students, while also incorporating typical phenomena observed in contemporary design education^[1].

Analytically, the study is structured around two dimensions: “empowerment” and “stratification.” On the one hand, it explores how GenAI enhances learning efficiency, expands modes of creative expression, and promotes the transformation of competency structures. On the other hand, it examines whether disparities in technological access, digital literacy, aesthetic

foundations, and educational resources may exacerbate inequalities among students.

4. Empowering Effects of Generative AI on the Competency Structure of Design Students

4.1 Enhancing Efficient Ideation and Design Expression

In the process of design learning, early-stage concept generation and visual representation typically require substantial time and effort. Existing studies indicate that generative artificial intelligence can provide efficient support in tasks such as conceptual sketching, stylistic exploration, reference image generation, and text-assisted explanation, thereby significantly improving the efficiency of design expression^{[7],[10]}.

For instance, Fleischmann's study of graphic design students found that learners widely believe GenAI will reshape future Zintegration. Similarly, research by Huh et al. on architecture and interior design students shows that learners recognize the value of AI image-generation tools in conceptual visualization, pedagogical relevance, and professional preparation, while remaining attentive to ethical responsibility and professional judgment.

Abrusci et al. investigated AI4Design, a web-based intelligent conversational system designed for design education. The system allows students to interact with a chatbot (based on ChatGPT) to obtain textual responses, which are then translated into one or more generated images, enabling further visualization of design concepts. Field evaluations demonstrate that such tools enhance conceptual clarity, improve the quality of visual outputs, and expand the range of design alternatives during iterative processes^[11]. Therefore, for novice learners, these tools lower the threshold of translating ideas into visual forms. For students with stronger disciplinary foundations, they function as experimental instruments for rapid prototyping, exploration of design possibilities, and iterative optimization^{[7],[11]}.

Figure 1. Data Collection Procedures and Ethical Considerations

4.2 Strengthening Information Integration and Multimodal Expression

Generative AI inherently involves the integration of textual understanding, semantic generation, visual transformation, and multimodal coordination. In using such tools, design students are required to continuously synthesize language, imagery, stylistic elements, narrative structures, and user needs into a coherent expressive framework^[2,8,10].

As a result, design learning increasingly shifts its emphasis away from purely formal representation toward effective information organization, semantic precision, and communicative clarity^[9-10].

4.3 Promoting Human–AI Collaboration as a Core Competency

Existing research suggests that generative AI fundamentally redefines the notion of “design competence”^[8,10-12]. Traditionally, design competence has been associated with drawing skills, software proficiency, and formal expression. However, in a GenAI-enabled environment, students are increasingly required to develop capabilities in problem framing, prompt construction, output evaluation, and value judgment^[9,11-12].

Accordingly, design competence is evolving from the ability to independently produce artifacts toward a composite capacity to orchestrate tools, guide intelligent systems, and critically assess generated outcomes.

4.4 Expanding Future Career Pathways

With the rapid development of AIGC-driven content production, intelligent visual communication, digital branding, and interactive experience design, the career trajectories of design students are becoming increasingly diversified^[4,8,10].

Rather than being confined to traditional roles such as graphic design or visual execution, graduates may pursue opportunities in content strategy, product experience design, digital communication, and AI-assisted creative industries.

5. Stratification Effects of Generative AI on the Future Development of Design Students

5.1 Inequality in Technological Access as a New Starting Point

Although generative AI is often described as a “low-barrier” tool, its effective use is not inherently equal. High-quality tools frequently require stable internet access, advanced hardware, paid subscriptions, foreign language proficiency, and sustained experimentation costs. These factors create significant disparities among students from the outset^[1,8,14].

Digital divide theory further suggests that technological inequality is not merely a matter of access, but also involves differences in frequency of use, depth of engagement, and the capacity to translate usage into meaningful outcomes^[14-15].

5.2 Divergence in Usage Competence Leading to Skill Differentiation

While generative AI appears to simplify operational processes, it actually raises the threshold for higher-order competencies. Students who can formulate high-quality prompts, identify aesthetic flaws, logical inconsistencies, and semantic deviations in generated outputs are more likely to achieve superior learning outcomes ^[8–9,13].

Students with stronger foundational knowledge tend to use AI as a tool for validating ideas and supporting decision-making, whereas those with weaker foundations are more likely to rely on it as a shortcut that substitutes for critical thinking ^[7,12–13].

5.3 Stratification Risks in Aesthetic Judgment and Originality

The core of design education lies not merely in producing images, but in cultivating value-laden creative practices through aesthetic understanding, cultural interpretation, and problem awareness. Existing research indicates that the impact of generative AI on creativity is inherently dual in nature: it can foster divergent thinking and expand expressive possibilities, yet may also reduce sustained engagement in original exploration and weaken creative self-efficacy ^[12].

Therefore, in AI-mediated design learning, the key differentiator among students is not whether they can generate images using AI, but whether they possess the ability to reinterpret, evaluate, and reorganize generated content in meaningful ways ^[7–8,12].

5.4 Inequality in Employment Competition

As certain routine and execution-oriented design tasks become increasingly automated or semi-automated, employers' expectations of design professionals are also shifting. There is growing demand for hybrid talents who combine problem understanding, tool proficiency, collaborative communication, and integrative problem-solving abilities ^[4,6,10].

In this context, existing disparities in foundational knowledge, access to resources, and digital literacy among design students are likely to translate into structural inequalities in employment competition ^[8,13–15]. In other words, generative AI does not eliminate barriers to entry; rather, it reshapes evaluation criteria while intensifying differentiation in career access, role adaptation, and developmental opportunities.

6. Mechanisms Underlying the Coexistence of Empowerment and Stratification

From a technological perspective, generative artificial intelligence transforms creative workflows through rapid generation and feedback mechanisms. While it lowers traditional barriers to design production, it simultaneously establishes new thresholds related to prompt construction, output evaluation, and iterative refinement ^[2,10–11].

From an educational perspective, institutional responses in many higher education contexts remain relatively lagging. Students' engagement with AI tools often relies on self-directed exploration and informal learning pathways, which further amplifies disparities in resource access and learning opportunities ^{[1][7–8][14–15]}.

From a broader socio-economic perspective, the creative industries and digital economy are increasingly favoring highly efficient, hybrid, and collaborative talents. In this sense, generative AI functions not only as a learning tool but also, to some extent, as a mechanism for labor market selection ^{[4][6]}.

7. Educational Responses in Design Education under the Context of Generative AI

In light of the dual impact of generative AI, design education should move beyond simplistic approaches of either “permitting” or “restricting” its use, and instead proactively reconfigure its pedagogical framework.

First, it is necessary to reconstruct the competency development system for design students, placing greater emphasis on problem definition, aesthetic judgment, critical thinking, and human–AI collaboration ^[7–8,11–12].

Second, AI literacy should be systematically integrated into the curriculum. This includes prompt design, output validation, information evaluation, ethical awareness, and intellectual property considerations ^[1,3,6].

Third, higher education institutions should strive to reduce disparities in access to AI technologies by providing shared platforms, standardized tools, and case-based resources, thereby ensuring more equitable learning opportunities for students from diverse backgrounds ^[1,14–15].

Fourth, it remains essential to strengthen human-centered design capabilities that are less susceptible to automation—particularly originality, social insight, cultural interpretation, and ethical reasoning ^[7–8,12].

8. Conclusion

Generative artificial intelligence is profoundly reshaping the learning processes, competency structures, and developmental

trajectories of design students. This study argues that, on the one hand, GenAI enhances efficiency and expands possibilities in creative ideation, visual expression, information integration, and human–AI collaboration, while also broadening future career pathways. On the other hand, it intensifies differentiation among students in terms of learning outcomes, work quality, and employment competitiveness through disparities in technological access, digital literacy, aesthetic judgment, and educational resources^[8–9,12,14–15].

Therefore, the impact of generative AI on design students should not be understood as a purely empowering process, but rather as a dual dynamic in which empowerment and stratification coexist. Ultimately, what determines the quality of students' future development is not whether they use AI, but whether they can cultivate higher-level capacities for judgment, critical thinking, integration, and creativity within an AI-mediated environment.

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