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THE EFFECTS OF ARTIFICIAL INTELLIGENCE GENERATIVE CONTENT ASSISTED PRODUCT DESIGN ON COLLEGE STUDENTS CREATIVE ABILITY AND MOTIVATION

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Abstract:

With the rapid advancement of artificial intelligence (AI) technology, the integration of AI-generated content (AIGC) in creative processes has sparked significant sociological interest. This study investigated gender differences in creative ability and motivation when using AI-assisted tools. Through a quasi-experimental design, this research examined 70 college participants to compare AI-assisted versus traditional approaches. Using standardized assessment metrics, the study measured these three key variables across gender groups. The results revealed three key findings. First, participants using AI-assisted tools demonstrated significantly higher creative ability compared to the control group, with male participants showing particularly strong performance improvements. Second, the AI-assisted group showed elevated levels of motivation across both gender groups. The findings contribute to understanding gender-based differences in human-AI interaction and creative processes in technological environments. This study advances the theoretical discourse on gender differences in AI-augmented creative processes and provides insights into the evolving relationship between gender, creativity, and technological advancement in contemporary society.

Keywords:

Artificial Intelligence, Design, Creative Ability, Gender, Motivation

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Introduction

The rapid development of artificial intelligence technology has led to widespread integration of AI-generated content (AIGC) in various fields, particularly in design education. Tools like Midjourney, DALL-E, and ChatGPT have been extensively incorporated into multiple design processes, posing both opportunities and challenges to traditional design education (Yang et al., 2024). This technological advancement has sparked concerns about the role of human designers and the need to enhance their creative capabilities in response to AI integration.

In the context of product design education, AIGC tools have demonstrated significant potential in concept generation, effect rendering, and user interaction design (Yin et al., 2023). These tools not only enhance design efficiency by enabling rapid generation and iteration of multiple design solutions but also help students visualize design concepts more intuitively.

The integration of AIGC technology in design education raises important questions about its impact on students' learning outcomes. Previous research has shown that while AIGC tools can inject new vitality into the design process and expand creative thinking, they may also lead to over-reliance on technology and increased cognitive burden (Liu et al., 2023). Additionally, gender differences in technology adoption and creative performance have been documented, suggesting that male and female students may exhibit different patterns in their approach to and utilization of new technologies (Putri et al., 2024).

To address these challenges and opportunities, this study aims to empirically investigate the effectiveness of AIGC-assisted design in educational settings, with a particular focus on its impact on students' creative abilities and motivation levels. Furthermore, considering the documented gender differences in technology adoption and creative performance (Huang et al., 2024), this research seeks to understand how these effects may vary between male and female students. Specifically, this study addresses the following research questions:

Research question 1: What is the impact of AIGC-assisted design on college students' creative ability compared to traditional design methods, and how does this impact vary by gender?

Research question 2: How does AIGC-assisted design influence college students' motivation levels in comparison to traditional design methods, and what role does gender play in this relationship?

Related Work

AIGC Technology

As Shao et al. (2025) define, Artificial Intelligence Generated Content (AIGC) refers to the process of using artificial intelligence technology, particularly machine learning and deep learning algorithms, to automatically generate various forms of content including text, images, audio, and video. These technologies learn from vast amounts of domain-specific data to understand patterns and rules, generating novel content based on user input or instructions (Yang et al., 2024). The core strength of AIGC lies in its ability to enhance both efficiency and creativity through its deep learning architectures, including generative adversarial networks (GANs), variational autoencoders (VAEs), and transformer language models (Liu et al., 2024). The current Web 3.0 era marks the emergence of AIGC as a mainstream force in content production, exemplified by breakthrough applications like ChatGPT, Midjourney, and Stable

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Diffusion. These tools have significantly enhanced content production efficiency while maintaining quality standards, offering new possibilities for personalized content recommendations and real-time generation (Pokhrel & Banjade, 2023).

Furthermore, while AIGC demonstrates remarkable potential in enhancing creative processes, it also presents unique challenges in cognitive processing and motivation. As Lin and Chen (2024) highlight, AIGC can enhance learning engagement through interaction and personalized design, but may also impact creative ability and induce cognitive load due to fixed frameworks. The balance between technological empowerment and maintaining learner motivation becomes crucial. Furthermore, research by Stöhr et al. (2024) indicates significant gender differences in AIGC adoption and usage patterns, with male students generally showing higher usage rates and more optimistic attitudes, particularly in technical fields.

Product Design

Product design represents a complex and multidisciplinary intellectual activity that integrates design, science, and engineering principles. As defined by (Huang et al., 2024), it encompasses the process of identifying market opportunities, defining problems, providing appropriate solutions, and validating these solutions with actual users. The development of product design methods has evolved through three main stages: function-oriented, cognition-oriented, and system-oriented approaches (Quan et al., 2023). This evolution reflects a progression from focusing purely on functional principles and structural forms to incorporating cognitive science insights and finally adopting a holistic, systemic perspective. Recent technological advances, particularly in artificial intelligence, have introduced new possibilities for innovation in design processes. The emergence of intelligent design technologies, including AIGC tools, is reshaping traditional design practices by enabling automated content generation and offering new approaches to creative problem-solving (Lee et al., 2024), though this also raises important questions about the balance between technological assistance and human creativity in the design process.

Creativity and Motivation

Creativity is a cognitive ability that refers to the capacity to generate novel and appropriate ideas or products within a specific domain (Green et al., 2023). In product design education, creativity serves as a fundamental skill that directly influences students' design performance. However, creative processes are intrinsically linked to motivation levels and cognitive resources (Wu et al., 2024; Wu & Wang, 2024). Research has shown that students with higher intrinsic motivation tend to exhibit greater creative performance, as they are more willing to explore novel solutions and persist through design challenges (Huang et al., 2024).

Motivation, as the internal driving force behind cognitive activities and behavior (Filgona et al., 2020), plays a crucial mediating role between creative potential and actual creative performance. When students are highly motivated, they invest more cognitive resources in creative tasks and demonstrate greater persistence in problem-solving. However, this relationship is moderated by cognitive load - when cognitive demands become excessive, even highly motivated students may experience decreased creative performance (Tao et al., 2023).

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Methodology

Participants

The study initially recruited and retained 70 second-year Chinese college students majoring in product design, aged 19-25. The participants consisted of 36 students in the experimental group (18 males, 18 females) and 34 students in the control group (17 males, 17 females). All participants voluntarily joined the study and signed informed consent forms before participation, with the right to withdraw at any time. Since all participants maintained attendance rates above 70%, provided valid responses, and completed the entire assessment protocol, no exclusions were necessary. None of the participants had previous experience with the design tools related to the study topic, and all were reported to be free from significant physical or mental health issues. All collected data were anonymized and used exclusively for research purposes, with strict confidentiality measures in place.

Research Process

Before the start of the study, a research proposal was submitted to the Institutional Review Board (IRB). This proposal included details such as the research objectives, design, participant recruitment, informed consent process, data management, and privacy protection. The study commenced after obtaining IRB approval.

The experiment was conducted in September 2024 at a university in China. Initially, all participants completed a pretest in the first week. To mitigate the maturation effect, which helps participants partially forget the specific content of the pretest and thus reduces its impact on the subsequent experiment results, the design tasks began in the third week. Participants were randomly assigned to either the AIGC-assisted design group (experimental group) or the traditional tools design group (control group). Both groups simultaneously completed a 3-hour product design task. After completing the design tasks, experts were invited to use the creative solution diagnosis scale (CSDS) to score the creativity of the participants' design works and evaluate the innovativeness of their final products. Additionally, participants completed the motivation test

Questionnaires

Pretest and Posttest

The study employed two design tasks to assess participants' creative abilities. The pretest required participants to design smart shoes within 30 minutes, while the posttest involved designing a smart cane for elderly or mobility-impaired individuals within 3 hours. Both tasks emphasized considering target user characteristics, smart technology applications, functional innovation, and human-machine interaction design. For the posttest, participants submitted their designs in A3 size format using common image file types.

Both tests utilized the creative solution diagnosis scale (CSDS) developed by (Cropley, 2015) for evaluation. The CSDS comprises 13 Likert scale items measuring multiple dimensions of creativity, including relevance & effectiveness, novelty, elegance, and innovation. Three domain experts independently scored each design on a 1-5 scale, with weighted averages yielding a total possible score of 65 points. The scale demonstrated good reliability with Cronbach's alpha coefficients of 0.743 for the pretest and 0.760 for the posttest, indicating suitable internal consistency for data collection.

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Motivation Test

This study utilized the situational motivation scale (SIMS), developed and validated by (Guay et al., 2000), to assess participants' motivation levels during the experimental tasks. The SIMS evaluates four types of situational motivation: intrinsic motivation, identified regulation, external regulation, and amotivation. The scale consists of 16 items, with 4 items for each motivation type. Participants respond to each item on a 7-point Likert scale (1 = does not correspond at all, 7 = corresponds completely). Example items include: "Because I find this activity interesting" (intrinsic motivation), "Because I personally value this activity" (identified regulation), "Because I feel I have to" (external regulation), and "I am doing this activity, but I am not sure if it's worth it" (amotivation).Furthermore, the scale demonstrates good internal consistency, with Cronbach's alpha coefficients ranging from 0.62 to 0.95, indicating reliable measurement across various studies and contexts.

Data Analysis

Group Difference in the Creative Ability

$H_0$1.1: There is no significant difference in college students' creative ability between experimental group and control group.
$H_0$1.2: There is no significant difference in creative ability between male college students in two groups.
$H_0$1.3: There is no significant difference in creative ability between female college students in two groups.
$H_0$1.4: There is no significant difference in creative ability between male and female college students in the experimental group.
$H_0$1.5: There is no significant difference in creative ability between male and female college students in the control group.

The ANCOVA results revealed significant differences in creative ability between the experimental and control groups, with both overall comparison and gender-specific analyses showing higher performance in the AIGC-assisted design group ($p < 0.05$). Specifically, the experimental group demonstrated higher creative ability scores compared to the control group (Mean Difference = 2.881), with similar patterns observed when comparing male students (Mean Difference = 2.596) and female students (Mean Difference = -2.596) across groups. However, when examining gender differences within each group, no significant differences were found between male and female students in either the experimental group ($p = 0.185$) or the control group ($p = 0.717$), suggesting that AIGC-assisted design tools enhanced creative ability regardless of gender. Based on these results, we reject $H_0$1.1, $H_0$1.2, and $H_0$1.3, while failing to reject $H_0$1.4 and $H_0$1.5. See Table 2 for details.

Table 1: ANCOVA Results Of Creative Ability Across Groups

	Mode 1	Mode 2	Mean Difference (I-J)	Std. Error	Significance (p)
$H_0$1.1	Experimental group	Control group	2.881	0.882	0.002
$H_0$1.2	Experimental group/Male	Control group/Male	2.596*	0.813	0.002

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$H_01.3$	Experimental group/Female	Control group/Female	-2.596*	0.813	0.002
$H_01.4$	Experimental group/Male	Experimental group/Female	1.018	0.763	0.185
$H_01.5$	Control group/Male	Control group/Female	-0.287	0.791	0.717

Group Difference in the Motivation

$H_02.1$: There is no significant difference in college students' motivation between experimental group and control group.

$H_02.2$: There is no significant difference in motivation between male college students in two groups.

$H_02.3$: There is no significant difference in motivation between female college students in two groups.

$H_02.4$: There is no significant difference in motivation between male and female college students in the experimental group.

$H_02.5$: There is no significant difference in motivation between male and female college students in the control group.

As shown in Table 2, the ANOVA results revealed varying patterns of motivation across groups and genders. Overall, there was a significant difference in motivation between the experimental and control groups (Mean Difference = 6.400, $p = 0.015 < 0.05$), with the experimental group showing higher motivation levels. When examining gender-specific differences, male students in the experimental group demonstrated significantly higher motivation compared to male students in the control group (Mean Difference = 11.669, $p = 0.002 < 0.05$). However, no significant differences were found between female students across groups (Mean Difference = 1.357, $p = 0.703 > 0.05$), between male and female students within the experimental group (Mean Difference = 3.399, $p = 0.351 > 0.05$), or between male and female students within the control group (Mean Difference = -6.913, $p = 0.057 > 0.05$). Based on these findings, we reject $H_02.1$ and $H_02.2$, while failing to reject $H_02.3$, $H_02.4$, and $H_02.5$.

Table 2: ANOVA Results Of Motivation Across Groups

	Mode 1	**Mode 2**	**Mean Difference (I-J)**	**Std. Error**	**Significance (p)**
$H_02.1$	Experimental group	Control group	6.400	2.583	0.015
$H_02.2$	Experimental group/Male	Control group/Male	11.669*	3.665	0.002
$H_02.3$	Experimental group/Female	Control group/Female	1.357	3.543	0.703
$H_02.4$	Experimental group/Male	Experimental group/Female	3.399	3.628	0.351
$H_02.5$	Control group/Male	Control group/Female	-6.913	3.581	0.057

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Discussion

Impact of AIGC on Creative Ability

The research findings reveal that AIGC-assisted design tools had a significant positive impact on students' creative ability compared to traditional design methods. From the perspective of constructivist theory, AIGC tools create an environment conducive to active knowledge construction by providing immediate visual feedback and diverse reference materials. During the design process, AIGC tools enhanced both problem understanding and design exploration phases. The system's rapid generation of reference cases significantly expanded students' design knowledge base, resulting in richer design language and broader creative sources. The immediate feedback provided by the system allowed students to explore their creativity more freely, with observational data showing higher willingness to experiment and lower levels of "innovation anxiety" among experimental group participants.

While male students in the experimental group showed significantly higher creative performance compared to the control group, no significant differences were observed among female students between groups. This gender-specific pattern may be attributed to different cognitive styles and technology adoption tendencies. As Asy'ari and da Rosa (2022) suggest, male students tend to favor systematic thinking approaches, which align well with AIGC tools' modular design features. Notably, the absence of significant gender differences within each group highlights the inclusive nature of both traditional and AIGC-assisted design environments.

AIGC's Influence on Student Motivation

The results indicate that AIGC-assisted design tools significantly enhanced students' overall motivation compared to traditional design methods, with particularly pronounced effects among male students. Through the lens of self-determination theory, this enhancement can be attributed to two key factors. First, AIGC tools provided students with greater creative autonomy and exploration space by allowing them to freely adjust design solutions according to their preferences and control the creative pace. This aligns with Formosa's (2021) findings that increased autonomy directly sparks interest. Second, the immediate feedback mechanism of the AIGC system played a crucial role in developing competence, as students could quickly see their creative ideas transformed into tangible design outcomes, creating a positive motivation loop that supports Wu et al.'s (2024) observations.

A notable gender difference emerged in the findings, with male students in the experimental group showing significantly higher motivation compared to those in the control group, while no significant differences were found among female students. Zhang et al. (2014) found that male students generally exhibit higher levels of acceptance and willingness to use new technologies. However, the lack of significant motivation differences between male and female students within both groups suggests that once students adapt to a particular tool, the influence of gender on motivation gradually diminishes, supporting Ozor et al.'s (2024) emphasis on creating inclusive, technology-supported learning environments. This suggests the need to strike a balance between technical support and autonomous design (Yang et al., 2024).

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Contributions and Conclusion

This study makes several significant theoretical and practical contributions to understanding the impact of AIGC-assisted design tools in educational settings. From a theoretical perspective, it extends the application of constructivist theory in technology-enhanced learning environments, demonstrating how AI tools can facilitate active knowledge construction through immediate feedback and diverse references. The findings enrich our understanding of human-computer collaborative innovation by revealing how AIGC tools create new mechanisms for knowledge construction, where students build understanding through dialogue with AI systems rather than solely through traditional teacher-student interaction.

The empirical findings suggest that AIGC tools can enhance students' creative ability and motivation levels compared to traditional design methods, though with varying effects across gender groups. The study's results provide valuable practical insights for educational institutions implementing AIGC technologies, particularly emphasizing the need for corresponding skill training and capacity-building programs. As predicted by Chiu et al. (2023), AI-driven intelligent educational services will become a significant growth point in the design education market, making these findings particularly timely for future educational development. However, the complex relationship between AIGC tools and learning outcomes, influenced by individual differences in learning styles and technology adoption, suggests the need for careful consideration in implementing these tools within design education curricula.

Limitation

The study has several noteworthy limitations. First, regarding sample characteristics, the study only selected 70 college students from a single university in China, which limits the generalizability of the findings. As Lakens (2022) pointed out, smaller sample sizes in educational technology research can affect the statistical power of tests, thereby influencing the reliability of the research findings. The singular geographic origin may not fully reflect the actual effects of AIGC-assisted design education in different regions or types of universities, particularly given that the effectiveness of educational technology applications is often influenced by factors such as regional development levels and institutional resources.

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