

Collaboration with Generative Artificial Intelligence in the Early Stages of Design Studio: A Model Proposal

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Abstract

This study investigates the integration of Generative Artificial Intelligence (GAI) into early-stage design studio education, where students navigate ill-defined problems requiring ideation, scenario-building, and conceptual development. A structured collaboration model was developed using text-to-text (ChatGPT) and text-to-image (Bing Image Creator) platforms and implemented in a second-year interior design studio with 15 students. The model guided students in creating user-based scenarios, generating atmospheric visualizations, and framing initial design concepts through analog collages. To assess the impact, expert jury members—practicing interior architects with GAI experience—evaluated student outputs based on predefined criteria. Quantitative analysis revealed that GAI-supported workflows improved conceptual clarity, representational skills, and productivity. Visual documentation of student work further illustrated these outcomes. This research contributes to the growing discourse on AI-enhanced pedagogy by proposing a replicable, human-centered GAI integration model. It offers practical insights into how generative tools can support creativity, foster reflective thinking, and enhance communication in early design education.

Keywords: Generative artificial intelligence, conceptual design, design studio education, text to text, text to image.

Tasarım Stüdyosu Erken Aşamalarında Üretken Yapay Zeka ile İşbirliği: Bir Model Önerisi

Öz

Bu çalışma, tasarım stüdyosu eğitiminde öğrencilerin fikir üretimi, senaryo oluşturma ve kavramsal geliştirme gibi becerilerle başa çıktığı erken aşamalarda Üretken Yapay Zekâ (GAI) entegrasyonunu araştırmaktadır. GAI destekli insan-merkezli bir iş birliği modeli, metinden-metne (ChatGPT) ve metinden-görüntüye (Bing Image Creator) platformlarıyla geliştirilmiş ve ikinci sınıf iç mimarlık stüdyosunda 15 öğrenciyle uygulanmıştır. Model, öğrencilerin kullanıcı senaryolarını ifade etmelerini, mekânsal atmosferleri görselleştirmelerini ve ilk tasarım kavramlarını analog kolajlar aracılığıyla şekillendirmelerini desteklemeyi amaçlamıştır. GAI deneyimi olan iç mimar jüri üyeleri, öğrencilerin çıktılarını üzerinde önceden tanımlanmış değerlendirme ölçütlerine göre uzman değerlendirmesi gerçekleştirmiştir. Nicel analizler, GAI destekli süreçlerin öğrencilerin kavramsal netliğini, temsil becerilerini ve stüdyo verimliliğini artırdığını göstermiştir. Öğrenci çalışmalarına ait görsel belgeler de bu bulguları desteklemiştir. Bu araştırma, AI destekli stüdyo eğitimine dair tekrar edilebilir ve insan merkezli bir entegrasyon modeli önererek, yapay zekâ temelli tasarım pedagojisi literatürüne anlamlı bir katkı sunmaktadır.

Anahtar kelimeler: Üretken yapay zeka, konsept tasarım, tasarım stüdyosu eğitimi, metinden metine, metinden görsele.

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1. Introduction

In design education, particularly in fields such as architecture and interior design, the early stages of the creative process as understanding, ideation, and conceptual development, are essential for cultivating critical thinking, creativity, and spatial reasoning (Goel, 1992; Gero & McNeill, 1998; Mankins, 2014). These stages are often ill-structured, requiring designers not only to generate solutions but also to define and reframe the problem itself (Akin, 2008; Goldschmidt, 2014). Studio-based pedagogy reinterprets these early design phases through design thinking principles, emphasizing empathy and contextual awareness as key inputs for concept formation (Brown, 2009; Hettithanthri et al., 2023). Representational tools—such as sketches, diagrams, scenarios, and narratives which play a central role in this phase, helping students transform abstract ideas into tangible design proposals (Goldschmidt, 2004; 2019; Somer, 2015; Çubuk, 2023).

More recent studies have further refined this framework, describing architectural design as a detailed process involving ideation, conceptualization, iteration, and refinement (Liao et al., 2024; Bandi et al., 2023; Rane et al., 2023; Enjellina et al., 2023). These iterative stages demand not only creativity but also the ability to reframe and navigate ambiguous design problems while considering users and context (Gero & McNeill, 1998; Pena et al., 2021).

In this context, Generative Artificial Intelligence (GAI) presents new opportunities to enhance the representational and ideation capabilities of students. Especially in text-to-text and text-to-image models, GAI can assist in articulating user scenarios, visualizing contextual atmospheres, and supporting early design exploration (Gozalo-Brizuela & Garrido-Merchan, 2023). While generative systems in architecture date back over fifty years (BuHamdan et al., 2021), today's deep-learning-powered platforms—such as OpenAI's ChatGPT and Microsoft's Bing Image Creator—offer accessible, intuitive tools capable of generating novel yet relevant content, including text, images, and more (Rane et al., 2023; Rafsanjani & Nabizadeh, 2023).

This study addresses a critical gap in architectural education by exploring how GAI tools can be pedagogically integrated into early-stage studio processes. Specifically, it investigates: (1) how text-to-text models may support students in translating user-based scenarios into architectural programs, and (2) how text-to-image models can enhance visualization of context, atmosphere, and spatial qualities in conceptual design.

The study adopts a design-based research methodology, incorporating AI-assisted workflows into experimental design studio exercises. The scope focuses on the ideation and conceptualization phases, where abstraction and ambiguity are most pronounced. By proposing a structured model for incorporating GAI in studio education, this study contributes to the evolving discourse on AI-enhanced design pedagogy, emphasizing its potential to foster creativity, enrich user-context engagement, and strengthen early representational skills among architecture students

1.1. Scenario-Based Design Studio and Early Stages

Design disciplines such as architecture and interior design rarely yield a single “correct” solution to a spatial problem. Rather, they accommodate multiple valid responses derived from iterative processes of variation, exploration, and informed decision-making (As et. al., 2018). Design education, in turn, is characterized by its abstract and complex nature, challenging students to navigate ambiguity while cultivating both creativity and analytical thinking. According to Park and Lee (2022), design studios foster an understanding of the entire design process, thereby nurturing students' innovative capacities. Cho (2017) similarly argues that creativity and spatial reasoning are key cognitive functions critical to success in architectural and interior design education.

The early stages of design studio, particularly in architectural contexts, demand the transformation of program briefs into spatial concepts through representations such as sketches, drawings, and physical models (Prawata, 2017). This phase emphasizes broad conceptual thinking and the articulation of project vision. Numerous studies underscore the pedagogical importance of this phase, highlighting its role in shaping foundational design skills (AboWardah, 2020; Idi & Khaidzir, 2015; Bueno & Turkienicz, 2014; Leon & Laing, 2013).

Scenario-based design studios have emerged as a particularly effective pedagogical approach for early design education. This method introduces students to realistic, context-rich problems and emphasizes user-directed design processes. It fosters understanding of user-space relationships while preparing students for the complexities of professional design environments (Mazhari et al., 2022; Tvedebrink & Jelic, 2018). As Eilouti (2018) and Casakin et al. (2016) note, this pedagogical model supports experiential learning by encouraging students to engage deeply with contextual narratives and functional constraints. Rooted in constructivist principles, it promotes learning through doing, reflection, and collaboration.

Scenarios, as Carroll (1999) describes, are narrative constructs that represent people and their activities, helping designers translate abstract user and contextual input into coherent spatial strategies. These narratives function as cognitive tools for envisioning how spatial environments support behavior, thereby shaping architectural and interior solutions.

However, creating scenarios in traditional studios can be cognitively demanding, especially for novice students. Islam (2019) emphasizes the challenge of generating coherent, experience-driven narratives without sufficient real world grounding. Furthermore, early-stage difficulties often arise around idea generation, conceptual clarity, contextual analysis, and balancing functional and aesthetic priorities (Islam, 2019; Bueno & Turkienicz, 2014; Leon & Laing, 2013, Uzun & Çakır, 2022).

Scenario-based studio education addresses these challenges by framing design as a process of situated problem-solving enhancing students' abilities to analyze, ideate, and iterate in response to rich and plausible situations. The early phases of this approach typically involve research, problem definition, concept development, and prototyping within a reflective and interactive studio culture.

1.2. Human-AI Collaboration in Design Studio

By leveraging the strengths of both human intuition and machine intelligence, the architectural design process can be significantly enhanced, resulting in buildings and spaces that better meet the needs (Ergül et.al., 2024). While human-centered tools are critically required, the latest extent of AI contributions to the architecture domain are mostly machine centered without taking into account human preferences (Rafsanjani & Nabizadeh, 2023). In other words current implementations of AI generally consist a deficiency in human interaction, which has sparked concerns regarding the potential erosion of human purpose. This awareness has stimulated a demand to re-assess the interrelation of humans and AI (Markauskaite et al. 2022). Attaining equilibrium between human-centered education and AI applications has become essential (Rafsanjani & Nabizadeh, 2023; Cheung & Dall'Asta, 2024). Since the collaboration between humans and machines is garnering increasing interest from researchers (Dai et. al , 2023), this study targets to investigate a new way to cooperate with AI in design studio education. Particularly for the design studio education domain there are some previous studies experimenting digital and analog interactions in the literature. In this manner Schubert et.al. (2011) proposed a collaborative design platform (CDP) which serves as a tool during the initial design phases, aiding the designer in developing and evaluating design concepts.

ChatGPT (text to text) possesses the capacity to comprehend and analyze the meaning of text while it is also used for generating text in creative writing (Adeshola and Adepoju, 2023). Raza et. al (2023) mentioned ChatGPT as an invaluable collaborator in the ideation stage of architectural design. Further, Raza et al (2023) indicated the crucial role of ChatGPT in interior design, specifically on idea generation. Further, Sainani (2023) pointed out that by feeding in specific parameters like style option, color patterns, and spatial needs, various design ideas can be provided.

Since Bing Image Creator (text to image) released in the first quarter of 2023, there has been very limited research yet. From a broader text to image perspective, Albaghajati et. al., (2023) focused on prompt engineering while exploring the potential of employing text-to-image platforms for instance DALL-E, Midjourney, and Stable Diffusion, in the design process in architecture.

Zhang et. al. (2023) emphasized that the GAI models have the potential to generate a wide range of unconventional patterns and solutions, thereby expanding the limits of traditional design thinking. On

the other hand, in order to incorporate AI effectively, the importance of development of appropriate educational models and strategies was pointed out in the same study.

In the early stages of the design process, text-to-image models can facilitate the creation of visuals that support the comprehension of context and user needs. These visuals enhance visual storytelling by producing distinctive conceptual images that capture the core of design ideas, while helping to set the intended atmosphere, mood, and environment for a project. He et. al. (2023) explored how generative AI can revolutionize essential tasks in a standard interior design workflow, including ideation, schematic drafting, and layout planning. Abrishami et. al. (2021) has developed a generative BIM framework that integrates generative design methods into a cohesive and dynamic BIM environment to assist in the early stages of the conceptual design process.

Despite these advances, research on the practical application of generative AI within architectural design studios remains limited (Cheung & Dall’Asta, 2024). This study addresses this gap by proposing and implementing a collaborative model that fosters productive interaction between students and GAI tools in early design education.

2. Material and Method

2.1. Research Design

A mixed-methods research approach was employed, combining the development of a conceptual model (Figure 1) grounded in a literature review with a quantitative evaluation of generative AI (GAI) integration in the early stages of design education. The study focused on third-semester interior architecture students undertaking their first design studio after completing a basic design education. Due to their early stage in the curriculum, novice students were not yet trained in computer-aided design tools. As a result, the studio emphasized manual representation techniques alongside GAI-supported design exploration.

The design task involved the interior design of a duplex residential unit in a given shell-and-core building. Key architectural features such as the structural system, window openings, entrances, and technical shafts were predetermined. Within these constraints, students were expected to make design decisions related to functional arrangements, spatial organization, vertical circulation, and interior finishes, thereby translating abstract design ideas into a complete interior scheme.

2.2. GAI Integration Model Development and Implementation

The GAI collaboration model proposed and implemented in this study was structured into four interrelated phases in addition to an assessment and analysis phases with a total duration of 6 weeks together with the jury assessment (Figure 1). These phases reflect a dynamic and iterative workflow that integrates GAI tools into the early stages of design education.

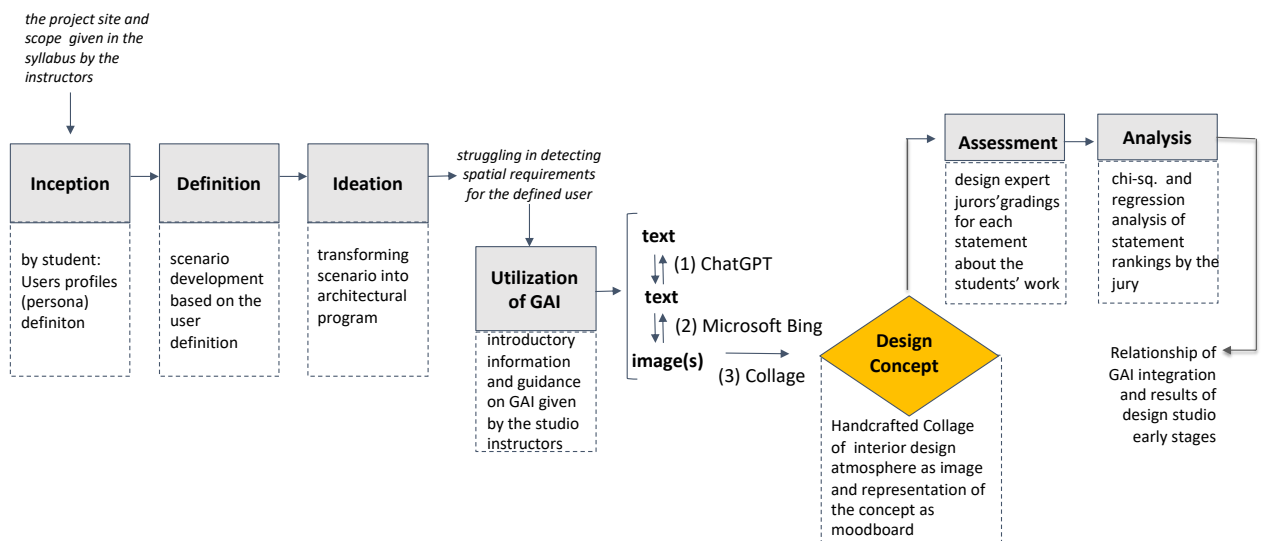


Figure 1. GAI integration model for the early stages of design studio (Created by authors)

Inception Phase (1), marked the starting point of the design process, where students generated fictional user profiles by defining parameters such as age, lifestyle, daily routines, and preferences. These profiles served as a foundation for personalized design scenarios.

Definition Phase (2), involves students developing personalized scenarios based on their fictional personas (Figure 1). Scenarios served as narrative tools that illustrated users' day-to-day experiences, needs, and spatial interactions. As Eilouti (2018) states, scenarios act as "what-if" constructs that foster holistic and user-centric solutions.

Ideation Phase (3) was transforming the scenario into an architectural program (Figure 1). According to AIA, the program provides criteria for interior layouts, finishings and other issues at that level of detail (EPC, 2013). Accordingly, students were required to develop architectural programs involving atmospheric features, functional requirements, spatial needs such as types, sizes, relationships and constraints. Scenario-based programming encouraged students to transition from narrative thinking to spatial reasoning (Carrol, 1999; Nazidizaji et.al., 2015)

Utilization of GAI Phase (4), focused on the structured integration of GAI tools into the design process. Studio instructors introduced students to GAI platforms and guided them through interaction protocols using both text-to-text and text-to-image models, as illustrated in Figure 1. Before the design task, all students received structured instruction on GAI tools, covering their capabilities, limitations, and applications in design. Through lectures and guided exercises, students were prepared to use GAI effectively, ensuring a consistent skill level regardless of prior experience.

The integration process was structured around a three-stage model (stage 1) text-to-text, (stage 2) text-to-image and (stage 3) collage making to develop concept. The model designed to scaffold conceptual development through iterative collaboration with GAI tools (Figure 1).

- (1) Text-to-text model (Chat GPT) was utilized in two different ways; improvement of the scenario and converting the scenario into an architectural program which describes the interior space design requirements (text). Texts from the architectural program were redefined by students to create prompts for image generations. In other words, students detected key terms from the architectural program to define atmospheric attributes and generate visual prompts.
- (2) Text-to-image model (Bing image creator). According to the prompts (text), alternative visuals (image) for the intended interior atmosphere were generated through Microsoft Bing Image Creator.
- (3) In order to develop a design concept, students critically engaged with the GAI-generated visuals through manual collage-making. Rather than relying solely on digital outputs, students deconstructed and reinterpreted these images to develop their own analog collages, reflecting individual interpretations of the intended spatial experience. This manual process not only reinforced students' authorship but also facilitated the translation of abstract atmospheres into design concepts. These collages subsequently informed architectural drawings, thus advancing the conceptual development of the interior space.

As part of "utilization of GAI phase", to provide a detailed view of how students interact with GAI tools during the early design process, Figure 2 illustrates the step-by-step use-case workflow developed for this study. The use-case diagram approach (Kawabata et.al., 2007) outlines how an interior architecture student engages with both text-to-text and text-to-image GAI platforms throughout the conceptual development process. The sequence begins with the creation of a user profile and life scenario in text format, facilitated by ChatGPT. These narratives are then restructured into diagrams and translated into an architectural program. By identifying keywords within their textual work, students generate interior atmosphere alternatives using Microsoft Bing Image Creator. These AI-generated images support collage-making that express the design concept. Figure 2 emphasizes the iterative and exploratory nature of GAI-supported design ideation in a studio-based educational setting

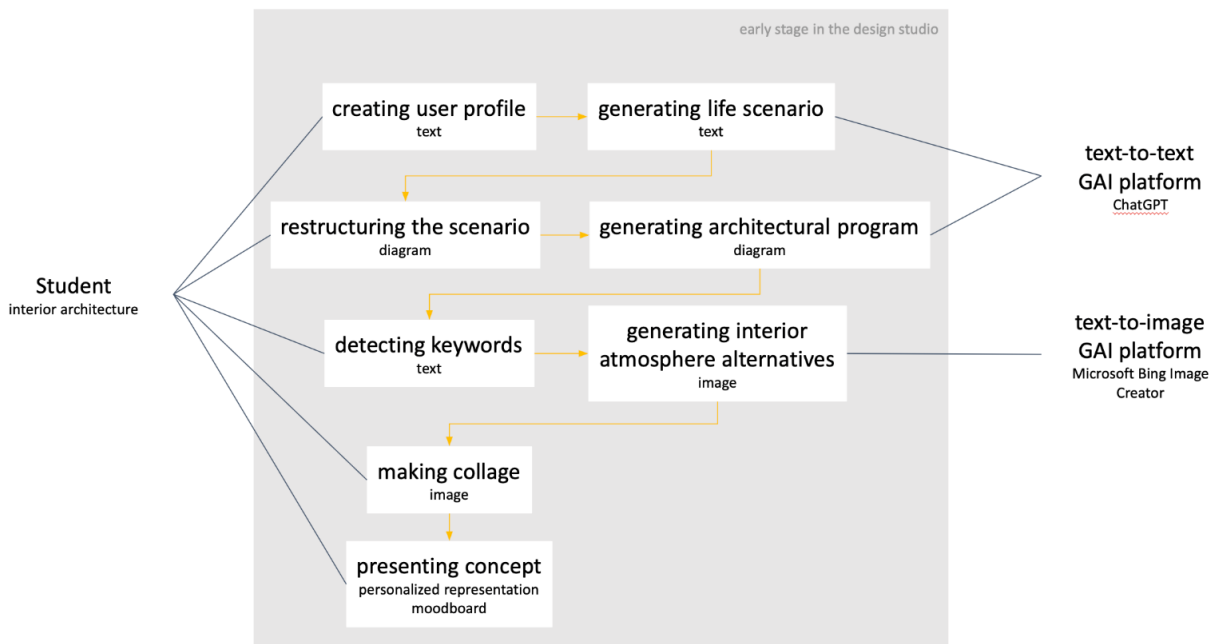


Figure 2. Student-GAI collaboration model in design studio (Created by authors)

The developed concepts were then subject to a structured assessment process carried out by expert reviewers, followed by an analysis in which the effectiveness of GAI integration was evaluated in relation to predefined impact areas such as representational skills, conceptual development (Figure1).

The outcome of this cyclical interaction led to the formation of a coherent Design Concept. This model emphasizes the non-linear, exploratory nature of early-stage design thinking and demonstrates how GAI tools can be purposefully embedded into each phase to support ideation, representation, and evaluation.

2.3. Assesment of The Model

Peer-reviews, instructor-reviews and/or expert-reviews are customary methods for assessment of creative works (Sawyer & Henriksen, 2024). While peer reviews and instructor critiques were inherently part of the design studio process, the formal evaluation of the research model was intentionally conducted by external experts to ensure impartiality and professional relevance.

A jury panel of three practicing interior architects, all of whom had prior experience integrating AI into their professional workflows, was invited to evaluate the final student outputs. These experts were not involved in the instruction of the studio, ensuring their assessments reflected an independent professional perspective.

The evaluation was carried out through a structured jury session, during which each expert reviewed the submitted student projects and rated them using a 5-point Likert scale across a set of predefined evaluation criteria. Each statement was designed to assess a specific impact area of GAI use, including; representation skills, Text-to-text GAI collaboration, Text-to-image GAI collaboration, conceptual development, overall effectiveness of GAI collaboration as expressed in Table 1.

Experts were asked to rate each item on a scale from 1 (Strongly Disagree) to 5 (Strongly Agree). The full set of evaluation statements is presented in Table 1. These ratings provided a quantitative basis for analyzing the perceived effectiveness of GAI-supported processes in the students' conceptual and representational performance.

The collected expert evaluation data were analyzed using chi-square tests and regression analysis to explore the impact of GAI integration on student outcomes. These methods tested the hypothesis that GAI integration correlates with improved conceptual clarity and visual representation.

Table 1. Jury statements for each student and corresponding impact areas

N	Statement	Impact Area
1	The student has been able to convey the ideas about their intended atmosphere of interior space.	representation skills
2	AI-generated scenarios have been helpful for students to describe their intended atmosphere.	text-to-text AI collaboration
3	AI-generated images have been helpful for students to describe their intended atmosphere.	text-to-image AI collaboration
4	Considering a five week progress, I think the student has achieved the overall intended atmosphere.	conceptual development
5	I think that human-AI collaboration has enhanced the student's productivity.	overall AI collaboration

3. Findings and Discussions

3.1. Findings

Figure 3 illustrates the result of GAI collaboration model implementation through one of the student’s work in order to express how students interpreted AI-generated content to convey interior atmosphere design.

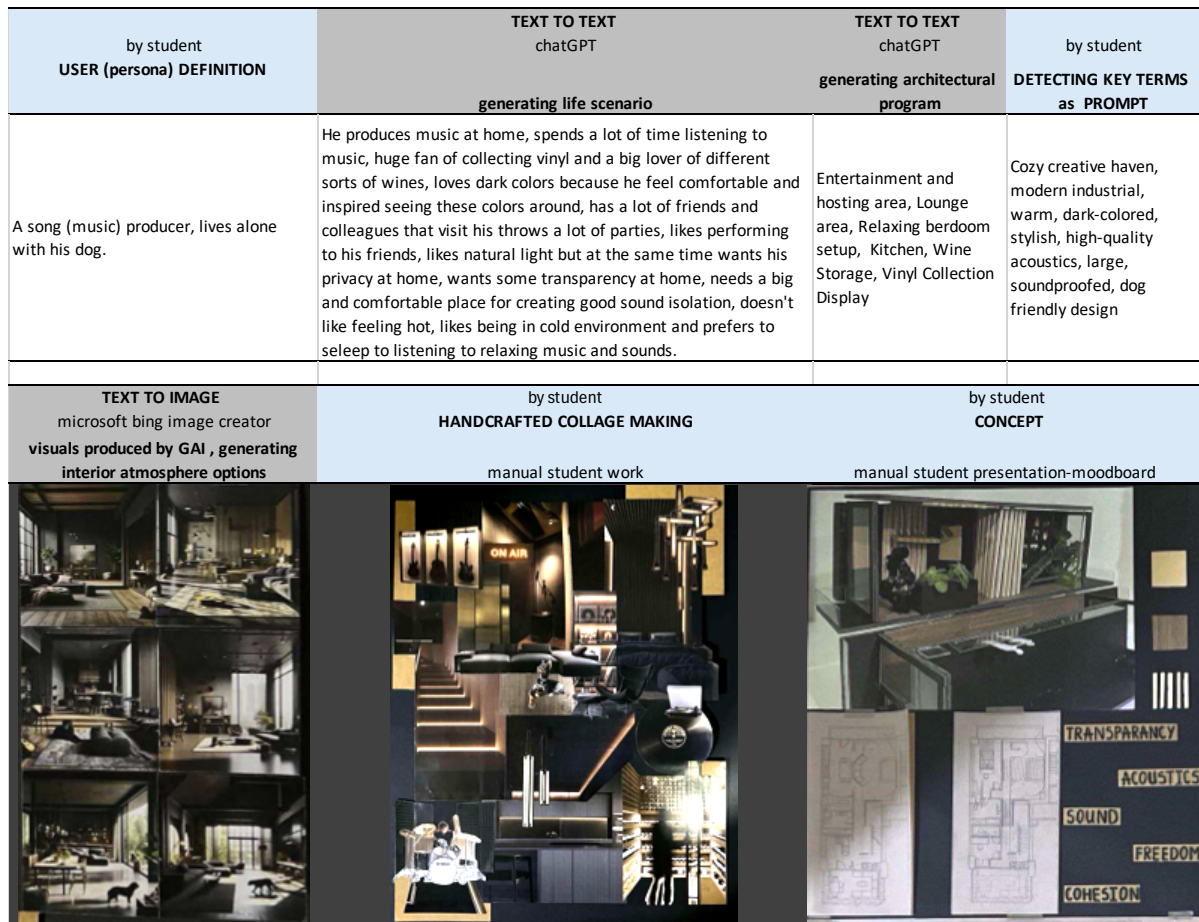


Figure 3. Implementation of the GAI collaboration model-student Akhundova’s work (project information and visuals by student Akhundova and the figure developed by the authors)

A total of 15 student projects were evaluated during the final jury session. Figure 4 and Figure 5 shows the student works involving user profile, detected key words, AI generated images and handcrafted collages along with the evaluation points for each impact area by the jurors.










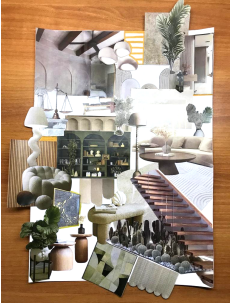

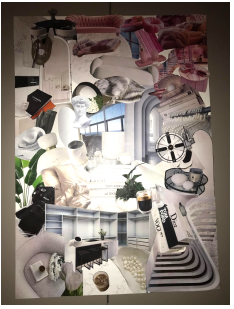



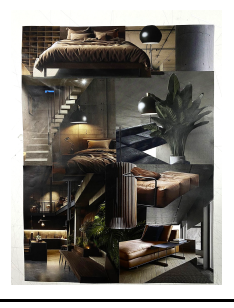
user profile	Repr. Skills	Txt to txt	Txt-to- img	Concept Dev.	Over All AI.	detected keywords (text)	generated interior atmosphere alternatives (image)	collage
song producer who lives alone with a dog	5	5	5	5	5	cozy creative haven, modern, warm, dark-colored, stylish, high-quality acoustics, large, soundproofed.		
thompson family; a teacher dad, an artist mom, a book-loving teen and an infant	4	4	4	4	4	sunlit boho-country oasis, well-lit, pastel colors, bright, airy atmosphere, indoor plants, lightwood details, creative sanctuary, inviting atmosphere.		
50-year-old renowned nature photographer who lives alone in a suburban house	4	4	4	4	4	nature photographer, photography department, dedicated darkroom, perfect lighting conditions, dark, neutral tones, large storage cabinets, comfortable work area, wooden details, blackout curtains		
bodybuilder couple with a teenage son	4	3	4	4	4	modern minimalist design, natural color palette with occasional bold accents, industrial touch, natural wood accents.		

Figure 4. GAI collaboration model implementation results and assessment of students by the jury members (visuals and project information by the students A.Akhundova, H.Hammami, Ş.S.Tonguc, A.Degirmenci, S. Özdemir and the figure developed by the authors)

The jury, consisting of domain experts in interior architecture, assessed each student's design presentation using five structured statements targeting specific impact areas: representation skills, AI collaboration (text-to-text and text-to-image), conceptual development, and overall performance (Figure 4 and Figure 5).

user profile	Repr. Skils	Txt to txt	Txt-to-img	Concept Dev.	Over All AI.	detected keywords (text)	generated interior atmosphere alternatives (image)	collage
32-year-old lawyer wife and 35-year-old computer engineering husband	4	3	2	4	3	contemporary style, warm color palette, modern and simple touch, deep interest in art, well-equipped kitchen, comfortable dining area		
two friends; one is 25-year-old fashion and beauty influencer, the other is 22-year-old unemployed	3	3	3	3	3	modern, spacious, suitable for video shooting, stylish vanity for good lighting, full-length mirror, adjustable lighting for video shooting, tech-friendly furniture		
a rising YouTuber who enjoys inviting his YouTube fellows for collaborative projects	3	3	3	3	3	intimate and communal atmosphere, white gray and beige palette, oversized sofas and cozy fireplace, open kitchen, studio space, professional lighting, creative and motivating atmosphere		
30-year-old psychologist who lives alone and works from home	3	3	3	3	3	modern, industrial, small reception, therapy room, large bookcases, plants, dark and natural tones, comfortable furniture, cozy environment, open-plan living area.		

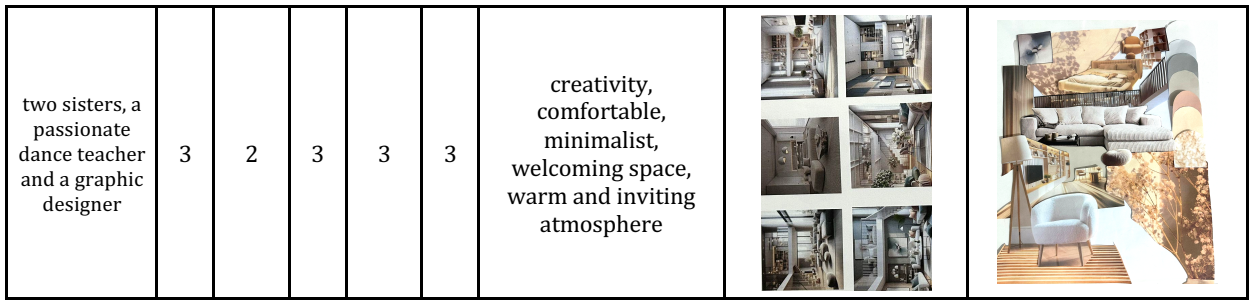


Figure 5. GAI collaboration model implementation results and assessment of students by the jury members (visuals and project information by the students A.Kalkan, I.Agus, M.A.Egin,S.Önder,C.Elmas and the figure developed by the authors)

To provide a clearer understanding of the expert evaluation outcomes, both frequency distributions and average scores have been calculated for each assessment criterion. Frequencies reveal how often each Likert scale response (ranging from 1 = Strongly Disagree to 5 = Strongly Agree) was selected by the jury members for each impact area for each of the 15 students, resulting in 45 evaluations per item., offering insight into response patterns and consensus levels. Average scores, on the other hand, allow for a quantitative comparison across the five evaluation dimensions: representation skills, text-to-text AI collaboration, text-to-image AI collaboration, conceptual development, and overall GAI collaboration. Table 2 summarizes these results by presenting the count of jury responses for each rating level alongside the computed average score per item, thereby combining qualitative tendencies with numerical clarity.

Table 2. Frequency and average scores of jury evaluation

Evaluation Criterion (impact areas)	FREQUENCY OF EVALUATION OF EACH STATEMENT					Average Score
	1 strongly disagree	2 disagree	3 neutral	4 agree	5 strongly agree	
1. Representation Skills	0	4	18	18	5	3,53
2. Text-to-Text AI Collaboration	0	10	20	12	3	3,18
3. Text-to-Image AI Collaboration	2	8	20	11	4	3,16
4. Conceptual Development	0	9	16	15	5	3,36
5. Overall GAI Collaboration	0	8	18	17	2	3,29

For representation skills, most responses clustered around the mid to high range, with 18 “agree” and 5 “strongly agree” responses, resulting in an average score of 3.53. This suggests that GAI tools moderately supported students’ ability to communicate their intended spatial atmosphere. Text-to-text collaboration, with an average score of 3.18, received 20 jurors selected “neutral,” and only 3 marked “strongly agree.” This indicates that while the use of ChatGPT was helpful, it was not uniformly impactful across all students. Text-to-image collaboration received an average score of 3.16, and 11 responses in the “agree” and 4 responses “strongly agree” categories. This points to a relatively more consistent positive effect of tools like Bing Image Creator on visual ideation and representation. The conceptual development criterion saw stronger agreement with 15 “agree” and 5 “strongly agree” evaluations, reflecting the model’s notable contribution to students’ idea formation and narrative clarity. Lastly, overall AI collaboration received one of the highest recognitions with 17 agree and 2 strongly agree. Nevertheless, across all categories, there was a noticeable absence of strong negative responses, and most evaluations clustered around the “agree” category. These findings support the view that GAI platforms can enhance early-stage interior design education, especially when properly guided and integrated into a structured model.

To explore whether the observed differences in expert evaluations were statistically meaningful, a chi-square test was employed. This test is particularly useful for assessing relationships between

categorical variables, helping determine if any associations exist beyond random chance. The chi-square test was applied to assess whether there were statistically significant associations between categorical variables, particularly the use of GAI tools (text-to-text and text-to-image) and students' performance in key impact areas such as representation skills and conceptual development. This analysis aimed to test the null hypothesis that GAI usage and design performance are independent. The results, summarized in Table 3, yielded a chi-square value of 0.75 with 2 degrees of freedom ($p = 0.575$), indicating that the null hypothesis could not be rejected. While this suggests no statistically significant dependency between GAI integration and individual impact areas, descriptive patterns revealed consistently positive evaluations in areas such as conceptual development and overall collaboration (Table 3).

Table 3. Chi-sq. table ($\chi^2=0,75$; $DF=2$; $p=0,575$)

Impact Area	Good (5-4)	Neutral (3)	Bad (2-1)
N.1 representation skills	1,03	0,44	0,11
N.2 text-to-text AI collaboration	1,21	1,00	0,11
N.3 text-to-image AI collaboration	0,06	0,11	1,83
N.4 conceptual development	0,03	0,00	0,11
N.5 overall AI collaboration	0,03	0,00	0,11

To further investigate the nature of the relationship between GAI collaboration and student outcomes, regression analysis was conducted. The regression model examined whether the frequency and quality of AI engagement—particularly in prompt crafting and atmospheric scenario development—correlated with higher jury scores. As shown in Figures 6,7,8,9, the regression results indicated a moderate positive correlation between effective GAI usage and increased student performance, particularly in conceptual development and visual representation.

In terms of “Representation skills vs. Overall AI collaboration” (statements 5-1) as seen in Figure 6, the overall AI collaboration has a potential positive effect on the students’ representation skills ($R^2 = 0,539$).

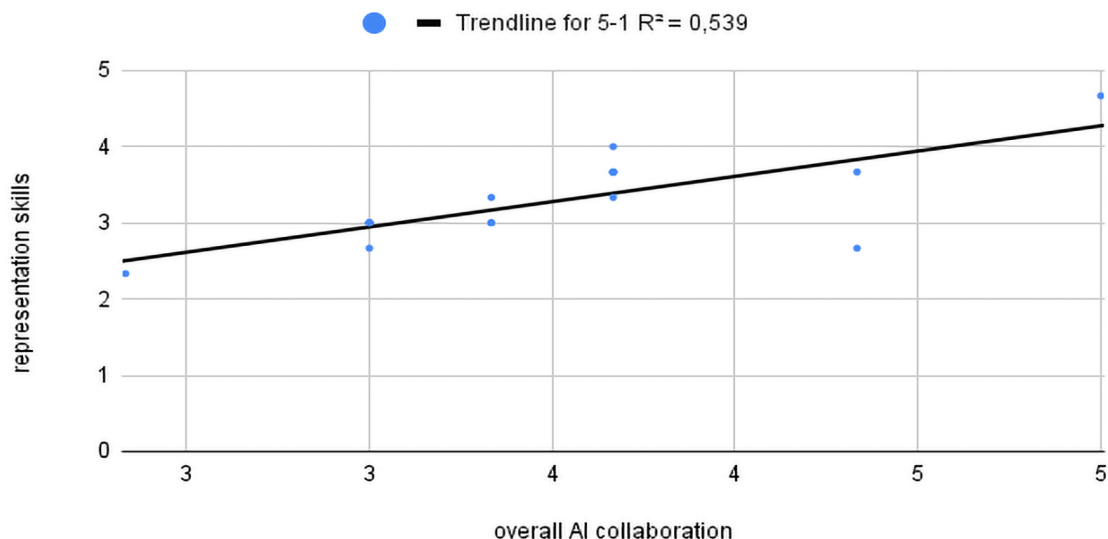


Figure 6. Effect of overall AI collaboration on students’ representation skills, the chart based on relationship of statements 5-1 in the questionnaire.

In terms of “Text-to-text AI Collaboration vs. Conceptual Development” (statements 2-4), As text to text collaboration increases the conceptual development also increases as the value $R^2 = 0,626$ (Figure

7). The relationship between text-to-text collaboration and conceptual development is the strongest one statistically.

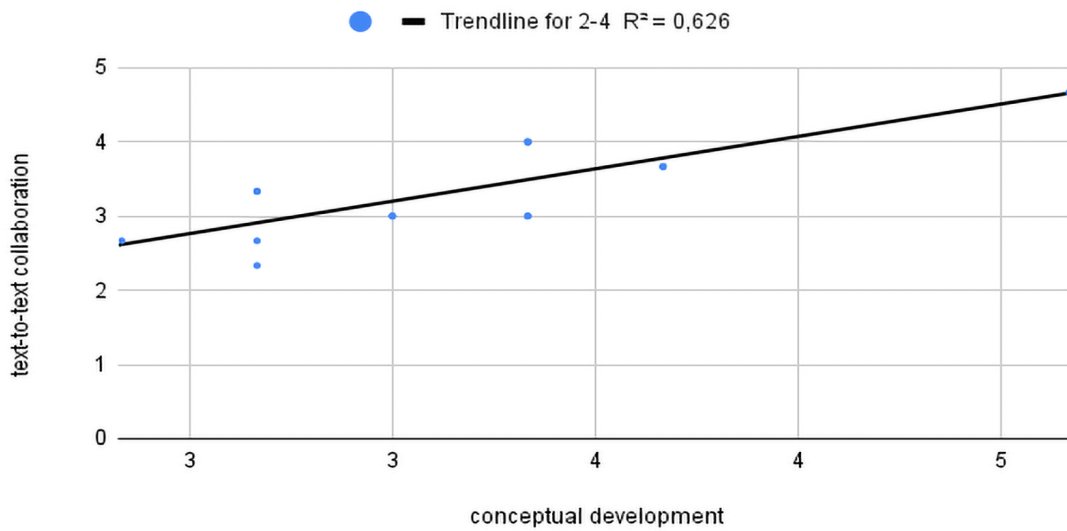


Figure 7. Effect of text-to-text AI collaboration on projects’ conceptual development, the chart based on relationship of jury statements 2 and 4

In terms of “Text-to-image AI Collaboration vs. Conceptual Development” (statements 3-4), as seen in Figure 8, text-to-image collaboration has a potential positive effect on the students’ conceptual development of ($R^2 = 0,532$).

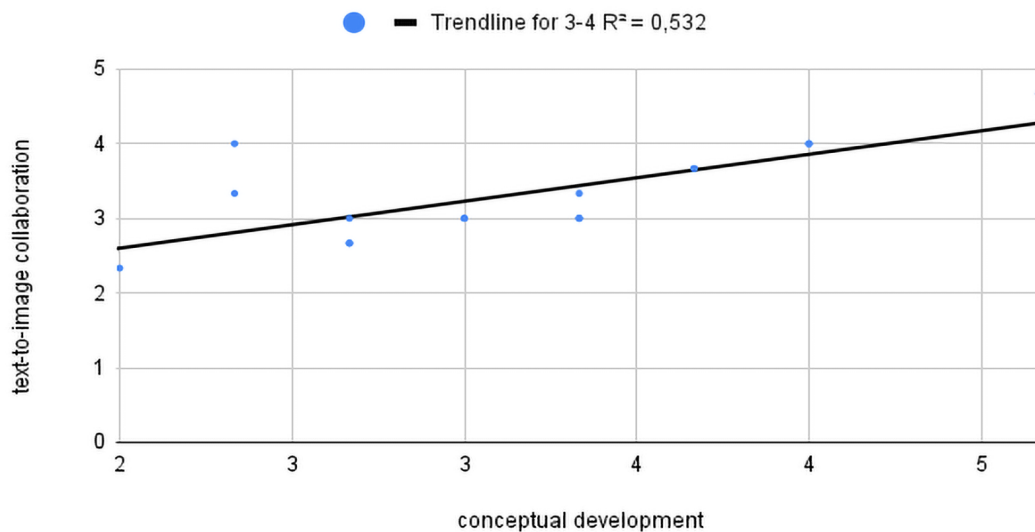


Figure 8. Effect of text-to-image AI collaboration on projects’ conceptual development, the chart based on relationship of jury statements 3 and 4

In terms of “Text-to-image AI Collaboration vs. Representation Skills” (statements 1-3) as seen in Figure 9, the relationship between text-to-image collaboration and representation skills of students is the weakest statistically ($R^2 = 0,44$). However, it can be interpreted that there is a worthwhile effect of text-to-image collaboration on the students’ representation skills. The study aimed to improve conceptual development of the students rather than the representation skills. However the relationship is proven to be weak. There is a potential for adapting other tools like VR and AR to improve these skills. In this manner, the overall AI collaboration effect was stronger on the students’ representation skills. This also points out to the potential for adapting external tools.

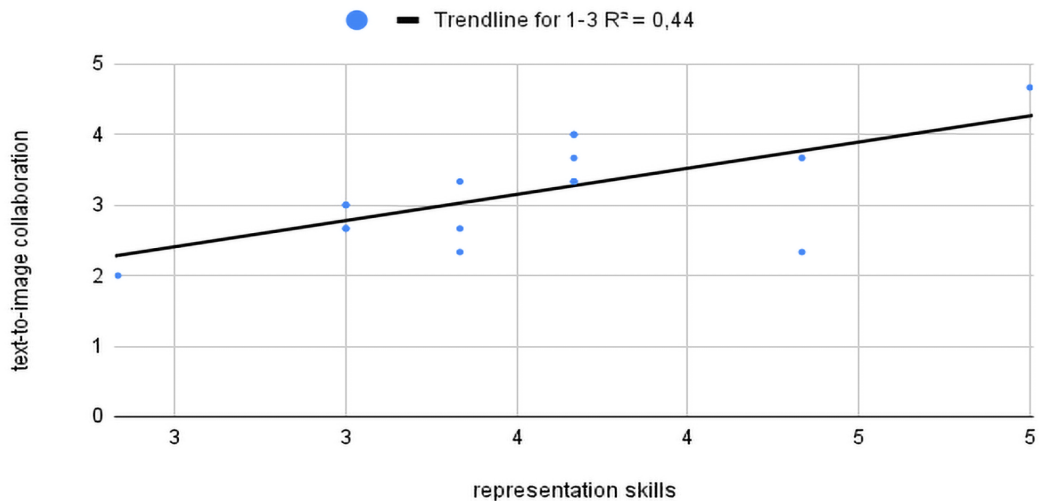


Figure 9. Effect of text-to-image AI collaboration on students’ representation skills, the chart based on relationship of jury statements 1 and 3 (created by authors).

3.2. Discussion

This study proposes and implements a novel GAI collaboration model tailored for the early stages of design studio education specifically ideation and conceptual development within a scenario-based design studio. Conducted with second-year interior design students during the 2023-2024 fall semester and evaluated by design professionals, the model demonstrated positive contributions to early design processes by enhancing the communication of ideas and overall productivity in the studio setting. These findings contribute to a nuanced understanding of the dynamics involved in integrating human-AI collaboration within architectural and interior design education.

The strongest relationship observed was between text-to-text collaboration and conceptual development, highlighting the importance of focusing on students’ conceptual thinking and design literacy during early education stages. ChatGPT, as a conversational text-to-text GAI platform, facilitates scenario development and program articulation through iterative exploration of keywords, narratives, and dialogues. This supports the notion from Gozalo-Brizuela & Garrido-Merchan (2023) that GAI platforms generate novel content that can inspire professional-level work. The process of prompt engineering, which involves carefully structuring input text to guide AI-generated outputs, emerged as a critical skill for students to maximize the benefits of such platforms, aligning with recent pedagogical calls for scaffolded AI literacy (Rafsanjani & Nabizadeh, 2023).

Consistent with the literature emphasizing the conceptual phase as a space for “playing with ideas” rather than finding immediate solutions (Goldschmidt, 2014; Akin, 2008), our model enabled students to externalize and refine design intentions through text-based expressions that analyzed user preferences, functionality, and spatial needs. This reflects Carroll’s (1999) description of scenarios as narrative constructs that help translate abstract user and contextual inputs into coherent spatial strategies, and supports findings by Mazhari et al. (2022) regarding the pedagogical value of scenario-based design studios in fostering situated problem-solving. In this study, the use of GAI helped students avoid generalizations, allowing them to frame specific design problems and propose tailored solutions, thereby reinforcing the critical early-stage skills of problem definition and conceptual clarity noted by Islam (2019).

The text-to-image collaboration similarly demonstrated positive effects on conceptual development by providing visual materials that functioned like collage elements—representations of design intentions that could be iterated rapidly. This accelerated process aligns with He et al.’s (2023) exploration of generative AI’s capacity to enhance essential interior design tasks such as ideation and schematic visualization. The rapid generation of diverse visual iterations supported students’ representation skills, echoing Goldschmidt’s (2004; 2019) emphasis on the central role of visual tools like sketches and diagrams in early design cognition. The improved expressiveness of design intentions

also facilitated communication between students, instructors, and external design experts, showcasing the collaborative potential of AI-supported representations in studio settings (Cheung & Dall'Asta, 2024).

However, some relationships, particularly between text-to-image collaboration and representation skills, were less definitive. This may be explained by the studio's parallel use of non-AI image sources, which raises important questions about how GAI-generated content integrates with traditional expressive media. It suggests that future models should consider hybrid workflows that balance AI-generated and conventional representations, thereby addressing the multidimensional nature of design communication (Somer, 2015; Cubuk, 2023).

Overall, the developed GAI collaboration model offers a novel framework for student-AI interaction within the design studio. By positioning AI as a collaborative partner rather than a replacement, the model aligns with the growing consensus in the field regarding the importance of maintaining human-centered design pedagogy alongside emerging technologies (Markauskaite et al., 2022; Rafsanjani & Nabizadeh, 2023). This study contributes empirical insights into the evolving discourse on AI-enhanced design education and underscores the potential for GAI to foster creativity, enrich user-context engagement, and strengthen foundational skills in architectural and interior design studios.

4. Conclusion and Suggestions

This study has explored the utilization of GAI platforms specifically text-to-text and text-to-image models in the early stages of design studio education. The motivation to integrate GAI arose from the potential to adopt AI as a collaborative partner, providing a reflective environment that supports numerous design iterations. The findings confirmed that GAI platforms are particularly effective in enhancing conceptual development during phases where design problems are complex and open-ended, requiring multiple valid solutions.

Platforms such as ChatGPT and Microsoft Bing Image Creator can complement architectural and interior design processes by offering additional support, inspiration, and assistance throughout various design stages. However, the effective integration of GAI extends beyond mere digital tool usage; it demands collaborative approaches that foster productive human-AI interaction. As AI technologies evolve, future research is expected to yield innovative collaborations between GAI and design disciplines, further enriching educational and professional practices.

Moreover, GAI has the potential to integrate seamlessly with other advanced platforms, such as Building Information Modeling (BIM), Virtual Reality (VR), and Augmented Reality (AR), opening new horizons for immersive design experiences that enhance representation skills and conceptual development. This intersection remains a promising but underexplored area warranting future investigation in both education and professional practice.

This study's scope was limited to evaluating text-to-text and text-to-image models, leaving other generative AI modalities—such as text-to-video and text-to-3D—open for further exploration. Additionally, multiple GAI platforms (e.g., Bard, Midjourney) deserve comparative analysis to better understand their relative strengths and pedagogical impacts.

The evaluation of conceptual development was conducted with expert jurors, yet the small expert panel ($n=3$) constitutes a limitation affecting the robustness and generalizability of the statistical analysis. Thus, the findings regarding GAI's effects in the studio context should be interpreted cautiously as indicative of potential positive contributions rather than definitive conclusions.

By automating and augmenting aspects of the early design process, GAI has the potential to become a catalyst for innovation, enabling architects and designers to rapidly generate, evaluate, and iterate design concepts more effectively. Consequently, the collaborative GAI model presented here offers value not only for design education but also as a promising tool in architectural and interior design practice.

Future research should aim to expand the scope of GAI applications, involve larger expert evaluations, and develop pedagogical frameworks that emphasize balanced human-AI collaboration, preserving the creativity and contextual sensitivity that remain at the heart of design.

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All authors contributed equally to the article. There is no conflict of interest.

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