Leveraging Human-in-the-Loop Engagement Through AI in Web Design Education: A Case Study on Adapting to Dynamic Client Requirements

Jason Lively, Lindenwood University, USA jlively@lindenwood.edu

ABSTRACT

The integration of Artificial Intelligence (AI) within educational frameworks, particularly in disciplines such as web design and development, represents a significant evolution in pedagogical strategies. This article examines a unique educational setup where students, while engaging in a web design class, utilize AI tools for text, image, and code creation within a simulated real-world scenario involving a client—dubbed "Chef Cookie Cutter". This simulated client interaction introduces unpredictability through mid-assignment requirement changes, thereby mimicking the dynamic nature of real-world web development projects. The focus of this case study is the critical role of human-in-the-loop (HITL) engagement in AI-assisted assignments, where students' adaptability, creativity, and problem-solving skills are put to the test. Such engagement not only prepares students for the intricacies and challenges of their future professions but also emphasizes the importance of human oversight in AI-driven processes. By incorporating generative AI, video avatars, and personalized learning mechanisms, this educational approach fosters a rich, interactive learning environment that enhances digital pedagogy. The findings suggest that integrating HITL in AI assignments significantly improves learning outcomes by fostering an adaptive learning environment that closely mirrors the complexities and demands of the industry, thereby preparing students more effectively for their future careers.

Keywords: *Human-in-the-loop, AI-assisted web design, Dynamic client requirements, Educational pedagogy, Adaptive learning environment*

INTRODUCTION

The ascent of generative artificial intelligence (AI) tools, including but not limited to Stable Diffusion and Lensa.ai, has not only captivated social media users but also propelled these technologies into the mainstream, marking a significant milestone in their adoption (DelSignore, 2022). Despite this widespread popularity, a segment of traditional artists and designers has articulated a staunch opposition towards the integration of AI in the realm of art creation. Their concerns primarily revolve around issues of copyright infringement and the perceived erosion of artistic merit, a stance supported by various scholarly contributions (Ansari, 2022; Murphy, 2022; Hazucha, 2022). Furthermore, the legal landscape concerning AI-generated artworks has been fraught with complexities, as evidenced by recent judicial precedents. Notably, a decisive ruling by the U.S. Copyright Office on February 21, 2023, underscored these challenges. In this case, copyright protection was granted solely to the textual content and its organization within Kris Kashtanova's comic book, Zarya of the Dawn, which was illustrated via the text-to-image AI program Midjourney. The AI-generated imagery, however, was deliberately excluded from copyright protection. This decision catalyzes a broader discourse on the implications of AI in

artistic and creative processes, questioning the delineation between AI contributions and human creativity (Ford, 2023).

As the development and accessibility of artificial intelligence (AI) technologies advance, the academic realm has encountered escalating concerns regarding the potential for widespread plagiarism, igniting debates over the appropriateness of AI's incorporation into higher education settings (Francke & Alexander, 2019; Sherry, 2022). Despite these apprehensions, the impending arrival of Web 3.0 and 6G technologies heralds a new era for the internet, promising enhancements in processing capabilities and the introduction of sophisticated 3D generative technologies. Such advancements underscore the necessity of integrating AI into educational curricula, particularly to equip students with the requisite skills for navigating the future landscapes of web design, development, and user interface/user experience (UI/UX) design. Nonetheless, there persists a notable reluctance within the academic community to delve into the practical applications and delineate best practices for the incorporation of AI into coursework. The discourse has predominantly concentrated on the theoretical and aesthetic ramifications of AI's disruptive potential, with insufficient attention to its pragmatic benefits (Ajani, 2022). Ajani's exploration into the nuances of human authorship within AI-generated content brings to the fore a debate on the essence of "art," oscillating between the dichotomy of technique expression and sentiment display (p.253). Consequently, dialogues have predominantly focused on the intrinsic value of "art" in encapsulating the human experience as opposed to showcasing technical virtuosity (Rosenberg, 1983; Mulholland, 2022).

The assessment of artificial intelligence (AI) and non-fungible tokens (NFTs) within the art domain continues to provoke diverse opinions, underscoring the ongoing discourse regarding their value and impact (Zhang & Yang, 2021; Wellner, 2022). Despite these debates, the undeniable influence of AI on the creative endeavors of contemporary artists stands as a testament to the technology's disruptive potential (Slotte Dufva, 2023). AI-driven art generators are empowering artists by offering novel solutions and enhancements to their creative processes. These innovations range from the provision of new color schemes and compositions to the instigation of unique forms of inspiration and the facilitation of iterative creative methodologies (Compton, 2022). Nonetheless, the full spectrum of these applications remains underexplored, with scholarly and methodological frameworks for the analysis of AI-generated art still in their infancy. Furthermore, the implications of generative AI technologies for the fields of web design and development warrant more comprehensive scrutiny. There exists speculation that traditional coding practices may become obsolete, replaced by more intuitive interfaces such as drag-and-drop functionalities for website construction. Despite these advancements, the requisite for human expertise remains paramount, particularly in refining AI-generated content and ensuring the operational integrity of websites (Anonymous, 2023). Consequently, the ongoing evolution of AI poses critical questions regarding the necessity of traditional websites in the future, highlighting AI's pivotal role in redefining the parameters of the fine arts and creative processes at large.

In the context of the evolving landscape of web design and development education, new educational approaches are needed. As such, the Restaurant Project assignment under discussion here serves as an exemplary model for integrating AI into academic curricula. This model not

only facilitates direct engagement with cutting-edge AI tools but also emphasizes the indispensable role of human creativity and oversight in the development process. The crux of this assignment—a project that tasks students with creating a website using AI for text, image, and code generation—underscores the practical applications and potential of AI in real-world scenarios. By introducing a simulated client, "Chef Cookie Cutter," who mid-way alters the project requirements, the assignment simulates the dynamic and often unpredictable nature of real-world web design projects, thus preparing students for the complexities and challenges inherent in their future professions.

This pedagogical approach, grounded in the principles of human-in-the-loop (HITL) engagement, accentuates the synergistic relationship between human ingenuity and AI capabilities. It highlights that while AI can offer innovative solutions, human expertise is paramount for navigating the nuances of client interaction, interpreting evolving project requirements, and making critical design decisions. This synergy between human creativity and AI-driven efficiency enables the creation of web designs that are not only technically sound but also aesthetically pleasing and user-friendly.

Moreover, by exposing students to the iterative process of design and development, influenced by both technological advancements and client feedback, the assignment fosters a holistic understanding of the web design profession. It encourages students to view AI tools not as replacements but as collaborators that augment their creative process. This paradigm shift towards a collaborative model of human-AI interaction prepares students for a future where technological literacy and creative problem-solving skills are equally valued.

The assignment exemplifies a forward-thinking educational strategy that prepares students for the complexities of the web design and development industry. By balancing the innovative potential of AI with the critical need for human creativity and interaction, it offers a comprehensive framework for understanding and leveraging AI in web design and development coursework. This balance ensures that students are not only proficient in utilizing AI tools but are also adept at integrating these tools within the creative process, thus fostering a new generation of web designers and developers who are equipped to navigate the challenges and opportunities presented by the integration of AI in their field.

LITERATURE REVIEW

The integration of generative artificial intelligence (AI) tools within the realm of contemporary art has ignited a fervent discourse concerning the legitimacy of AI-generated artworks and their ramifications on conventional artistic practices (Bonadio & Lucchi, 2019; Zhang & Lui, 2021). Such a paradigmatic shift towards the embrace of generative AI outputs has concurrently fostered poststructuralist inquiries into the essence of artistic identity and the materiality of art objects (Anderson, 2017). This literature review endeavors to delineate the contours of current academic dialogue and to chart prospective avenues of inquiry into the nexus of AI and artistry. It specifically addresses the influence of social media, the fine arts, and algorithmic computation on artistic creation and perception, while also considering the metaverse as a revolutionary

context that transcends traditional modalities of art engagement, thereby crafting novel paradigms for artist-audience interaction. Furthermore, the review examines how the process of creative prompting might recalibrate the relationship between the creator and the created, invoking poststructuralist perspectives on the generation and interpretation of meaning, as well as reception theory.

Despite the burgeoning interest in AI's application to art creation, discourse has predominantly lingered on philosophical or theoretical considerations, with scant attention to the practical methodologies, strategies, or workflows that artists and designers might employ. Existing literature often gravitates towards abstract discussions. Coeckelbergh (2017), for example, articulates a conceptual framework poised at the intersection of philosophy and technology, questioning the very nature of "creation," "art," and the capacity of machines in "creating art." This inquiry challenges conventional dichotomies between human and machine-made art, advocating instead for a nuanced, collaborative interpretation of creativity where technological tools augment the artistic process. Similarly, Mazzone and Elgammal (2019) delve into AI's role in discerning stylistic nuances and identifying overarching patterns in art history, suggesting a reevaluation of the symbiotic relationship between machine-driven and human-driven creativity. This relationship, framed as an "actor network" by Tao (2022), envisions humans and machines as co-contributors to the artistic endeavor, each amplifying the other's strengths.

Further discourse probes into the essence of creativity within the nexus of AI and art, scrutinizing the capacity of machines to partake in the creative process and the characterization of the process itself as inherently creative. Ahmed (2020) posits a design-oriented perspective on AI, advocating for its interpretation not merely as an artifact for exhibition within media museums but as an instrument facilitating design. Through the analysis of interactive and immersive media installations, Ahmed contends that AI's capacity to render "immaterial humanistic characteristics"—such as emotions, experiences, senses, and memories—tangible, advocates for a reconceptualization of AI beyond its conventional perception as a product or traditional design element. This perspective suggests that the interactions and emotional engagements elicited by AI-generated art should themselves be considered integral components of the design process. Nevertheless, these discussions often circumvent the contentious debate surrounding the notion of creativity in art.

The discourse surrounding AI-generated art frequently gravitates towards the concept of creativity and its applicability to works produced by AI. Csikszentmihályi's (1988) conceptual framework for creativity, encompassing a knowledge domain, a volitional agent, and field experts, provides a foundational basis for this analysis. Jennings (2010) extends Csikszentmihályi's model, stipulating three criteria that define a volitional agent with creative autonomy. In the context of AI-generated art, "creativity" implies the system's ability to independently navigate creative avenues, unconstrained by the directives of programmers or operators. However, Ajani (2022) emphasizes that creativity necessitates an individual's capacity for innovation, the assimilation of knowledge, and validation by domain experts. Given that creativity demands external affirmation, AI's creative outputs, in both art and design, must undergo evaluation by field experts to attain recognition as genuinely creative endeavors.

The prevailing scholarly discourse underscores an imperative for further investigation into the practical applications of generative AI tools in the artistic and design spheres. With the ascendance of generative AI technologies, there emerges a clarion call for the establishment of novel methodologies for generating and interpreting AI-facilitated content. A pivotal area of emphasis is the cultivation of collaborative and co-creative processes that empower artists to synergize with AI, thereby extending its functional purview. Artists and designers are encouraged to proactively explore the potentialities and constraints of AI in art creation, striving to integrate these technologies into their work in ways that transcend novelty. Concurrently, there is a necessity for the formulation of new evaluative frameworks capable of appraising the creative and artistic merits of AI-generated content, recognizing the intricacies of human-AI collaboration. This endeavor may necessitate the introduction of novel criteria for assessing creativity and artistic value, alongside innovative strategies for audience engagement. Through interdisciplinary collaboration between the arts and technology sectors, artists hold the potential to significantly influence the trajectory of AI-generated art, unlocking unprecedented avenues for creative expression and the construction of meaning.

METHODS

The methodology section outlines the pedagogical approach and structure of a web design class focused on integrating artificial intelligence (AI) tools into the curriculum. The class, hosted by a private college in the Saint Louis region, included a diverse cohort of 26 undergraduate and graduate students. These students hailed from various disciplines, including Computer Science, Computer Information Systems, Digital Marketing, Finance, Game Design, Marketing, and Art and Design. They were enrolled in Web Design I - User Experience, a project-based course that is the second in a series dedicated to web design. This course advanced student knowledge in HTML and CSS, while also incorporating JavaScript, various frameworks, and libraries to deepen their understanding of web design, with a particular emphasis on user experience through simulated client interactions.

A key component of the course involved familiarizing students with content management systems (CMS) and equipping them with the skills to configure, modify, and populate a CMS-driven site. Moreover, the curriculum covered search engine optimization techniques and digital marketing strategies, essential for promoting and marketing websites effectively **(Table 1).** The overarching goal of integrating AI tools—specifically focusing on text- and image-based generative AI—was to evaluate pedagogical best practices in web design and development. This evaluation aimed to ascertain student perceptions, performance, and feedback, augmented by instructor observations and insights.

Week	Focus	Activities	Objective
1	Introduction to Course and Web Design	Course objectives briefing, Introduction to the pivotal role of web design	Familiarize students with the course structure and the significance of web design

2	Overview of AI Applications in Web Design	Video presentation on eleven AI applications for web design, Guided exploration of AI tools	Introduce AI tools and applications relevant to web design, Encourage exploration of AI capabilities
3-4	CMS Configuration and Population	Learning CMS skills: configuration, modification, and site population	Equip students with practical skills in CMS management
5-6	Search Engine Optimization and Digital Marketing Strategies	Covering techniques for effective website promotion and marketing	Teach effective strategies for SEO and digital marketing
7-8	AI Integration in Design Process and Final Project Completion	Using AI for content generation and visual design, Iterative design process, Final project submission with AI elements annotated	Apply AI tools in the creative process, Emphasize the integration of coding, functionality, and aesthetics in web design

The course was structured as an eight-week module, with each week dedicated to a specific aspect of web design and AI integration. Initially, students were introduced to the course's objectives and the pivotal role of web design. Subsequently, a video presentation outlined eleven different AI applications pertinent to web design, guiding students on how to leverage AI for various design decisions. Special emphasis was placed on the use of AI in enhancing the aesthetic dimensions of web projects, encouraging an iterative design process. In this context, AI was positioned as a supplemental tool for content generation and visual design, aiming to bridge the gap, particularly for students with a stronger background in computer science, who might find the design aspects more challenging.

Notably, the assignment framework encouraged students to articulate how AI was utilized within their creative process (**Figure 1**). This included the annotation of their projects with HTML comments to denote AI-generated elements, fostering transparency and reflective engagement with the AI tools used. While the direct application of AI for coding tasks was constrained by certain framework limitations, its utility in content and visual design remained a focal point of the course. The curriculum aimed to foster a nuanced understanding of AI as an augmentative resource in web design, emphasizing its potential to enhance traditional educational paradigms through the strategic integration of coding, functionality, and aesthetics.

Figure 1. Introduction of AI Overview

The Restaurant Project was part of the larger website project **(Figure 2)**. The assignment in question unfolds within the structure of an eight-week course, aimed at melding the traditional tenets of web design with the avant-garde capabilities afforded by AI. The initial phase of the course serves to acclimate students to the overarching objectives and the pivotal role of web design in the contemporary digital landscape. A critical component of this phase involves an extensive exploration of AI applications pertinent to web design, facilitated by a comprehensive video presentation. This introduction to AI is not merely theoretical; it is a call to action for students to engage with AI tools, thereby bridging the gap between coding proficiency and aesthetic sensibility, especially for those with a robust background in computer science.

As the course progresses into the mid-section, students delve into the intricacies of content management systems (CMS), acquiring the skills necessary to configure, modify, and populate CMS-driven sites. This hands-on experience is complemented by lessons in search engine optimization (SEO) and digital marketing strategies, equipping students with the tools to effectively promote and market their websites. The culmination of the course is marked by an emphasis on the integration of AI in the design process. Students are tasked with employing AI tools for content generation and visual design, fostering an iterative process that champions creativity and innovation. The assignment necessitates a reflective engagement with the AI tools utilized, requiring students to annotate their projects with HTML comments to denote AI-generated elements. This exercise not only fosters transparency but also encourages a critical evaluation of the role of AI in the creative process.

Throughout this journey, the direct application of AI for coding tasks is acknowledged to be constrained by certain framework limitations. However, the assignment underscores the utility of AI in content and visual design, positioning AI as a supplemental tool rather than a replacement for traditional education. The goal is to foster a nuanced understanding of AI as an augmentative resource, emphasizing its potential to enhance the educational paradigm through the strategic integration of coding, functionality, and aesthetics.

Figure 2. Module Overview for Assignments

In the fourth week of the course, the students were introduced to a pivotal assignment involving a simulated client, Chef Cookiecutter **(Figure 3)**. This task required the students to apply the knowledge and skills they had acquired thus far to develop a website that met the specific needs of the client. A unique aspect of this project was the mandate to incorporate artificial intelligence (AI) tools into the development process, a challenge that necessitated both technical proficiency and creative acumen. Students were tasked with not only constructing the site but also producing a video report detailing their progress. This report was expected to highlight the utilization of AI tools in their project, providing insights into how these technologies were leveraged to fulfill client requirements.

Given the exposure to 11 AI applications earlier in the course, students were now challenged to judiciously select and apply at least four of these tools throughout the duration of the project. This selection process was critical, as students needed to demonstrate an understanding of the

functionalities and potential applications of these tools in the context of web design and development. The video report served as a platform for students to articulate the rationale behind their choice of AI tools, describe the integration of these tools into their project, and reflect on the impact of AI on the design and development process.

The subsequent week, week five, introduced an additional layer of complexity to the project through the client's request for an animated logo. This requirement not only tested the students' design skills but also their ability to employ AI in creative ways. The animation of the logo, inspired by or directly generated through AI, necessitated a deep dive into the capabilities of AI tools for graphic design and animation. Students were required to navigate the intersection of AI technology and creative design to produce an animated logo that aligned with the client's vision. This component of the assignment emphasized the role of AI as a collaborator in the creative process, pushing students to explore innovative approaches to animation and design.

Throughout these phases of the project, students engaged in a continuous iterative process, applying feedback from the client (simulated as part of the educational experience) and adapting their designs accordingly. This process mirrored the dynamic nature of real-world web design projects, where client feedback and iterative refinement are integral to achieving the desired outcomes. The Chef Cookiecutter assignment, with its emphasis on the practical application of AI tools in web design and development, served as a microcosm of the broader industry trends, preparing students for the complexities and opportunities that lie ahead in their professional careers. By navigating the challenges presented by this assignment, students gained invaluable experience in integrating AI into the creative process, a skill set that is increasingly relevant in the rapidly evolving field of web design.

Figure 3. Meet the Client Video Assignment

Instructor Observations

In the context of the web design course, instructor feedback on the integration of AI tools was unequivocally positive, centering on the potential and benefits these technologies afford in an educational setting. A salient strategy employed by the instructor was the preliminary demonstration of generative AI capabilities, effectively showcasing to students the broad array of possibilities these tools present. Although the inclusion of AI in the final projects was not a stipulation, a significant majority of students independently chose to incorporate AI tools into their work. According to the instructor, this voluntary integration substantially augmented the quality of the final projects, mirroring the students' perception of AI's potential to elevate their design projects in forthcoming endeavors.

A pivotal component of the course, the Chef Cookie Cutter assignment, underscored the application of AI within a practical, real-world scenario. This project required students to navigate the complexities of integrating AI tools into their design process, reflecting a real-world workflow modification that prepares them for contemporary challenges in web design and development. The assignment facilitated discussions on the ethical use of AI, underscoring the importance of imbuing students with not only the technical acumen for AI application but also an ethical framework for its use. The course culminated in a reflective dialogue on the ethical implications of AI in design, advocating for an educational approach that dispels initial negative biases and focuses on the positive potential of AI. This necessitates a paradigm shift in

institutional culture towards AI, promoting an environment that encourages the exploration and application of AI tools.

Instructional methods included extensive demonstrations on utilizing AI for diverse design needs, such as image generation, color palette creation, and logo ideation. By concentrating on the positive applications of AI and steering clear of its potential drawbacks, students were motivated to explore the extensive capabilities of AI. Additionally, the adaptation of course rubrics to include AI fostered an atmosphere of experimentation among students. As well, the strategy led to a positive reception among students, who initially harbored reservations about AI. Through the Chef Cookie Cutter assignment, students experienced firsthand the modifications required in their workflow to incorporate AI effectively, mirroring real-world scenarios. The course structure, built on showcasing the utility and ethical considerations of AI, coupled with encouragement for AI experimentation in design projects, cultivated a learning environment that not only alleviated initial apprehensions but also underscored the practical and creative advantages of AI in web design and user experience.

CONCLUSION

The integration of AI-generative tools within the realms of art and design education heralds a transformative era, imbuing the creative process with unprecedented potential. This study has illuminated the significant utility of AI in web design and user experience courses, showcasing its applicability across a spectrum of student backgrounds. While the path forward necessitates further research and refinement in the deployment of these technologies, the evidence underscores their profound influence on creative methodologies. It is imperative to acknowledge that AI is not a replacement for human creativity but a powerful adjunct that augments and expands the artistic repertoire. Ethical concerns and copyright considerations related to AI-generated content demand meticulous attention within art and design pedagogy. As the discipline continues to evolve, it becomes essential for educators to recalibrate the curriculum, emphasizing the conceptual underpinnings of creativity alongside technical skill.

The future trajectory of research should delve into both the aesthetic potential and coding capabilities of AI-generative tools, with a particular focus on the strategic use of text prompts for generating art. The capacity for artists to engage directly with algorithms opens new horizons for creative exploration. It is incumbent upon governing bodies, such as NASAD, to articulate guidelines for the seamless integration of these tools into educational frameworks. Moreover, this study underscores the efficacy of AI in enriching web design competencies, advocating for a deeper integration of such technologies into academic curricula as they continue to advance.

The advent of AI avatars introduces a novel dimension to these discussions, offering the potential for diverse character interactions beyond the singular role of the instructor. This innovation presents an opportunity to enrich the learning experience with a variety of personas, each bringing unique perspectives and challenges to the educational tableau. With the emergence

of platforms like ChatGPT-4 and its enhanced functionalities, the horizon of possibilities for integrating AI in art and design education broadens further. The continuous exploration and adoption of AI technologies promise to redefine the landscape of art and design education, equipping artists with a new arsenal of tools and opportunities for creative expression and innovation.

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