The Integration of Artificial Intelligence in Furniture Design: A Case Study

Yaren ŞEKERCİ*, Mehmet Uğur KAHRAMAN**, Hakan BAL***

Abstract

The Purpose of the Study: *The importance of artificial intelligence (AI) in design-related education, particularly in interior architecture, has become increasingly significant in today's world. This study aims to explore the integration of AI in furniture design education and its impact on student projects. The primary objective is to evaluate how AI can be incorporated into the design process and how it can enhance students' creative abilities.*

Conceptual/Theoretical Framework: *This research reviews the literature on AI's application in interior architecture and furniture design, highlighting its potential benefits and contributions to current educational methodologies. This study focuses on the "Material and Construction Techniques for Furniture" course, examining how AI-based projects influence students' learning and design outcomes. The study also includes a discussion of the 'text-to-image' literature related to the visual creation technology that the students utilized.*

Method: *The study was conducted with 47 students from the Department of Interior Architecture and Environmental Design at Antalya Bilim University. Students were tasked with redesigning plastic stools into seating elements inspired by selected figures using AI tools. The students were advised to use the artificial intelligence programs MidJourney and DALL-E. In the study, the students' projects were evaluated and graded by a jury. In this context, the projects of students who received 80 points or above were selected. Thus, seven projects were included in the article for detailed analysis. Data were analyzed using qualitative methods to assess students' experiences and learning processes with AI.*

Özgün Araştırma Makalesi (Original Research Article)
Geliş/Received: 10.06.2024 **Kabul/Accepted:** 29.06.2025
* Corresponding Author, Asst. Prof. Dr., Antalya Bilim University, Faculty of Fine Arts and Architecture, Department of Interior Architecture and Environmental Design, Antalya, Türkiye.
E-mail: yaren.sekerci@antalya.edu.tr ORCID https://orcid.org/0000-0003-4509-6299
** Asst. Prof. Dr., Antalya Bilim University, Faculty of Fine Arts and Architecture, Department of Interior Architecture and Environmental Design, Antalya, Türkiye. E-mail: ugur.kahraman@antalya.edu.tr
ORCID https://orcid.org/0000-0003-1237-1792
*** Res. Asst., Antalya Bilim University, Faculty of Fine Arts and Architecture, Department of Interior Architecture and Environmental Design, Antalya, Türkiye. E-mail: hakan.bal@antalya.edu.tr
ORCID https://orcid.org/0000-0003-1816-265X

Findings: *The findings indicate that effective use of AI design tools requires a strong foundation in existing design principles; otherwise, the results can be arbitrary. AI tools were most beneficial during the ideation and creative stages. The analysis underscores the transformative potential of AI in traditional design education through innovative methodologies and the promotion of interdisciplinary skills. Clear and guided instruction is crucial for maximizing AI's effectiveness in an educational setting.*

Conclusion: *This study provides valuable insights into the application of AI in design education and suggests that AI-generated imagery can add practical value to the ideation process. The findings highlight key considerations for educators and researchers when integrating AI into design education.*

Keywords: *Artificial Intelligence, Design Tool, Furniture Design, Interior Design, Interior Design Education*

Mobilya Tasarımına Yapay Zekanın Entegrasyonu: Bir Vaka Çalışması

Öz

Giriş ve Çalışmanın Amacı: *Yapay zekanın tasarım eğitimi, özellikle iç mimarlık alanında, giderek daha önemli hale gelmiştir. Bu çalışma, yapay zekanın mobilya tasarımı eğitimine entegrasyonunu ve bu entegrasyonun öğrenci projeleri üzerindeki etkilerini araştırmayı amaçlamaktadır. Çalışmanın amacı, yapay zekanın tasarım sürecine nasıl dahil edilebileceğini ve öğrencilerin yaratıcı yeteneklerini nasıl geliştirebileceğini değerlendirmektir.*

Kavramsal/Kuramsal Çerçeve: *Bu çalışma, iç mimarlık ve mobilya tasarımı alanındaki literatürü gözden geçirerek, yapay zekanın bu alanlarda nasıl kullanılabileceğini ve mevcut eğitim yöntemlerine nasıl katkı sağlayabileceğini ortaya koymaktadır. Bu araştırma, özellikle "Mobilya Malzemeleri ve Yapım Teknikleri" dersi bağlamında, yapay zeka tabanlı projelerin öğrenciler üzerindeki etkisini incelemektedir. Öğrencilerin kullanmış oldukları yapay zeka ile görsel oluşturma teknoloji olan "text-to-image" literatürüne de araştırmada yer verilmektedir.*

Yöntem: *Araştırma, Antalya Bilim Üniversitesi İç Mimarlık ve Çevre Tasarımı Bölümü'nde öğrenim gören 47 öğrencinin katılımıyla gerçekleştirilmiştir. Öğrenciler, yapay zeka araçlarını kullanarak plastik tabureleri seçtikleri figürlere göre yeniden tasarlamışlardır. Öğrencilere kullanmaları için MidJourney ve DALL-e yapay zeka programları tavsiye edilmiştir. Çalışmada, öğrencilerin projeleri bir jüri tarafınadn değerlendirilerek notlandırılmıştır. Bu bağlamda 80 puan ve üzeri alan öğrencilerin projeleri seçilmiştir. Böylece yedi proje detaylı analiz için makalede yer almıştır. Veriler, nitel analiz yöntemleri kullanılarak incelenmiş ve öğrencilerin yapay zeka kullanımındaki deneyimleri ve öğrenme süreçleri değerlendirilmiştir.*

Bulgular: *Araştırma bulguları, yapay zeka tasarım araçlarının etkili bir şekilde kullanılabilmesi için mevcut tasarım ilkelerine dair güçlü bir bilgi birikimine ihtiyaç olduğunu göstermektedir. Yapay zeka araçları, özellikle fikir üretme ve yaratıcılık aşamalarında öğrencilerin performansını artırmıştır. Ancak, net ve yönlendirici talimatlar olmadan, sonuçlar rastgele olabilmektedir. Analizler, yapay zekanın yenilikçi metodolojiler ve disiplinler arası becerilerin teşviki sayesinde geleneksel tasarım eğitiminde büyük bir dönüşüm potansiyeline sahip olduğunu ortaya koymaktadır.*

Sonuç*: Bu çalışma, yapay zekanın tasarım eğitiminde nasıl uygulanabileceğine dair önemli içgörüler sunmakta ve yapay zeka ile görüntü oluşturmanın fikir üretimine pratik bir değer katabileceğini*

önermektedir. Çalışmanın sonuçları, eğitimciler ve araştırmacılar için rehberlik sağlayarak, yapay zekanın tasarım eğitimine entegrasyonunda dikkat edilmesi gereken noktaları vurgulamaktadır.

Anahtar Kelimeler: *Yapay Zeka, Tasarım Aracı, Mobilya Tasarımı, İç Mimarlık, İç Mimarlık Eğitimi*

1. Introduction

Interior architecture encompasses various facets of interior design, including fundamental design principles, communication, color palettes, texture utilization, material combination, interior construction techniques, lighting, environmental control, and furniture design. As outlined by international standards (European Council of Interior Architects, n.d.; International Federation of Interior Architects/Designers, n.d.; Council for Interior Design Accreditation, n.d.), the subject of furniture design holds a significant position within interior architecture curricula. These could be complete courses, pretty extensive, concerning expectations with contemporary trends and leading technology, and involving critical aspects to deal with design methodologies, technical solutions, material selections, ergonomic considerations, and human-centered design. Ultimately, they ready the students with the knowledge and skills involved in covering a dynamic field.

The integration of Artificial Intelligence (AI) as a design tool stands out as a prominent technological advancement in recent times. While incorporating AI into design curricula is now a widespread trend, it is not an entirely novel concept within higher education. The origins of this topic can be traced back to the 1970s, exemplified by David Rosenboom's pioneering "Artificial Intelligence in the Arts" course, held between 1970 and 1981–84 (Rosenboom, 1983). Today, the conversation around AI's role in design education has gained momentum. Hedges (2023) suggests that departments establish clear guidelines, necessitating students to properly reference AI tools and specify the prompt language employed (Hedges, 2023). Başarır (2022) has already spearheaded the creation of an elective AI course within an architecture department, advocating for similar additions across various design disciplines (Başarır, 2022). On the other hand, there is no course model for integrating AI into furniture design courses.

In light of these facts, this study aims to introduce AI into the furniture design curriculum and execute a pilot study on its potential implications. The study's focal point involves students selecting a character or persona and subsequently crafting an extensive end-user profile. Moreover, participants will be tasked with formulating a prompt for an AI-powered conceptual furniture design using the end-user profiles. The assessment process will include the evaluation of the students' chosen personas, prompts, and conceptual furniture designs generated through AI, thereby fostering a comprehensive understanding of this interaction. The use of AI tools to enhance students' creative abilities has the potential to transform design processes.

This study examines the process of 47 students at Antalya Bilim University redesigning plastic stools using artificial intelligence tools. The students developed their projects with AI programs such as MidJourney and DALL-E, and these projects were evaluated by a jury. Furthermore, the findings highlight essential factors to consider in the integration of AI into design education, providing significant guidance for educators. Ultimately, artificial intelligence offers innovative contributions to traditional educational methods.

2. Literature Review

2.1. Furniture's Interrelation with Spatial Design Disciplines

Within the realm of design, numerous specialized subfields exist, each with its own unique focus. Architecture, city planning, urban design, interior design, and product/industrial design all focus on the concept of scale (Elshater, 2017; Koçer, 2019; Kaya et al., 2022). The emergence of this specialization can be attributed to the increasing complexity of design processes, resulting in diverse work scales, materials, technological advancements, and requirements (March & León, 2015). In terms of product design that emerges from this complexity, furniture design is at the forefront in interior design.

Furniture is a concept that holds a pervasive presence in everyday life as a core design item. This concept resides at the convergence of seemingly unrelated fields of study—engineering, natural sciences, and artistic practices—each contributing to its historical evolution (Erdem, 2019). Urban furniture, beyond serving practical needs, harmonizes with both the local environment and cultural norms. Given its general use by the entire local population, it must embody inclusivity and human compatibility as much as possible (Çatalyürekoğlu & Altıparmakoğulları, 2023). The creation of urban furniture should be the result of a collaborative effort among diverse professionals, including industrial product designers, architects, urban planners, and landscape architects based on the primary characteristics of urban space and urban furniture. Urban furniture serves as a cohesive link between public spaces, connecting functionality, architectural aesthetics, and the natural environment (Madanipour, 1997). Furniture design courses are taught across various departments, including arts, industrial (product) design, interior architecture, and landscape architecture (Alpak et al., 2020).

In the context of spatial design disciplines, "furniture" is embedded in all domains. Although furniture design is expressed through drawings ranging from 1/20 to 1/1 scale, disciplines focused on smaller scales have surged in popularity, as large-scale detailing surpasses their competence. If a spatial design discipline were capable of detailing from 1/100,000 to 1/1 scale, other disciplines would be redundant. Thus, furniture design aligns more with product design and interior architecture due to shared scale affinities. Product designers handle not only spatial design but also electronic appliances, machinery, and automobiles.

This extends to workspaces through its products. In the field of furniture, it possesses the capability to craft personalized items while maintaining a primary focus on the mass production of furniture, a domain usually curated by product designers. Interior architecture as a discipline, on the other hand, tailors specific furniture designs to individual users. It is in this context that understanding the interior architect's end-user needs and custom furniture design takes on an important role. About this, the need to include furniture design courses exclusively detailing the making of comprehensive end-user profiles may ultimately find a place in the curriculum of course offerings of the interior architecture department.

2.2. Furniture and Intelligent Technologies

The widespread use of intelligent technologies within furniture design has been propelled by the rapid advancement in science and technology. These technologies can be embedded directly into the furniture itself, such as through the Internet of Things (IoT) (Xiong et al., 2023), or they can serve as tools during the furniture design process (Kim, 2011). In both scenarios, furniture designers need to remain vigilant about emerging technological trends. When focusing on the latter scenario, the prevalent intelligent technologies encompass Virtual Reality (VR) (Xin, 2022; Zou et al., 2023), Augmented Reality (AR) (Phan & Choo, 2010; Tang et al., 2014; Viyanon et al., 2017; Chang et al., 2019; Verawardina, 2023), and Artificial Intelligence (AI) (Jordahn, 2019; Trivellin et al., 2020; Barker, 2023; Bickersteth, 2023).

When we look at AI, which is the main subject of the research, AI technologies necessitate the joint efforts of designers and computer/electronic engineers. The creation of applications stands out as one of the most popular ways of use. On the other hand, VR technologies require the use of virtual reality headsets. While some of these headsets are quite affordable, others come with a significant cost, limiting their widespread use among the general public. In contrast, AI technology offers a much more cost-effective approach, bordering on being almost free. Besides, AI technologies do not necessitate additional technological tools beyond personal computers. Furthermore, these technologies serve as invaluable tools during the conceptualization phase of design. Whether applied to spatial or furniture design, AI technologies enable the creation of unique designs with minimal effort.

The design landscape has shown substantial interest in AI technologies after 2023. This is exemplified by Dezeen's introduction of the "AItopia" series in June 2023, dedicated to exploring how AI will impact architecture and design (Barker, 2023). Within this series, an article poses the question of whether AI will actually replace designers' roles (Bickersteth, 2023). According to the article, AI represents a new era in design akin to CAD (Computer-Aided Design) and BIM (Building Information Modelling) tools. AI technologies are not poised to replace designers' roles imminently; rather, they will serve to liberate time for the more creatively rewarding aspects of

design. Designers primarily utilize AI in sketching (Yan et al., 2022; Zhang et al., 2023), rendering (Yan et al., 2022), and conceptualization (Mikalonytė & Kneer, 2022; Dai et al., 2023; Ratican et al., 2023).

Instances of designers adopting AI technologies in their creative processes are becoming more evident. Notably, Philippe Starck conceptualized an "AI Chair" entirely designed by AI (Jordahn, 2019) (Table 1). Today, this chair is still available for purchase and integration into our living spaces. In a study from 2016, Arthur Harsuvanakit and Brittany Presten employed the Autodesk Dreamcatcher project to design a medieval Danish-style seating element known as the Elbo Chair, with a seat size of 18 inches (roughly 46 cm) off the ground and a load capacity of 300 lbs (roughly 136 kg) (Rhodes, 2016). The AI involvement significantly facilitated designers in ensuring essential ergonomic conditions while simultaneously emphasizing aesthetic aspects (Wong, 2016). Additionally, a design created in 2020 through the utilization of a three-dimensional printer, another product of AI and evolving technology, showcases AI's capabilities. In this study, AI-generated chair models were 3D printed at a 1/10 scale. The use of innovative wood-based filaments in the printer's construction led to designs that boasted the look, feel, and scent of authentic wood (Bongiovanni, 2020).

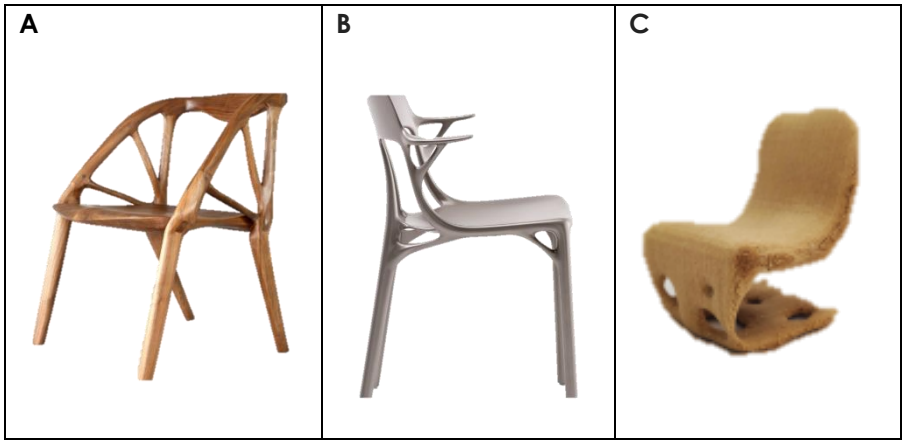


Table 1. (A) Elbo Chair (Harsuvanakit, n.d.); (B) AI Chair Created by Phillippe Stack by Using AI Technologies (Jordahn, 2019); (C) Wooden 3D-printed furniture in 1:10 scale (Bongiovanni, 2020)

AI, initially introduced in the mid-20th century, has now emerged as a prominent player in the field of education. Its foray into education commenced soon after its inception. By the 1980s, AI evolved into an industry, subsequently attaining scientific status in 1987. Its extensive proliferation began in the early 21st century, reaching diverse masses (Pirim, 2006). Chatterjee (2018) delineates two pivotal advantages of incorporating AI into higher education: a micro-

level impact that enhances business efficiency and effectiveness while curbing costs, and a macro-level influence that fosters global dominance, facilitating multifaceted applications such as distance learning (Chatterjee, 2018).

In the age of new technologies, advancements in AI algorithms have made it possible to generate visuals from text. This process is referred to as text-to-image generation. Since the images produced are often highly realistic, this technique can be utilized to create a diverse range of visual content. As AI technology continues to evolve, text-to-image generation is expected to become an increasingly important tool in the field of design. The term 'Text-to-Image Generation' refers to computer techniques that can convert human-written textual descriptions, like keywords or phrases, into visual representations that convey the same meaning as the text (Hanafy, 2023).

The concept of generative art using artificial intelligence has recently gained a new dimension. AI programs, especially those used to create images from text — such as Midjourney and DALL-E — are competing in the fields of image quality, productivity and skill. In Hakimshafaei's (2023) doctoral dissertation comparing Midjourney, DALL-E 2 and Stable Diffusion programs, Hakimshafaei notes that Midjourney interprets a broader range of words than other AI programs. Additionally, Midjourney generates original designs by closely adhering to the provided prompts.

Figure 1. Four results for the prompt "chair, white and black, futuristic design and elliptic form" using Midjourney bot

In furniture production, AI effectively utilizes colors, textures, and realism in its designs. Alawadhi and Yousef (2023) found that the designs were particularly effective when specifications such as material, color, style, texture, and form were clearly defined in the chair samples created using Midjourney (Fig. 2).

Figure 2. Midjourney's designs according to factors (Alawadhi & Yousef, 2023)

Midjourney and DALL-E are currently popular tools due to their ease of use in generating visuals through the 'text-to-image' (txt2img) method. In his research, Hanafy (2023) compared these artificial intelligence programs and identified differences in their workflows beyond the core components of the underlying technologies. This is often the result of various interface strategies. Midjourney focuses on developing and evaluating image variants from several txt2img models and then sampling the best ones. In contrast, DALL-E allows for direct editing of uploaded images or txt2img outputs (Hanafy, 2023).

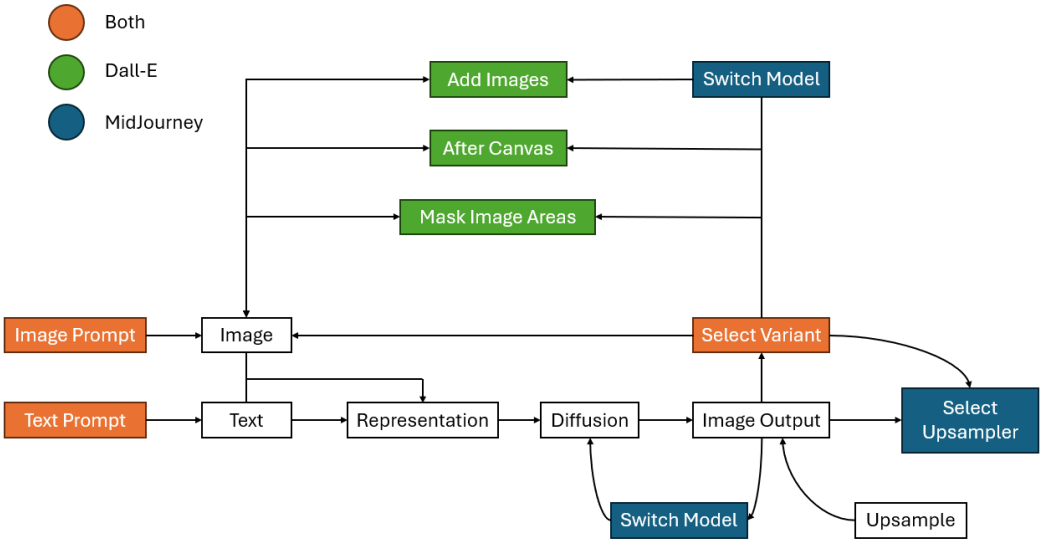


Figure 3. Image production techniques of Midjourney and DALL-E (Hanafy, 2023)

Especially in furniture design, AI programs that accelerate the design process not only have the potential to support designers but also enable the creation of more visuals in a shorter time period (Caires et al., 2024).

3. Material & Method

3.1. Design Project

This project was developed as a preliminary assignment, completed over a span of 6 weeks within a 15-week semester. Students were tasked with crafting a chair utilizing a white plastic stool. At the end of this 6-week period, the students produced a seating element of a figure they chose (artist, actor, singer, cartoon character, designer etc.) using artificial intelligence. Given that AI would also be used in the practical tasks students undertake during the course, this initial project offered them their first exposure to its implementation. Within the course framework, students were introduced to various forms of AI, particularly within the Midjourney and DALL-E platforms. At the same time, there were no restrictions on students in terms of artificial intelligence. Apart from these two artificial intelligence platforms, the students were also free to make their designs with the programs they found themselves. Through these presentations, students were educated on constructing effective prompts and using them to generate images. Furthermore, students were instructed on the utilization of additional AI tools,

such as blending multiple photos or images and employing a combination of prompt and blending tools. In this context, the source material of the current study was formed by a collection of 1/1 scale models of seating furniture. These models had been crafted by junior class students from the Interior Architecture and Environmental Design Department at Antalya Bilim University (Turkey) as part of the "Material and Construction Techniques for Furniture Design" course.

3.2. Participants

A total of 47 students were enrolled in the course. Each student evaluated this assignment independently. 47 chair designs were evaluated by the department instructors at the end of the project based on the figure choice, understanding the figure and defining it, AI usage, understanding the image created via AI and creating a design accordingly, using the appropriate material, creating the technical solutions and details if it is necessary and drawing it, and making an actual product. Since it was not possible to include all design products in present study, only the projects of students who received 80 points or above were included. Therefore, the study includes seven students' projects.

3.3. Methodology

In the first step, students chose a figure (Singer, artist, actor, designer, cartoon character etc.). Students then found the best words to describe the figure they chose. They entered the words as prompts through the artificial intelligence programs (MidJourney and DALL-E) taught in the course and tried to find the best seating element that describes the figure they chose. Using artificial intelligence, students researched the suitable materials for the seating element they designed and made the necessary 3D digital modeling and technical drawings. At the end of this study, students produced their designs using white plastic stool. The sequence of steps undertaken by students during this process is depicted in Figure 4.

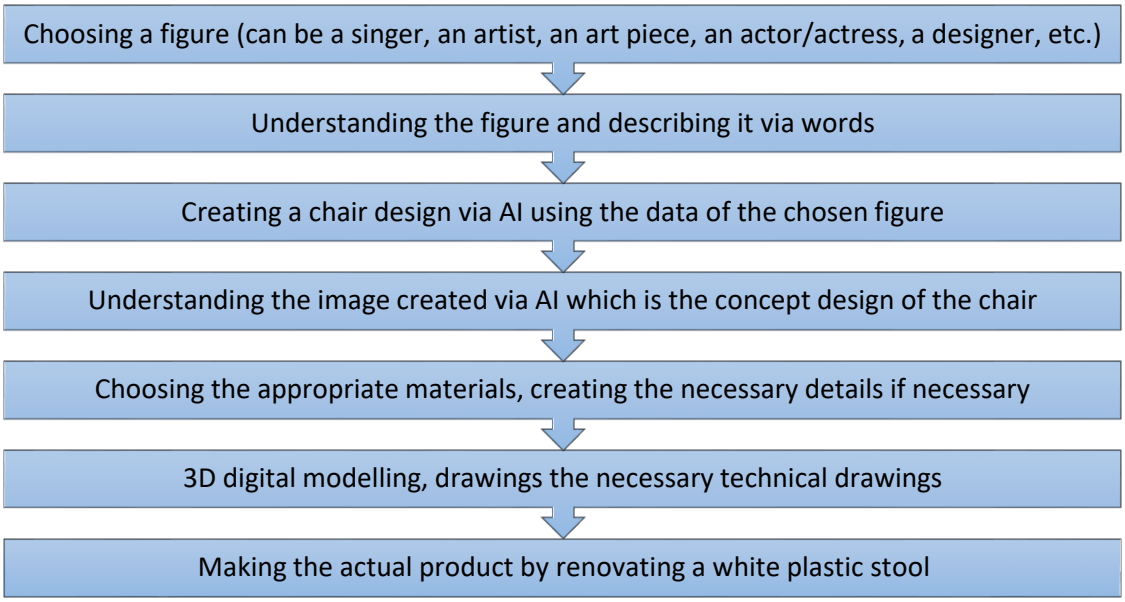


Figure 4. The sequence of steps by students

3.4. Evaluation Process

For the evaluation process, a systematic framework consisting of five criteria was established to ensure an objective assessment of each student project. These criteria, which aim to standardize the evaluation and reduce subjectivity, include the following:

Character and Style Consistency: The alignment of the design with the selected character's attributes and stylistic elements.

Material and Form Compatibility: The appropriateness of materials and form, ensuring that choices reflect the intended aesthetic and functional aspects.

Technical Solutions and Details: The incorporation of technical details and solutions, such as structural stability and practical design elements.

AI Utilization Skills: The effectiveness and creativity in utilizing AI tools, particularly in generating visuals that accurately reflect the student's vision.

Consistency with the Physical Product: The degree of alignment between the AI-generated conceptual image and the actual manufactured product.

The evaluation process was conducted by three faculty members (authors) from the Department of Interior Architecture and Environmental Design at Antalya Bilim University, all of whom have expertise in interior architecture and furniture design Each evaluator independently scored the projects on a scale of 1 to 5 for each criterion. After the individual evaluations were completed, the scores from all three evaluators were averaged to ensure a balanced and objective assessment. This averaging method provided a standardized evaluation framework, minimizing individual biases and enhancing the reliability of the results.

4. Results and Discussion

This section presents information on seven student projects selected from the works completed during the course. In the class, which did not impose limitations on the AI programs used, students predominantly utilized Midjourney and DALL-E tools (Fig. 5). The visuals generated based on the prompts were revised multiple times until the most effective representation of the chosen character was achieved. In this context, students continuously sought to improve themselves in order to find more precise prompts for their selected characters. The final prompts entered were those presented during the jury evaluation.

Students	Figure	Used AI	Prompt
1	Vikings – Ragnar	Dall-E	Plastic Stool Design, Viking Ragnar, Barbarian Plastic Stool Design, Barrel-Like Body, Horn, Black And Brown Leather, Use of Fur And Leather, Volknut Alphabet, 8k
2	Bumblebee	Midjourney	Stool Design Inspired by the Bumblebee Robot From the Transformers Movie
3	Genghis Khan	Dall-E	Stool design for Genghis Khan, Middle Asian, nomad people, mongolian hat, horse foot
4	Jeff Koons	Dall-E	Ultra Blue And Gold Shiny Fabric, Balloon Stool Legs And Ellipse Backrest, Ultra Detailed, Bubble Stool With Backrest
5	Michelangelo - Ninja Turtles	Midjourney	A stool shape just like ninja turtles, stool belongs to Michelangelo from ninja turtles, HD stool, four legs, turtle shape
6	Wonder Woman	Midjourney	Burgundy navy blue and golden yellow, Wonder Woman's golden yellow belt, stars, shield, stool design for Wonder Woman, 8k, rendering, real appearance, stool
7	Pablo Picasso	Midjourney	A Stool Inspired by Picasso's Cubism Movement Should be Created by Separating the Object into Geometric Shapes and Bringing together Images from Different Angles.

Figure 5. AI programs used by students and the entered prompts

Upon analyzing the prompt used for the "Ragnar" seating element (Table 2), it becomes evident that entries such as "Plastic Stool Design" and "8k" were incorporated to encapsulate the overall form and achieve a high-resolution render quality. In fact, the entries "Viking Ragnar, Barbarian Plastic Stool Design" were cleverly introduced into the prompt to align the stool with the robust warrior and invader concepts exemplified by the "Ragnar" image. Additionally, the student sought to reinforce the Viking essence in the stool by drawing inspiration from the globally renowned 1974 cartoon "Vicky the Viking" or "Wickie und die starken Männer", which

charmingly portrays Viking lifestyle, costumes, and belongings. Accordingly, the prompt was enriched with "Barrel-Like Body" and "Horn" entries, symbolizing essential Viking elements. These entries were intended to evoke the Viking era and its distinctive attributes. However, it was noted that the AI did not account for the "Barrel-Like Body" entry and the inclusion of the "Valknut Alphabet" entry in the prompt. Consequently, the absence of these entries, along with the exclusion of mythological triads and symbols like the "Valknut rune" and "triquetra," potentially linked to Viking culture, contributed to the suggestion of a conventional 4-legged design for the seating element. This design lacked the reflection of Viking mythology, lifestyle, and belongings, despite the description of various characters' outfits within the prompt. As a result, a curious transformation of the character into a stool emerged rather than the intended creation of a stool embodying the character. Despite encountering challenges in actualizing the AI-generated stool image, the student's modeling skills, efforts in aligning materials, and addressing disparities in proportions and posture with the physical stool in the processes of perceiving, remodeling, technical expressing, and producing, a remarkably parallel student project was presented.

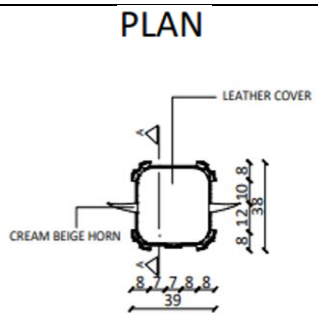
FIGURE	**PROMPT**	**AI CONCEPTUAL IMAGE**
Vikings – Ragnar 	Plastic Stool Design, Viking Ragnar, Barbarian Plastic Stool Design, Barrel-Like Body, Horn, Black and Brown Leather, Use of Fur and Leather, Volknut Alphabet, 8k	 Created by DALL-E
RENDER	**MANUFACTURED FURNITURE PHOTO**	**SOME OF THE TECHNICAL DRAWINGS**
		

Table 2. 1st student's project (Jeanne, n.d.)

When analyzing the prompt used for the stool inspired by the "Bumblebee" character (Table 3), it became apparent that the input sentence was fairly superficial, lacking emphasis on specific details and essentially entrusting all creative aspects to artificial intelligence. In this context, the student's input or guidance was notably absent. It is worth noting that the "Bumblebee" character belongs to a movie called Transformers, which is capable of transforming into various machines, including vehicles, upon seeing them. While such information is available within the AI database, the absence of a specific direction led to the AI generating a design where Bumblebee was transformed into a stool. The resulting design closely resembled the "Volkswagen Beetle Mk1" version of the character. It is also known that the character transforms into different models of "Chevrolet Camaro" in different movies. However, the stool design was likely influenced by the more contemporary "Beetle" version from the character's latest movie.

In the context of this student project, where AI was not guided, artificial intelligence was employed not as a design tool but as a determinant factor in decision-making. Consequently, this could be considered a reverse process—AI-influenced but human-executed. However, it was observed that during the phases of perception and realization of AI design, decision-making responsibility shifted to the student, ultimately affecting the outcome of the study in line with the student's acquired knowledge and proficiency in rendering, modeling, and technical expression. As a result, the student covered the plastic stool with colored MDF pieces, achieving the intended design.

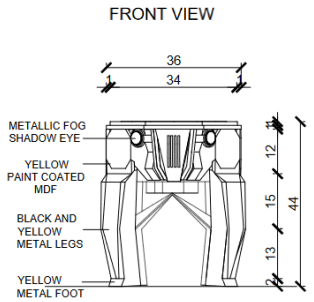
FIGURE	**PROMPT**	**AI CONCEPTUAL IMAGE**
Bumblebee 	Stool Design Inspired by the Bumblebee Robot from the Transformers Movie	 Created by Midjourney
RENDER	**MANUFACTURED FURNITURE PHOTO**	**SOME OF THE TECHNICAL DRAWINGS**
		

Table 3. 2nd student's project (Failes, 2019)

When examining the prompt crafted for the Genghis Khan stool (Table 4), it is evident that the initial input was "stool design for Genghis Khan." To enhance the ethnic influence on the stool's design, the traditional Mongolian helmet, known for its fur lining, was incorporated into the prompt using the entry "Mongolian hat." This addition led to the integration of a furry seating surface concept into the stool design. Furthermore, the inputs "nomad people" and

"Horse foot" contributed to the interpretation of the seating surface as a horse saddle adorned with tassels, reinforcing the ethnic aspect. Additionally, implementing the "Horse foot" entry for hooves on the stool's feet amplified the ethnic expression. Meanwhile, the use of the term "middle Asian" in the prompt aimed to highlight "Central Asian." Strikingly, despite the absence of a specific prompt request, an eclectic decorative front section with a pointed arch, primarily reminiscent of the "Seljuk" architectural style from the region, was introduced. This design choice, influenced by the term "hat" in the prompt, closely resembles the traditional Seljuk helmet's form.

In this student project, the prompt content is relatively directive, yielding a design that aligns well with the intended concept. By delving into Genghis Khan's lifestyle and pertinent details rather than focusing solely on his attire in the prompt's image, the result was a seating element in harmony with his concept, rather than a transformation of Genghis Khan himself into a stool. Throughout the remainder of the student project, the AI-generated design was actualized with remarkable similarity, characterized by minor variations in details. For this purpose, the student shaped the plastic stool by covering it with cardboard. She then obtained the colorful and soft textures of the final design by using textile products such as waste clothes and fur.

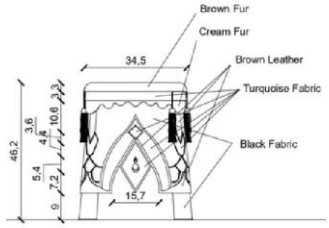
FIGURE	**PROMPT**	**AI CONCEPTUAL IMAGE**
Genghis Khan 	Stool design for Genghis Khan, Middle Asian, nomad people, mongolian hat, horse foot	 Created by DALL-E
RENDER	**MANUFACTURED FURNITURE PHOTO**	**SOME OF THE TECHNICAL DRAWINGS**
		

Table 4. 3rd student's project (Mestyle Studio3, n.d.)

In this student project drawing inspiration from the iconic inflated sculptures of world-renowned artist Jeff Koons (Table 5), the appearance, color, and material for the desired stool were meticulously outlined to guide artificial intelligence while formulating the prompt. The stool's hues and material composition were specified using the "Ultra Blue and Gold Shiny Fabric" entry, yet the decision on which parts should be rendered in ultra-blue or gold was delegated to the AI. Consequently, the backrest and feet of the stool exhibited a golden sheen, while the legs and seat boasted an ultra-blue hue. Utilizing the input "Balloon Stool Legs and Ellipse Backrest," the inflatable legs of the stool were formed, alongside a loosely outlined shape for the backrest. Notably, the AI also endeavored to apply the "Ellipse" interpretation to the stool's feet. With the request for a detailed render image via the "Ultra Detailed, Bubble Stool with Backrest" entry, the intention was to engage with images of inflatable stools or seating elements stored in the AI database.

In this student project, on the other hand, AI operated as a design tool, successfully achieving the intended objective of the study. However, disparities arose in the leg positioning

between the AI-generated stool and the existing plastic stool. Furthermore, the student's endeavor to replicate the "mirror-polished stainless steel with transparent color coating" effect of the original "Balloon Dog" sculpture using different foil material resulted in minor divergences in the produced stool.

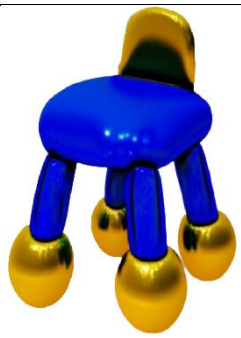
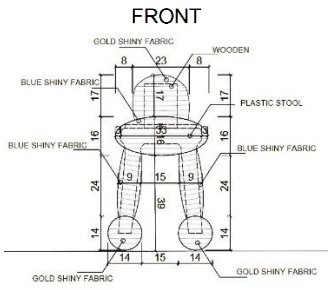
FIGURE	**PROMPT**	**AI CONCEPTUAL IMAGE**
Jeff Koons 	Ultra Blue and Gold Shiny Fabric, Balloon Stool Legs and Ellipse Backrest, Ultra Detailed, Bubble Stool with Backrest	 Created by DALL-E
RENDER	**MANUFACTURED FURNITURE PHOTO**	**SOME OF THE TECHNICAL DRAWINGS**
		

Table 5. 4th student's project (Martet, 2023)

This student project revolved around the portrayal of "Michelangelo" (Table 6), one of the distinct turtle characters from the renowned Ninja Turtles cartoon. Each turtle character in the series boasts a unique eye patch color, martial arts weapon, and individual spirit, contributing to diverse personalities. Thus, the process of devising a design prompt offers a plethora of describable elements. For this specific study, "Michelangelo" was chosen. He embodies a lively demeanor, relishing parties, and pizza. His character's eye patch is orange and his weapon is a nunchaku. However, it is apparent that the initial prompt, while relatively superficial, posed

challenges in effective AI utilization. Thus, the entry "A stool shape just like ninja turtles" was employed, vesting artificial intelligence with the decision-making authority for the design. Inevitably, the typical AI response of "transforming the character himself into a stool" was triggered. Similarly, the second prompt input, "stool belongs to Michelangelo from ninja turtles," surrendered design choices to AI, anticipating a stool that resonates with the character. Regrettably, the AI struggled to grasp this specification, leading to the incorporation of abstracted turtle legs and an ambiguous Ninja Turtle head—a consequence of the input "four legs, turtle shape." Once again, the "turtle shape" entry within the prompt led to the creation of a seating surface mirroring a turtle's shell, juxtaposed with its head. In fact, this design presents evident limitations in terms of student control. The AI's accurate analysis of the Michelangelo character proved challenging, thereby constraining effective direction. During the actualization of the AI-generated design, a similar outcome emerged, barring minor variations in the posture of the real stool and the leg formation. The student used polyurethane foam to produce this design. However, the study also exhibited shortcomings in technical expression, rendering it relatively weak.

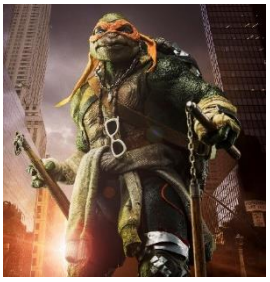
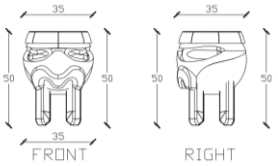
FIGURE	**PROMPT**	**AI CONCEPTUAL IMAGE**
Michelangelo - Ninja Turtles 	A stool shape just like ninja turtles, stool belongs to Michelangelo from ninja turtles, HD stool, four legs, turtle shape	 Created by Midjourney
RENDER	**MANUFACTURED FURNITURE PHOTO**	**SOME OF THE TECHNICAL DRAWINGS**
		

Table 6. 5th student's project (URL-1)

Upon analyzing the prompt tailored for the Wonder Woman stool (Table 7), the inputs "Burgundy navy blue and golden yellow, Wonder Woman's golden yellow belt, stars, shield, stool design for Wonder Woman" distinctly outline the colors and design elements intended for the AI-crafted stool. The remaining part of the prompt requests a high-resolution and realistic stool rendering through the entries "8k, rendering, real appearance, stool." However, these inputs fail to provide specific guidance on how and where these elements should be incorporated into the design. Consequently, the creation of the design was entrusted solely to artificial intelligence without any directed instructions. The prompt's mention of burgundy, navy blue, and golden yellow colors aligns with the character's current costume hues. Furthermore,

the request for the stool design encompassed the inclusion of Wonder Woman's belt, characterized by an abstracted "W," as well as her iconic shield, contributing to the design as an object belonging to Wonder Woman. Additionally, the "stars" entry in the prompt was added by the student as a frequently used detail in vintage comics and visual representations of the character.

It is evident that AI successfully processed all these elements to generate the stool design. The AI-designed stool features a burgundy seat placed atop a navy-blue conical body. The body was encompassed by a shield adorned with gold and burgundy details, prominently displayed on the front side. Beneath the seat, the golden Wonder Woman belt found its place. Positioned on the lower part of the body is a substantial star flanked by symmetrically arranged decorative small stars. Remarkably, all these design components were determined by AI, rendering the student's involvement relatively arbitrary. During the realization of the AI-generated design, a largely successful process of perception and modeling was observed, barring the issue arising from the narrowing section of the conical body in the AI-designed stool, which coincides with the point where the legs in the current plastic stool design expand outward. Despite this, the technical expression of the design remained somewhat underdeveloped.

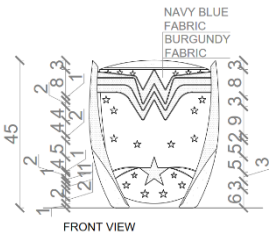
FIGURE	PROMPT	AI CONCEPTUAL IMAGE
Wonder Woman 	Burgundy navy blue and golden yellow, Wonder Woman's golden yellow belt, stars, shield, stool design for Wonder Woman, 8k, rendering, real appearance, stool	 Created by Midjourney
RENDER	**MANUFACTURED FURNITURE PHOTO**	**SOME OF THE TECHNICAL DRAWINGS**
		

Table 7. 6th student's project (Wiggan, 2020)

In this student project focusing on the renowned artist Pablo Picasso (Table 8), the objective involves crafting a stool design that draws inspiration from the artist's distinctive cubist creations. The initial prompt, "A Stool Inspired by Picasso's Cubism Movement," sets the creative direction. While Picasso's interpretation of cubism can be succinctly encapsulated as "Deconstructing Objects into Geometric Forms and Reassembling from Various Perspectives," the prompt lacks crucial details such as color palette, potential embellishments, or specific artworks for reference. Consequently, the current prompt's superficiality hinders meaningful guidance, resulting in the stool design process becoming susceptible to randomness.

Conversely, when the input "Picasso's Cubism Movement" is introduced, the AI generates a design that aligns with the movement's essence, characterized by dominant primary colors and prominent black contour lines reminiscent of Picasso's artworks. This design adopts a geometric and randomized arrangement, akin to Picasso's style. However, challenges emerge during the execution phase due to limitations in mastering intricate modeling software.

Consequently, accurately comprehending the student's vision, translating it into technical models, and effectively expressing the intended design become intricate tasks.

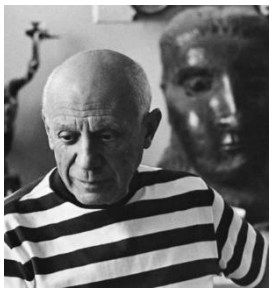
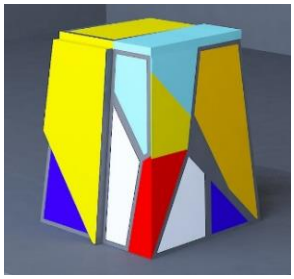
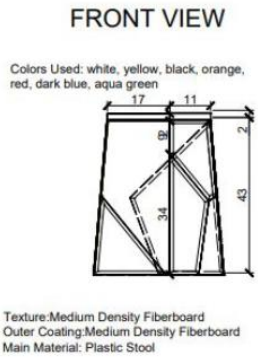
<table>
<tr><th>FIGURE</th><th>PROMPT</th><th>AI CONCEPTUAL IMAGE</th></tr>
<tr><td>Pablo Picasso
  </td><td>A Stool Inspired by Picasso's Cubism Movement Should be Created by Separating the Object into Geometric Shapes and Bringing together Images from Different Angles.</td><td> 
Created by Midjourney</td></tr>
<tr><th>RENDER</th><th>MANUFACTURED FURNITURE PHOTO</th><th>SOME OF THE TECHNICAL DRAWINGS</th></tr>
<tr><td>  </td><td>  </td><td> 
</td></tr>
</table>

Table 8. 7th student's project (McCully, 2023)

To ensure an objective and systematic assessment of each student's project, each project was evaluated based on five predefined criteria. These criteria were designed to capture essential aspects of each project's alignment with character and style consistency, material and form compatibility, technical solutions and details, effective use of AI, and the consistency between AI-generated visuals and the physical product. Each project was rated

on a scale from 1 to 5 for each criterion, with higher scores indicating a stronger alignment with the intended design goals.

The evaluation results are summarized in Table 9, providing an overview of each project's performance across these criteria. This structured approach allowed for a clear comparison of the projects and a standardized basis for discussing the findings.

PROJECT	1ST CRITERIA	2ND CRITERIA	3RD CRITERIA	4TH CRITERIA	5TH CRITERIA
1ST PROJECT	4	5	3	4	5
2ND PROJECT	3	3	2	3	4
3RD PROJECT	5	4	5	4	3
4TH PROJECT	4	4	4	5	5
5TH PROJECT	2	3	2	3	4
6TH PROJECT	5	4	3	4	3
7TH PROJECT	3	2	4	3	2

Table 9. Evaluation of Student Projects Based on Criterion

5. Conclusion

Artificial intelligence provides students with new learning opportunities in design processes. While interacting with AI, students have the chance to develop their creative thinking and problem-solving skills. AI tools enable interior architecture students to expand their ideas and generate innovative solutions while utilizing their existing knowledge more efficiently. This process helps them explore different aspects of design and enhance their critical thinking abilities. Students working with AI have the opportunity to achieve richer and more effective design outcomes by enhancing both their technical skills and creative thinking capacities. The use of AI tools has the potential to transform design processes, while also raising ethical issues such as resource utilization, copyright, and the role of designers. Consequently, this study provides scientific contributions regarding the integration of artificial intelligence into design education.

This preliminary study addresses two goals within the framework for incorporating AI into the curriculum for the furniture design studio course: to introduce the student to the notion of AI-generated images and to foster perspective toward the future of the use of design tools and to allow the student to have firsthand experience with the use of artificial intelligence in design.

This experiment well realizes its first goal, demonstrating how the incorporation of AI into traditional design tools will significantly evolve in the future and how designers will do this rapid change and adaptation. Other secondary goals involve engaging students with AI in the space of design, and, in this case, they are designed to learn how image generators can be put into use. The focus will be on how artificial intelligence can be controlled to achieve desired results through the current image generation mechanisms and features that depict the characteristic.

The AI image generators in the research generate images in two main formats. The first format that the prompts drive is in such a way that AI understands what the user expects out of its text inputs and then generates suggestions for images within the large dataset it has. Students with a clear articulation of expectations in the instructions were significantly better than the general instructions at guiding the image generator. Early-stage work would seem to have a part to play in best practice since how the definition of design detail, for example, styling or temporal, is a factor that conditions output to an incredibly much greater extent.

The mixed image is the second method in generating the image involving varying proportional compositions. This approach also facilitated the merging of isolated image details, which may be chosen from a provident pool of online images or visions generated by artificial intelligence. This process mainly was employed during the study for making alterations or additions to the vision. As the photos were already predetermined, their outcome could be more anticipated. However, the said technique relies upon the users to clarify their creative vision.

Despite users still being 'decision-makers,' it appears that from this study carried out with students, they must also hold a good knowledge of the design subject for them to have achieved results deemed satisfactory using AI as a design tool; otherwise, this is mostly done from random outcomes from vague briefs. The study also indicates that to some extent, the user has control over the images produced. At the current stage, AI image generators would be particularly suitable for conceptual ideation. While further interdisciplinary studies could enrich this development course, the idea of "AI as a design tool" can be further pursued.

REFERENCES

ALAWADHI, A. M., & YOUSEF, D. M. (2023). Revolutionizing plastic furniture design: Harnessing the power of artificial intelligence. *Arab International Journal of Information Technology & Data, 3*(4), 7-46.

ALPAK, E. M., DÜZENLI, T. & MUMCU, S. (2020). Raising awareness of seating furniture design in landscape architecture education: Physical, activity-use and meaning dimensions.

International Journal of Technology and Design Education, 30(3), 587-611. https://doi.org/10.1007/s10798-019-09514-8

BARKER, N. (2023, June 19). *You are now entering the AItopia*. Dezeen. https://www.dezeen.com/2023/06/19/aitopia-artificial-intelligence-series/

BAŞARIR, L. (2022). Modelling AI in architectural education. *Gazi University Journal of Science*, 35(4), 1260-1278. https://doi.org/10.35378/gujs.967981

BICKERSTETH, R. (2023, July 29). *Dezeen in depth asks if AI will really take architects' jobs*?. Dezeen. https://www.dezeen.com/2023/07/29/dezeen-in-depth-asks-if-ai-will-really-take-architects-jobs/

BONGIOVANNI, E. (2020, July 15). *AI powered furniture design.* Inedit. https://www.inedit-project.eu/2020/06/15/ai-powered-furniture-design/

CAIRES, C.S., ESTADIEU, G., OLGA NG KA MAN, S. (2024). Design thinking methodology and text-to-image artificial intelligence: A case study in the context of furniture design education. In: Martins, N., Brandão, D., Fernandes-Marcos, A. (Eds.), *Perspectives on Design and Digital Communication IV. Springer Series in Design and Innovation, vol. 33*. Springer, Cham. https://doi.org/10.1007/978-3-031-41770-2_7

CHANG, Y. S., HU, K. J., CHIANG, C. W. & LUGMAYR, A. (2019). Applying mobile augmented reality (AR) to teach interior design students in layout plans: Evaluation of learning effectiveness based on the arcs model of learning motivation theory. *Sensors*, 20(1), 105. https://doi.org/10.3390/s20010105

CHATTERJEE, P. (2018). *Artificial intelligence and higher education.* Siliconindia. https://www.siliconindia.com/magazines/December2018/AI/#page=20

COUNCIL FOR INTERIOR DESIGN ACCREDITATION. (n.d.). *CIDA professional standards 2022.* https://static1.squarespace.com/static/5c9ae7530490796e32442342/t/61def12b98890e3d27744c59/1642000683919/Professional+Standards+2022.pdf

ÇATALYÜREKOĞLU, S. & ALTIPARMAKOĞULLARI, Y. (2023). Kent mobilyalarinin tasarım süreçlerinin ve ergonomisinin üretici ve kullanıcı görüşleri çerçevesinde değerlendirilmesi: Kent mobilyası tasarım süreci ve ergonomisi. *Tasarim+ Kuram*, 19(39), 296-315. https://doi.org/10.59215/tasarimkuram.398

DAI, S., LI, Y., GRACE, K. & GLOBA, A. (2023). Towards human-AI collaborative architectural concept design via semantic AI. In: Turrin, M., Andriotis, C., Rafiee, A. (Eds.), Computer-Aided Architectural Design. INTERCONNECTIONS: Co-computing Beyond

Boundaries. CAAD Futures 2023. *Communications in computer and information science: Vol 1819*. Springer, Cham. https://doi.org/10.1007/978-3-031-37189-9_5

ELSHATER, A. (2017). Widen the scale of urban design to the level of city planning: Argument beyond a case of two cities. UPLanD-Journal of Urban Planning, *Landscape & Environmental Design*, 2(2), 207-221. https://doi.org/10.6093/2531-9906/5266

ERDEM, Ş. T. (2019). Examining the effects of the industrial revolution on furniture. *A+ Arch Design International Journal of Architecture and Design*, 5(2), 103-118. http://dx.doi.org/10.17932/IAU.ARCH.2015.017/arch_v05i2005

EUROPEAN COUNCIL OF INTERIOR ARCHITECTS. (n.d.). *The European charter of interior architect training 2020.* https://ecia.net/news/the-european-charter-of-interior-architect-training-2020

FAILES, I. (2019, July 1). *Behind-the-scenes: Tricks and techniques that ILM used to transform characters in 'Bumblebee'.* Cartoon Brew. https://www.cartoonbrew.com/feature-film/behind-the-scenes-tricks-and-techniques-that-ilm-used-to-transform-characters-in-bumblebee-168309.html

FREITAG, M., WESTNER, P., SCHILLER, C., NUNEZ, M. J., GIGANTE, F. & Berbegal, S. (2018). Agile product-service design with VR-technology: A use case in the furniture industry. *Procedia CIRP*, 73, 114-119. https://doi.org/10.1016/j.procir.2018.03.305

HAKIMSHAFAEI, M. (2023). *Survey of generative AI in architecture and design* [Unpublished doctoral dissertation]. University of California.

HANAFY, N. O. (2023). Artificial intelligence's effects on design process creativity:" A study on used AI Text-to-Image in architecture". *Journal of Building Engineering*, *80*, 107999.

HARSUVANAKIT, A. (n.d.). *Elbo Chair.* Arthur Harsuvanakit. http://www.arthurharsuvanakit.com/#/new-page-1/

HEDGES, K. E. (2023, June 25-28). Artificial intelligence (AI) art generators in the architectural design curricula [Conference presentation]. 2023 *ASEE Annual Conference & Exposition*, Baltimore, Maryland. https://peer.asee.org/42293

INTERNATIONAL FEDERATION OF INTERIOR ARCHITECTS/DESIGNERS. (n.d.). *IFI interior architecture/design education policy* (IFI IA/D EP). https://ifiworld.org/wp-content/uploads/2020/10/IFI-Interiors-Education-Policy_IFI-IAD-EP-Sept2020.pdf

JEANNE [@OlympedeGouges]. (n.d.). "*Travis Fimmel*" [Photo]. Pinterest. https://www.pinterest.de/pin/361413938847180843/

JORDAHN, S. (2019, April 11). *Philippe Starck, Kartell and Autodesk unveil "world's first production chair designed with artificial intelligence*". Dezeen. https://www.dezeen.com/2019/04/11/ai-chair-philippe-starck-kartell-autodesk-artificial-intelligence-video/

KAYA, H. S., KAYA, M. E., YAKUT, E. S., ÇİÇEK, M. & TOZLUOĞLU, E. G. (2022). An interdisciplinary urban furniture design model. *A | Z ITU Journal of The Faculty of Architecture*, 19(3), 721-740. https://doi.org/10.5505/itujfa.2022.92979

KIM, J. (2011). *Modeling cognitive and affective processes of designers in the early stages of design: Mental categorization of information processing* [Unpublished doctoral dissertation]. Arts et Métiers ParisTech.

KOÇER, Ç. (2019). *Scale in urban design: The notion of scale in spatial design thinking* [Unpublished master's thesis]. Middle East Technical University.

MADANIPOUR, A. (1997). Ambiguities of urban design. *The Town Planning Review*, 68(3), 363-383.

MARCH, A. & LEÓN, J. (2015, December 9-11). Urban design: An underutilized tool for disaster risk reduction? [Conference presentation]. *7th State of Australian Cities Conference*, Gold Coast, Australia. https://apo.org.au/node/63341

MARTET, C. (2023, August 18). *Jeff Koons, the king of controversy!. Rise art*. https://www.kazoart.com/blog/en/jeff-koons-the-king-of-controversy/

MCCULLY, M. (2023, November 18). *Pablo Picasso*. Britannica. https://www.britannica.com/biography/Pablo-Picasso#/media/1/459275/68752

MESTYLE STUDIO3 [@mestyle.studio3]. (n.d.). *"Portrait of Genghis Khan or Chinggis Khaan in warriors traditionally wearing typical mongolian dress culture of mongolia"* [Photo]. Freepik. https://www.freepik.com/premium-photo/portrait-genghis-khan-chinggis-khaan-warriors-traditionally-wearing-typical-mongolian-dress-culture-mongolia_5956258.htm

MIKALONYTĖ, E. S. & KNEER, M. (2022). Can artificial intelligence make art?: Folk intuitions as to whether AI-driven robots can be viewed as artists and produce art. *ACM Transactions on Human-Robot Interaction (THRI)*, 11(4), 1-19. https://doi.org/10.1145/3530875

MOLINA, B. (2023, June 6). *Apple unveils Vision Pro headset for spatial computing*. USA Today, 02B. https://link.gale.com/apps/doc/A751994409/AONE?u=anon~59f4fbbd&sid=sitemap&xid=2c47a238

OH, H., YOON, S. Y. & SHYU, C. R. (2008). How can virtual reality reshape furniture retailing?. *Clothing and Textiles Research Journal*, 26(2), 143-163. https://doi.org/10.1177/0887302X08314789

ÖZTÜRKCAN, S. (2021). Service innovation: Using augmented reality in the IKEA Place App. *Journal of Information Technology Teaching Cases*, 11(1), 8-13. https://doi.org/10.1177/2043886920947110

PHAN, V. T. & CHOO, S. Y. (2010). Interior design in augmented reality environment. *International Journal of Computer Applications*, 5(5), 16-21. http://doi.org/10.5120/912-1290

PİRİM, H. (2006). Yapay zeka. *Yaşar Üniversitesi E-Dergisi*, 1(1), 81-93.

RATICAN, J., HUTSON, J. & WRIGHT, A. (2023). A proposed meta-reality immersive development pipeline: Generative AI models and Extended Reality (XR) content for the Metaverse. *Journal of Intelligent Learning Systems and Applications*, 15, 24-35. https://doi.org/10.4236/jilsa.2023.151002

RHODES, M. (2016, October 3). *So. Algorithms are designing chairs now.* Wired. https://www.wired.com/2016/10/elbo-chair-autodesk-algorithm/

ROSENBOOM, D. (1983). *Artificial intelligence and art education.* DavidRosenboom. https://davidrosenboom.com/s/AI_Art_Edu_1983.pdf

TANG, J. K., LAU, W. M., CHAN, K. K. & TO, K. H. (2014, December 9-12). AR interior designer: Automatic furniture arrangement using spatial and functional relationships [Conference presentation]. *2014 International Conference on Virtual Systems & Multimedia (VSMM)*, Hong Kong, China. https://doi.org/10.1109/VSMM.2014.7136652

TRIVELLIN, E., MARSEGLIA, M., FILIERI, J., LOTTI, G., CANTINI, F., TANZINI, A. & MATTEUCCI, E. (2020, July 16-20). Smart Garden (SMAG): A system of outdoor furniture equipped with artificial intelligence [Conference presentation]. Advances in Manufacturing, Production Management and Process Control: *Proceedings of the AHFE 2020 Virtual Conferences on Human Aspects of Advanced Manufacturing, Advanced Production Management and Process Control, and Additive Manufacturing, Modeling Systems and 3D Prototyping*, USA, 140-146, Springer International Publishing. https://doi.org/10.1007/978-3-030-51981-0_18

VERAWARDINA, U. (2023). 3D furniture application design applying augmented reality (AR) technology based on android. *Proceedings of the 9th International Conference on Technical and Vocational Education and Training (ICTVET 2022)*, 747, 24-34. https://doi.org/10.2991/978-2-38476-050-3_4

VIYANON, W., SONGSUITTIPONG, T., PIYAPAISARN, P. & SUDCHID, S. (2017). AR furniture: Integrating augmented reality technology to enhance interior design using marker and

markerless tracking. *Proceedings of the 2nd International Conference on Intelligent Information Processing*, USA, 32, 1-7. https://doi.org/10.1145/3144789.3144825

WIGGAN, A. (2020, January 19). *The best order for the Gal Gadot Wonder Woman movies. I'll get drive-thru.* https://illgetdrivethru.com/2020/01/19/the-best-order-for-the-gal-gadot-wonder-woman-movies/

WONG, N. (2016, August 11). *A chair created through generative design.* Design Milk. https://design-milk.com/elbo-chair-created-generative-design/

XIN, C. (2022). Exploring the effectiveness of VR-based product demonstrations featuring items of furniture. *Library Hi Tech.* https://doi.org/10.1108/LHT-01-2022-0001

XIONG, X., YUE, X. & WU, Z. (2023). Current status and development trends of Chinese intelligent furniture industry. *Journal of Renewable Materials,* 11(3), 1353-1366. https://doi.org/10.32604/jrm.2022.023447

YAN, H., ZHANG, H., LIU, L., ZHOU, D., XU, X., ZHANG, Z. & YAN, S. (2022). Toward intelligent design: An AI-based fashion designer using generative adversarial networks aided by sketch and rendering generators. *IEEE Transactions on Multimedia*, 25, 2323-2338. https://doi.org/10.1109/TMM.2022.3146010

YOON, S. Y. & CHO, J. Y. (2009, March). Understanding furniture decision making process and design preference using web-based VR technology [Conference presentation]. *Annual Conference of IDEC*, St. Louis, Missouri, 25-28.

ZHANG, C., WANG, W., PANGARO, P., MARTELARO, N. & BYRNE, D. (2023). Generative image AI using design sketches as input: Opportunities and challenges. *Proceedings of the 15th Conference on Creativity and Cognition*, USA, 254-261. https://doi.org/10.1145/3591196.3596820

ZOU, N., GONG, Q., CHAI, Q. & CHAI, C. (2023). The role of virtual reality technology in conceptual design: *Positioning, applications, and value. Digital Creativity*, 34(1), 53-77. https://doi.org/10.1080/14626268.2023.2166080

URL-1: https://blurppy.files.wordpress.com/2015/04/threezero-tmnt-2014-sixth-scale-figure-michelangelo.jpg