Integrating Artificial Intelligence in Interior Design Education: Concept Development

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This article aims to explore the integration of artificial intelligence (AI) as a design tool in interior design education. The research examines the students' interior design studio project outcomes over the usage of AI in creating conceptual images, and the implementation of the AI-created concept to the overall space. In the research, students' projects are divided into two groups of 5 according to sufficient or insufficient prompts for the "AI generated" conceptual images. Barnard's (1992) CAIDC (Consensual Assessment of Interior Design Creativity) scale was used for the assessment. Mann-Whitney U Test was conducted for the results. We understand that there is no significant difference between writing sufficient or insufficient prompts in the concept development phase of interior design projects according to the Barnard (1992)'s design merits. It has been confirmed that the main factor that influences this regard is the need for an appropriate "concept analysis" to adapt the concept generated with AI to the specified project spaces. The study concludes that AI tools, particularly in generating spatial concept images based on prompts, serve as aids rather than replacements for interior designers, highlighting the importance of designer interpretation and adaptation skills. Furthermore, it suggests the integration of AI into interior design education to equip students with essential 21st-century skills while emphasizing the need for future research to explore hybrid AI methodologies and the evolving role of AI in the profession.

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Yapay Zekayı İç Mimarlık Eğitimine Entegre Etmek: Konsept Geliştirme

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Bu makale, iç mimarlık eğitiminde bir tasarım aracı olarak yapay zekanın (AI) entegrasyonunu keşfetmeyi amaçlamaktadır. Araştırma, öğrencilerin mekan tasarım stüdyosu proje çıktılarını, kavramsal görüntülerin oluşturulmasında yapay zeka kullanımı ve yapay zeka tarafından oluşturulan konseptin genel alana uygulanması üzerinden incelemektedir. Araştırmada, öğrencilerin projeleri "Yapay Zeka tarafından oluşturulan" kavramsal görseller için yeterli veya yetersiz istemlere göre beşer kişilik iki gruba ayrılmıştır. Değerlendirme için Barnard'ın (1992) CAIDC (Consensual Assessment of Interior Design Creativity) ölçeği kullanıldı. Sonuçlar için Mann-Whitney U Testi yapılmıştır. Barnard'ın (1992) tasarım değerlerine göre, iç mimari projelerinin konsept geliştirme aşamasında yeterli veya yetersiz bilgi istemi yazmak arasında önemli bir fark olmadığını anlıyoruz. Bu konuda etkili olan ana faktörün, yapay zeka ile oluşturulan konsepti belirlenen proje alanlarına uyarlamak için uygun bir "kavram analizi" ihtiyacı olduğu teyit edilmiştir. Çalışma, özellikle belirli ipuçlarına dayalı mekansal kavram resimleri oluşturmada AI araçlarının iç mimarların yerine geçmek yerine yardımcılar olarak hizmet ettiğini, tasarımcı yorumlama ve uyarlama becerilerinin önemini vurgulayarak sonuçlanmıştır. Ayrıca, iç mimarlık eğitimine AI'nin entegrasyonunu önererek öğrencilere temel 21. yüzyıl becerilerini kazandırma ihtiyacını vurgularken, gelecekteki araştırmaların hibrit AI metodolojilerini ve AI'nin meslekteki evrilen rolünü keşfetmesi gerektiğini öne sürmektedir.

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Anahtar Kelimeler: İç Mekân Tasarımı, Konsept Geliştirme, Tasarım İletişimi, Tasarım Süreci, Yapay Zeka.

1. INTRODUCTION

The development of artificial intelligence (AI) technologies was accompanied by the emergence of some technological myths between the 1950s and the early 1970s. These myths centered on the idea of developing a machine that could think and be perfectly precise in its replication of human cognition. The potential of AI was the subject of a cultural narrative that led to high hopes and ambitions for the field (Natale & Ballatore, 2017). To identify decision-making patterns and minimize human intervention, AI can analyze big data using scientific methods, particularly machine learning. AI, machine learning, and deep learning were becoming increasingly important in this regard (Aggarwal et al., 2022). As of the beginning of 2022, new large-scale AI models have been released every month, marking the beginning of the deployment phase of AI (Maslej et al., 2023). AI software or systems were utilized by 24% of enterprises for ICT security, 23% for business administration processes, and the least, 9% for human resources management or recruiting (Eurostat, 2021).

The rapid rise of artificial intelligence (AI) raises questions about the future of jobs and whether current professions will become obsolete. The issue of which occupations will disappear and how AI will take over the jobs of professionals has become an important issue. Studies on the fear of autonomous robots and artificial intelligence (FARAI) have emerged to explore individuals' sense of losing their jobs due to autonomous robots and AI (Li & Huang, 2020; Golin & Christopher, 2022; Nilsson, 1984; Morikawa, 2017; Coupe, 2019; Prokopowicz, 2022; Chymis, 2020; Liang & Lee, 2017; Vu & Lim, 2021). These studies indicate that AI tools in various professional fields create a fear of job loss among employees. Additionally, Mirbabaie et al. (2022) examined the impact of AI on changes to work, loss of status position, and AI identity threats in the workplace.

Along with the increasing fear of job loss in various professional groups, the field of design also experiences a rapid rise in AI. However, there is a lack of studies investigating whether AI will eliminate the profession of interior design or if AI is merely a design and communication tool. Xu & Yu (2022) mainly studied the visual performance of psychological factors in interior design under the background of artificial intelligence. Zheng (2022) discussed the issue of interior design marketing and an

inevitable trend in the future development of interior space design solutions. Huang et al. (2022) focused on the evaluation method of interior design programs based on artificial intelligence processing technology. Wu & Han (2023) studied how to analyze and design an interactive interior decoration design system based on AI and VR technology. Wu (2022) discussed how to better integrate traditional elements into contemporary furniture under the background of contemporary technologies such as wireless communication and artificial intelligence decision-making.

Under these circumstances, an experiment is being carried out using student-created works in interior design to determine whether artificial intelligence can take the place of an interior designer in the field of interior design by choosing just one of the artificial intelligence methods currently used in the field.

2. LITERATURE REVIEW

2.1. 21st Century Skills, Necessary Abilities in Interior Design, and Communication

Education is critical in preparing people to solve real-world problems. It must constantly adapt to new technological advancements, sociological changes, and necessary skills in both professional and everyday lives (Howells, 2018). Real-world problems change as time passes. In the 21st century, there is a new world order. The important topics of the new order are different. We have to improve our skills. The skills required for education and employment in today's economy have been labeled '21st Century Skills (Laar et al., 2020). These skills are defined by different organizations. According to Howells (2018), 21st Century Skills are 'cognitive and meta-cognitive skills' (e.g. critical thinking, creative thinking, learning to learn, and self-regulation); 'social and emotional skills' (e.g. empathy, self-efficacy, and collaboration); and 'practical and physical skills' (e.g. using new information and communication technology devices).

Greenhill defines 21st Century Skills in their report published in 2010 as 'Learning and Innovation Skills' (Critical Thinking and Problem Solving, Communication, Collaboration, and Creativity and Innovation), 'Information, Media, and Technology Skills' (Information Literacy, Media Literacy, ICT Literacy (Information, Communications, and

Technology Literacy), 'Life and Career Skills' (Flexibility and Adaptability, Initiative and Self-Direction, Social and Cross-Cultural Skills, Productivity and Accountability, Leadership, and Responsibility). As we understand from 21st Century Skills, communication skills are important. They are essential in the expanding service sector. They concern the ability to transmit information while ensuring that meanings are effectively expressed. To successfully navigate the current social world, one must be able to effectively regulate one's needs and goals with those of the larger society. Employers require people with communication skills because our global economy is so interconnected (Van Laar et al., 2020). On the other hand, technology skills are also important and should be integrated into the curriculum. Effective communication is indeed a crucial skill for interior designers. It enables them to effectively convey their ideas, collaborate with clients and colleagues, and ultimately bring their design visions to life. Recognizing the significance of communication skills, the Council of Interior Design Accreditation (CIDA) has identified communication as one of the most important professional standards that interior design students need to meet.

CIDA sets learning expectations for students, requiring them to demonstrate an 'Apply/Ability/Able' level of learning for the 'Communication' standard. This implies that students should not only possess knowledge about communication principles but also can apply those principles effectively in real-world design scenarios. As the field of interior design continues to evolve, it becomes increasingly important for interior design programs to expose students to emerging communication technologies that can enhance their skills and competencies.

2.2. Artificial Intelligence (AI)

As Homo sapiens, we have given ourselves the title 'man the wise,' emphasizing the high value we place on our intelligence. Throughout history, we have strived to comprehend the workings of our minds - how we, with a limited amount of matter, can understand, analyze, predict, and shape a world far vaster and more intricate than ourselves (Russell & Norvig, 2014).

Alan Turing (1950) designed 'The Turing Test' to define intelligence. According to the test, a computer passes if it answers questions like a

human. People cannot tell if it's a human or a computer answering (Russell & Norvig, 2014). This aligns with John McCarthy's definition of AI in 1956. It describes machines executing tasks that humans can do (Zicari, 2018). To pass 'The Turing Test', a computer must have the following abilities:

- Natural language processing
- Knowledge representation
- Automated reasoning
- Machine learning

These abilities are now considered types of AI. However, AI goes beyond mimicking human intelligence. It seeks to develop intelligent entities (Hussell & Norvig, 2014).

AI and human intelligence share functional components. They both play essential roles in various areas. Computers rely on short-term memory and random processing units. The brain uses digital and analog systems. Despite these differences, both systems process information accurately and reliably. Computers and the human brain differ in electrical signal transmission, flexibility, and memory. Computers are currently the most efficient and rapid method of information processing available (Mansur, 2018).

AI has made significant contributions to various industries, including architecture, engineering, and construction. The concept of digital buildings has emerged as a key area of focus for AI development, aiming to use new technologies to enhance building safety and efficiency (McCarthy, 2007; Borglund, 2022). The interdisciplinary nature of AI draws upon concepts and methods from multiple disciplines, including mathematics, linguistics, psychology, neuroscience, mechanical engineering, statistics, economics, cybernetics, and philosophy, among others (Tecuci, 2011). This article focuses on the effects of AI in the interior design discipline. Even though there are different types of AI, the scope of this article is limited to machine learning.

Since we are in the era of big data, where an immense amount of information exists. As one type of AI, machine learning is one of the most popular concepts in the AI world. For example, there are one trillion web pages, and one hour of video is uploaded to YouTube every second, resulting in 10 years' worth of material each day. With the vast

amount of data available, machine learning is necessary for automated data analysis. This involves the use of techniques that can automatically recognize patterns within data, which can then be used to anticipate forthcoming data or make decisions under conditions of uncertainty. (Murphy, 2012). Even though there are different types of machine learning, we only focus on supervised learning.

Supervised learning involves using labeled training examples to capture the relationship between input and output data, allowing for the prediction of the output variable for new data (Ertel, 2017). It's commonly used for tasks such as image and speech recognition, spam filtering, and predictive modeling across various industries (Haykin, 1998; Kotsiantis, 2007). Supervised learning uses labeled data, while active learning improves performance by obtaining user feedback for labels. Nonetheless, supervised learning can be limited by high costs for collecting labeled data and ambiguity during monitoring or labeling (Liu & Wu, 2012).

In the interior design discipline, AI would be used as a tool in adding objects in renders, creating the concept, working on lighting, color-texture choosing, and combination, combining different images, etc. In this article, we focus on creating concept images via supervised learning tools such as DALL-E and Midjourney. All of these tools generate images from input text using multimodal generatives, but can reinforce biases from training data (Mishkin et al., 2022; Marcus, Davis and Aaronson, 2022; King, 2022).

2.3. Design Process

Design acts as a mediator between mental and social activity. It must be original and functional. It must add value to the existing world of design. The design process includes asking, imagining, planning, creating, and improving design ideas (Christiaans, 2002; Yu Shan et al., 2018). In the early 1960s, the realization that ‘design’ as a process was common to various fields—the various specialisms within engineering, industrial design, architecture, planning, and so forth—generated a fruitful new approach to design methodology (Darke, 1979).

The design process is a rational and creative activity, requiring design education that encompasses both technical knowledge and the development of creative thinking in the field of design (Kahvecioğlu, 2007; Öztürk & Türkkan, 2006). Throughout history, the concepts of

creativity, human intelligence, and knowledge creation have been highly regarded. They have held significant places in various academic disciplines. These concepts are as important as any other subject of study and have been addressed with curiosity and admiration throughout human history (Kahvecioğlu, 2007).

Indicators that distinguish creativity from other aesthetic standards include a design's typicality and how much it deviates from the viewer's mental image. Additionally, the definitions of creativity in both general and specific contexts were aided by a comparative analysis of pairs of designs. The ability to create novel and emotionally impactful designs, incorporate inventive forms, and functions, integrate shape, function, emotions, material, texture, and color, and show a willingness to experiment with different approaches and take calculated risks are all characteristics of creativity. Creativity is a special quality that designers and viewers can appreciate it works, even though it is difficult to quantify objectively (Christiaans, 2002).

Rey-Barreau & Whiteside (1983) defines the design process in 7 steps which are programming/research, schematic design/concept formation, preliminary design/concept development, design development/idea representation, construction documents/working drawings, construction documents/specifications, and implementation. According to Pile (1995), interior design projects require a structured approach, with the steps varying based on project size and client-designer relationship. Below are the steps identified by Pile (1995):

- Establish Contact with the Client - Define the project scope, set a budget and timeline, and decide on the need for other professionals.
- Obtain a Survey of Spaces - Determine the specific requirements of the project through interviews and data collection.
- Develop Preliminary Design - Find aesthetically pleasing solutions to the problems defined through programming.
- Develop Detailed Design - Create detailed drawings, plans, elevations, sections, and perspectives, and select materials, colors, and finishes.

- Prepare Constructions Documents - Create working drawings and specifications, establish a construction schedule, and select contractors.
- Supervise Construction - Ensure quality workmanship and adherence to specifications.
- Make Adjustments and Evaluations - Address issues promptly and conduct follow-up evaluations of completed projects.

Interior designers must balance creativity with effective project management to ensure successful projects. Excellent design and good project management are both necessary for success. Clients are more likely to be satisfied with poor design and good management than with excellent design and poor management. The 7 design phases are crucial for sufficient planning and decision-making in the design process, which minimizes errors and revisions. Formal training for designers typically only covers 10 to 25% of the design process, and the rest is learned on the job. Students in design school only experience a small part of the design process. They focus mainly on the presentation and response stages, without learning about project execution. As a result, graduating students have only a general understanding of the full design process (Pile, 1995).

2.4. Interior Design Education

Design education takes place in a physical and mental space called the design studio, which is considered a cultural phenomenon. Donald Schön (1983) characterizes design as 'reflection in action', while Johnson (2000) believes that a studio is a pedagogic tool used to teach the culturally rooted and individually creative process of design. The studio is a combination of place, people, and a structured process led by a mentor.

According to Schön (1983), studio education is about learning by doing. Students work on design challenges with the guidance of a mentor, which allows for the practice of good design. This process helps students understand spatial organization, composition, and articulation to create meaningful and beautiful spaces. Each design explores how space and its contents are expressed and related to each other (Öztürk & Türkkan, 2006).

According to Teixeira (2005), a design studio is a place where design-related information is created and consumed. The creation of this information involves transforming collected data and drawing from architectural and design cultures, as well as personal experiences. Teixeira believed that the main objective of a design studio is to identify the central concept underlying a design idea. The creative process begins with generating ideas, developing them into a concept, and finally refining them into a theme. To develop an interior design project in a studio, students should follow several phases from an initial idea to a completed project (Hasırcı et al., 2022).

While Pile (1995) identifies seven steps to facilitate the process of design, Botti-Salitsky (2005) has modified the process into 5 phases to fit within an academic curriculum:

- research and problem statement creation
- schematic design
- design development
- construction documentation
- final critique

Students are given a project with specific requirements and a concept or theme to integrate into their designs (Allen et al., 2004; Neilson & Taylor, 2002; Tate, 1987). They use various tools, such as bubble diagrams, perspectives, elevations, and CAD software, to develop their designs, select materials, and equipment (Botti-Salitsky, 2005; Tate, 1987; Gül, 2016; Weisberg, 1988; Yurtgün & Çınar, 2023). During each phase, students make decisions related to space allocation, color schemes, materials, furnishings, and lighting (Botti-Salitsky, 2005; Allen et al., 2004; Mitton, 2004; Pile, 1995). Sufficient documentation during the design phase, including various types of drawings, specifications, and schedules, is crucial for the final studio project critique (Allen et al., 2004; Neilson & Taylor, 2002; Botti-Salitsky, 2005). The final stage is the critique, where students receive feedback on their work from instructors. The goal is to produce a final design that fulfills the requirements of an imaginary client and meets the criteria set by the instructors (Anthony, 1991; Dozois, 2001; Dutton, 1991; Botti-Salitsky, 2005).

Concept development is the process of expanding and refining an idea or a concept. It often involves exploring different perspectives,

researching ideas, and considering the implications and potential outcomes of the concept, done by students. To communicate design concepts easily with visuals generated by AI, machine learning can be used to describe an image with words (Amritkar & Jabade, 2018). This helps clients or collaborators communicate design concepts with interior designers.

2.5. Artificial Intelligence and Concept Development

Developing a concept via AI requires similar stages. The process of concept development in an interior design studio typically begins with research and exploration of different design styles, materials, colors, and textures. An interior designer also needs to consider the function of the space, the needs of the client, and any existing architectural features. They may create sketches or mood boards to visualizing different design options. Machine learning can be used to describe design concepts in a way that is easy to understand and visually appealing. For example, a caption for an image of a cozy living room might read 'Warm colors, plush textiles, and a glowing fireplace create a comfortable and inviting atmosphere for relaxing and entertaining.' By using descriptive communication, the designer can convey the mood and aesthetic of the space to the client (Johnson, 1994). Just as with the phrase 'a picture is worth a thousand words', it is believed that using visual or graphic aids can facilitate better comprehension of novel ideas (Finke, 1996).

Written or verbal communication is the primary way of exchanging information between people and revealing the concept in design studios as a result of the concept of creativity. Furthermore, AI can assist with the selection and sourcing of materials and furnishings. This can save time and reduce errors, allowing designers to focus on the creative aspects of their work. However, it is important to remember that AI should not replace the critical thinking and problem-solving skills of the designer. Rather, it should be used as a tool to enhance the design process and bring new ideas to the table. Related to this, in the studies of Kahraman, Şekerci & Develier (2023), Yıldırım & Demirarslan (2020), Eskicioğlu & Öztürk (2020) and Çelik & Sağlam (2023), they experienced artificial intelligence and space designs with the text to image visual creation tool of artificial intelligence in the design process and reveals new ideas. Among these studies, the study by Kahraman, Şekerci & Develier (2023) emphasizes that the designer's critical

thinking and problem-solving skills surpass the database of today's artificial intelligence.

Interior architecture education and especially design studio courses are like a test of the professional profession. For this reason, the course contents should be kept up-to-date for students to adapt to the changes in the current situation with the changing and developing technology in their professional lives. The course contents, in which these current technologies are included, enable students to closely follow the developments in the profession.

3. MATERIAL AND METHOD

3.1. Design Project

In this course, we expected students to design a fair stand by creating the concept via AI. The students were asked to create and write 'prompts' by themselves. Prompt means a descriptive text for AI Large Language Model (LLM) which are text to image generators like Midjourney and DALL-E to create images accordingly. We write a text, and AI creates the image. In this context, first, we made a lecture about how to write a proper prompt. We advised students to imagine the conceptual fair stand design first and think about the colors, materials, style, spaces-subspaces, space organization, circulation, etc. After that, we asked them to try to explain what they imagine via words like writing a descriptive text. That's going to be the prompt of that project. If the imagining and writing of what they imagine part is not sufficiently well, the prompts will not be sufficient, either.

The fair stand would be located in a space designated for large exhibitions, especially those of a commercial nature where products are exhibited to promote trade or space for large conventions. The students were tasked with designing a fair stand for a brand, which they were to create along with its brand identity in the ANFAŞ Commercial Center in Antalya/Turkey, with every detail designed and a cost analysis conducted. To ensure the necessary functions for the brand identity are met, students are requested to design a project that appeals to different users, attracts people to the location, and provides an enjoyable experience where people can not only make purchases but also spend quality time in the area. Designing an exhibition stand was the task assigned to the students. that spans approximately 1200

square meters (ground floor: 800 square meters, mezzanine floor: max. 400 square meters). This project allowed them to freely conceptualize their design and provided a moderately larger-sized project for assessment purposes.

We expected students to create a brand and brand identity in the categories listed below under these conditions.

- Technology - Information Technologies
- Construction
- Sport - Healthy Nutrition
- Clothing – Accessories
- Cosmetics

We also shared a list of required functions.

- Relaxing area
- Info desks (optional, depends on brand identity & scenario)
- Catering area (café, bar & bistro)
- Experience rooms (3 rooms)
- General Office Space for min. for 3 people
- Administrative Office
- Meeting Room (For Employees)
- Presentation Room Based on The Brand Identity (for customers/visitors)
- VIP Room (for customers/ visitors)
- Cashier, Selling/shopping area (optional, depends on brand identity & scenario)
- Multipurpose/Performance Hall including subspaces (depends on brand identity & scenario)
- Additional Function Based on the Brand Identity (Exhibition Etc.)
- Storage

This course continues in 14 weeks including 1 week for midterm jury. After 14 weeks, the final jury was held. During 14 weeks, the steps listed in Figure 1 were followed.

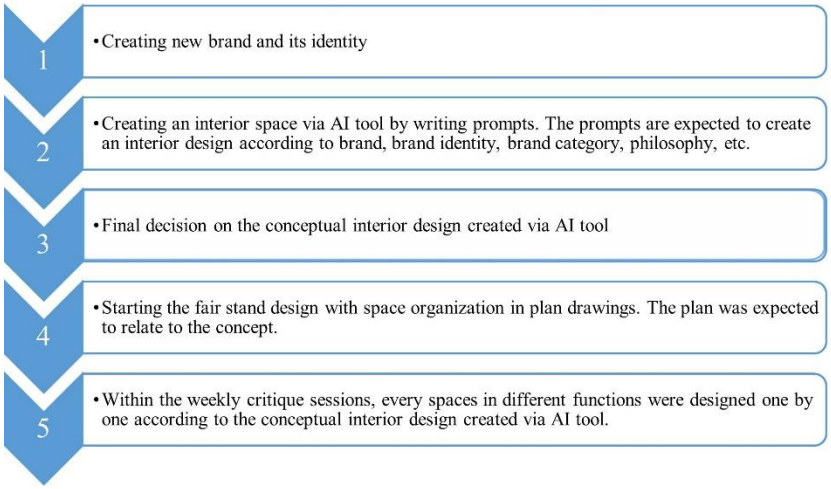


Figure 1: Fair stand design steps in the course.

One of the finalized projects is shown in one sample student project in **Table 1** and **Table 2**. The sample project is chosen since lighter colors are pre ferred in the design and since there is limited space for project renders and drawings, it would help with understanding. The student created a brand labeled 'Way' is specializing in snowboard equipment. Since she wanted to create a fair stand based on the idea of a ski slope in the snowy mountains, she wrote a prompt accordingly. Even though it is a weak prompt, she could able to get some conceptual images created via AI (**Table 1**). She completed the project with renders and total technical drawings from 1/50 to 1/1 in necessary detail after working on it for the entire semester. Some of the drawings and renders are shown in **Table 2**.

Prompt	Conceptual Images Created via AI
Snow and Sky, Triangular Shapes, Blue and White	

Table 1: Sample Project's Conceptual Images Created via AI and the Prompt.

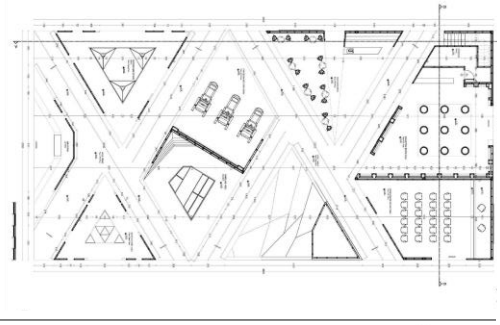
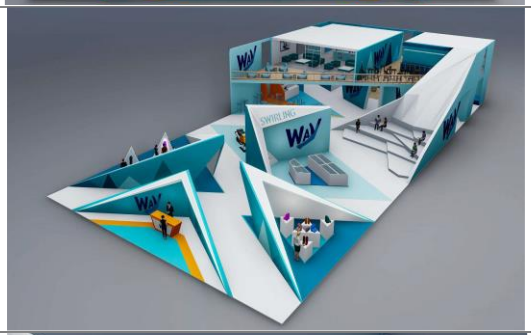
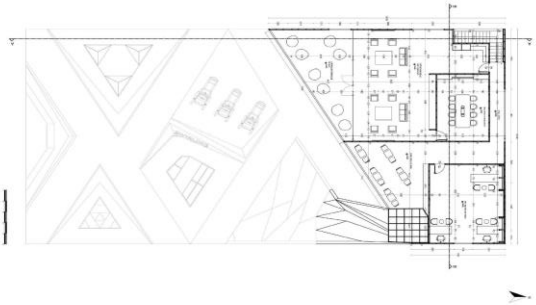
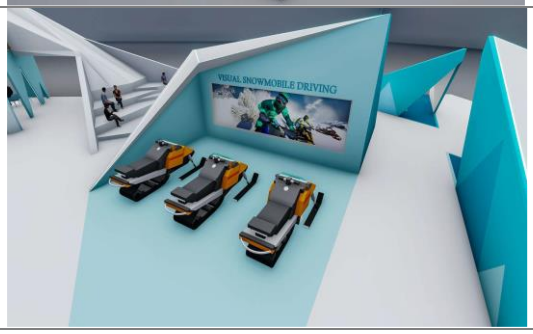
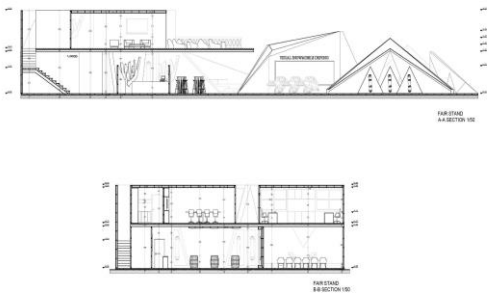
Renders	Some of the Technical Drawings
	
	
	

Table 2: Sample Project's Renders and Some of the Technical Drawings.

3.2. Evaluation Methodology & Criteria

For this study, Barnard's (1992) CAIDC (Consensual Assessment of Interior Design Creativity) rating scale, which evaluates aspects of the design merit of interior design solutions, was chosen. Barnard has identified different design aspects for evaluating interior design solutions, drawing inspiration from creative expressions in other fields. However, the term 'creativity' is often used without sufficient definition. Barnard aimed to develop an assessment tool, the Consensual Assessment of Interior Design Creativity (CAIDC), based on Amabile's assessment (1982, 1983) which is the Consensual Technique for Creativity Assessment, to evaluate interior design projects for their creativity and other design merits. The CAIDC provides a reliable way of rating the creativity and design merits of interior design projects.

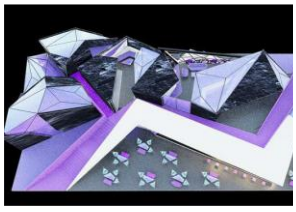
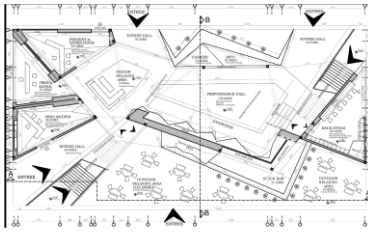
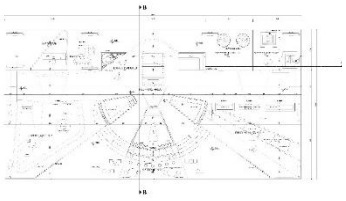
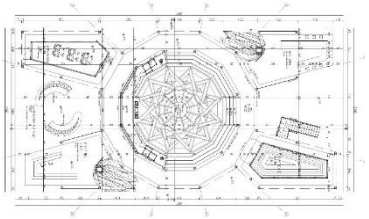
Barnard identified 12 design merit aspects (Barnard, 1992) which are aesthetic appeal, appropriateness, artistic merit, complexity, creativity, functionality, liking, novelty, originality, technical merit, thematic expression, and craftsmanship. From those 12 merits, only craftsmanship is eliminated since the craftsmanship skills shown in the presentation were not addressed in the study.

Barnard (1992) describes how we should understand any of the design merits to avoid misunderstanding. According to the descriptions, the course's 4 instructors evaluated and graded the projects based on the 11 merits by rating each project in both groups from 1 (lowest) to 9 (highest). The average of the grades given by the 4 instructors was calculated for each merit and project. This average grade was accepted as the project's score for that merit.

3.3. Subjects

This study focuses on 10 subjects, consisting of senior-level students (n=10) enrolled in an interior design studio course at Antalya Bilim University in Antalya/Turkey. The subjects were required to complete a fair stand design project, utilizing AI tools in the conceptual phase. There were 10 students in the course. While 5 students were able to write clear, detailed, and sufficient prompts, the rest of the 5 students wrote inadequate and shorter prompts. The detailing level determines whether a prompt is sufficient or insufficient. Superficial, not-detailed, general, and nonspecific prompts were considered insufficient prompts. Insufficient prompts result in artificial intelligence producing and presenting images in a somewhat random manner, with less designer influence.

Students who wrote sufficient prompts will be labeled as Group A, while those who did not write sufficient prompts will be labeled as Group B. The prompts, concept image created via AI, students' 3d model, and one of the technical drawings of the projects for Group A shown in Table 3, and for Group B are shown in Table 4.

Std No	Prompts	Conceptual Image Created via AI	Students' Interior Design Digital Model Developed According to the Conceptual Image	Students' Interior Designs' Technical Drawings
1	Geode Crystals, Reflection, Prismatic Forms, Crystal Cavity, Geological Structure and Formation, Crystal Ggrowth Patterns			
2	people. exploring showroom, cyberpunk,cubes, grid, lines, virtual reality, screens, interior, neon lights, metaverse, --ar 16:9			
3	Psytrance Neon light Ancient alien Highly detailed Perspective Dark place Techno music Stage Modern materials, Radial Symmetry			

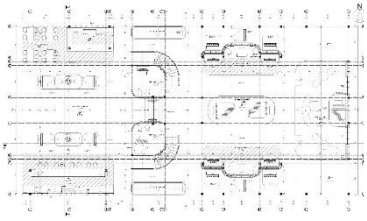
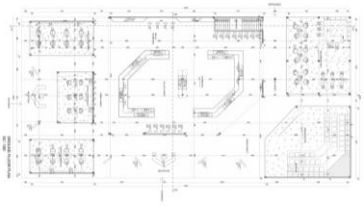
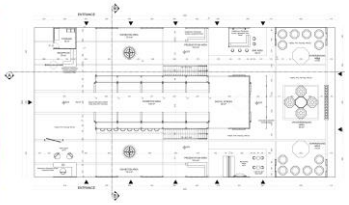
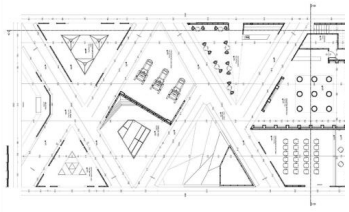
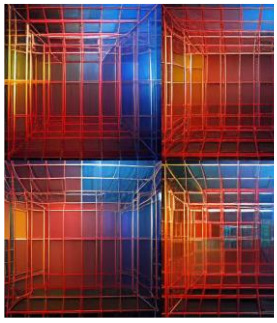
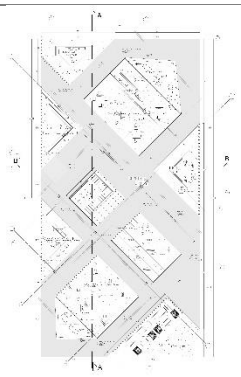
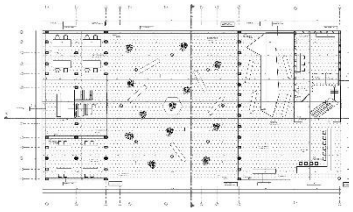
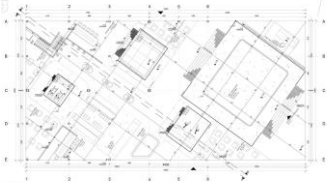
4	Modern, Opera, Dramatic Atmosphere, Elegant, Luxury, Glamorous, Sophisticate, Theatrical, Opulent and Chic Design			
5	Soft Pink, Soft Orange, Gold Details, Venesia, Showrooms, Platform, Jewelry, Display, Elegant, Luxury, Ancient, Gilded Accents, Exhibition			

Table 3: Group A Students' Conceptual Images Created via AI, Interior Design and Their Models and Technical Drawings.

Std No	Prompt	Conceptual Image Created via AI	Students' Interior Design Digital Model Developed According to the Conceptual Image	Students' Interior Designs' Technical Drawings
1	Gateway, Planets, Technology, Galaxy			
2	Snow and Sky, Triangular Shapes, Blue and White			
3	3D Grid System, Matrix Grid Plan, Color Psychology		 	
4	Costume, Fashion, Exhibition, Geometry, Fabric		 	
5	Dynamic Display, Purple, 360 Screen Coverage			

3.4. Hypotheses

In this study, the main question is whether artificial intelligence can take the place of an interior designer in the field of interior design. The limitation of the study is one type of AI tools which is from text to image ones. Additionally, AI will only be utilized during the conceptual stage of the design. According to the main problem and the limitations, twelve null hypotheses were tested:

H1. There is a significant difference between interior design projects created via sufficient, detailed, and insufficient prompts in the conceptualizing phase of the design.

H2: There is a significant difference in the merit ratings of design solutions conceptually created by AI by writing sufficient or insufficient prompts.

- Aesthetic appeal
- Appropriateness
- Artistic merit
- Complexity
- Creativity
- Functionality
- Liking
- Novelty
- Originality
- Technical merit
- Thematic expression

Table 4: Group B Students' Conceptual Images Created via AI, Interior Design and Their Models and Technical Drawings.

4. RESULTS AND FINDINGS

This study aims to compare the success levels of projects of students who have been able to write a sufficient prompt or not in the use of artificial intelligence tools during the conceptual phase in interior design. To conduct this comparison, due to the low number of subjects in the two groups, the Mann-Whitney U test, which is one of the nonparametric methods, was used.

Data analysis and data entries were provided to the SPSS 24 package program. No incorrect or incomplete data was found. The results of the Mann-Whitney U Test, which was conducted to examine whether the evaluation criteria used in the study differ statistically according to whether or not to write a good prompt or not, are given in Table 5.

	Situation	N	Order Average	Order Total	U	p
Aesthetic appeal	Group A	5	6,90	34,50	5,500	,151
	Group B	5	4,10	20,50		
	Total	10				
Appropriateness	Group A	5	5,10	25,50	10,500	,690
	Group B	5	5,90	29,50		
	Total	10				
Artistic merit	Group A	5	6,00	30,00	10,000	,690
	Group B	5	5,00	25,00		
	Total	10				
Complexity	Group A	5	5,70	28,50	11,500	,841
	Group B	5	5,30	26,50		
	Total	10				
Creativity	Group A	5	6,40	32,00	8,000	,421
	Group B	5	4,60	23,00		
	Total	10				
Functionality	Group A	5	5,30	26,50	11,500	,841
	Group B	5	5,70	28,50		
	Total	10				
Liking	Group A	5	6,00	30,00	10,000	,690
	Group B	5	5,00	25,00		
	Total	10				
Novelty	Group A	5	5,50	27,50	12,500	1,000
	Group B	5	5,50	27,50		
	Total	10				
Originality	Group A	5	4,80	24,00	9,000	,548
	Group B	5	6,20	31,00		
	Total	10				
Technical merit	Group A	5	5,30	26,50	11,500	,841
	Group B	5	5,70	28,50		
	Total	10				
Thematic expression	Group A	5	5,50	27,50	12,500	1,000
	Group B	5	5,50	27,50		
	Total	10				

Table 5: Mann-Whitney U Test Results.

Table 5 shows that there is no statistically significant difference in the mean criterion scores of students in terms of whether they wrote a good prompt or not for aesthetic appeal (U=5.500, p>0.05), appropriateness (U=10.500, p>0.05), artistic merit (U=10.000, p>0.05), complexity (U=11.500, p>0.05), Creativity (U=8.000, p>0.05), functionality (U=11.500, p>0.05), liking (U=10.000, p>0.05), novelty

(U=12.500, p>0.05), originality (U=9.000, p>0.05), technical merit (U=11.500, p>0.05), and thematic expression (U=12.500, p>0.05).

5. CONCLUSION

With this study, we understand that there is no significant difference between writing sufficient or insufficient prompts in the concept development phase of the interior design projects according to the Barnard (1992)'s design merits. This means that whether or not a sufficient prompt is written has no impact on any of the chosen criteria for this study in an interior design project. Because AI is just a tool. The important thing, as in this study, is how the professional interior architect or interior architecture student interprets this image and offers technical solutions and suggestions. Additionally, when the AI image generator is used as a design tool for interior design concept creation, we observed that the sufficient or insufficient prompts created by the students which directly affect are not factors in the adaptation of the created concept to the overall space.

We understood that the main factor that makes an impact in this regard is the 'concept analysis' required to adapt the concept produced with AI to the given project spaces. It can also be stated that the important thing is to understand the design style, which includes design principles, elements, color & material combination, lighting, general ambiance, and so on that are shown in conceptual images created using AI, as well as the ability to capture the same design style independently for different function and size spaces that are not shown in the conceptual image.

According to the findings of this study, AI tools are understood to be new tools that help in communication in interior design and do not have a significant impact on the creativity and design merits of the design. When we look at the history of interior design, we can see that the first interior designers could only draw by hand and digital tools were not available as a tool. As time passes, new digital tools are developed, and almost all interior designers now communicate using computer-aided drawing and modeling tools. Today, we live in the AI era and it appears that AI will be a useful tool for interior designers, but it will not have a significant impact on design. What matters is that the designer/AI user

STAGES OF THE PROCESS	1-PROGRAMMING / RESEARCH	2-SCHEMATIC DESIGN/ CONCEPT FORMATION	3-PRELIMINARY DESIGN/ CONCEPT DEVELOPMENT	4-DESIGN DEVELOPMENT / IDEA PRESENTATION
PURPOSE:	To identify the problem	to generate ideas by synthesizing previously determined project information	to analyze, develop and refine previously generated ideas	To present refined problem solutions to the client in order to obtain approval for further development
	To identify known facts			
	To outline project requirements			
PRIMARY COMMUNICATION METHODS:	**Graphic, written and verbal: Techniques used to identify, define and seek information:**	**Informal graphics and verbal:**	**Informal graphics and verbal communication:**	**Formal and/or informal graphics, and verbal communication:**
	Correspondence	Bubble diagrams	Orthographic drawings	Orthographic drawings
	Client interviews	Freehand sketches	Plans	Axonometric drawings
	Photographs	Loose orthographic drawings	Sections	Perspective drawings
	Existing project drawings	Brainstorming	Elevations	Rendering
	Analytical illustrations	Tracing	Detail drawings	Tonal value
	Techniques used to convert, evaluate and break down information:		Axonometric (paraline) drawings	Shade and shadow
	Bubble diagrams		Isometric	Color
	Flowcharts		Plan oblique	Verbal descriptions
	Matrix		Elevation oblique	
	Bargraphs		**Perspective drawings:**	
	Analytical photo-sketches		One-point	
			Two-point	
PRIMARY COMMUNICATION ORIGINATED BY:	Client and Designer	Designer	Designer and Other Professionals	Designer
DIRECTED TO:	Designer and Client	Himself	Client	Client

understands the created images and applies them to the interior design.

Rey-Barreau & Whiteside (1983) defines different types of stages of communication in interior design. In Table 6, we only show the stages where the AI tool focused on this study can be implemented.

Table 6: The Stages of the Interior Design Project Process which the AI Tools Focused on in this Study can be Implemented (Ray-Barreau & Whiteside, 1983)

The results also show the role of AI as a tool in aiding verbal description and translation of concept spaces into visual representations. By incorporating AI into the interior design curriculum, students can acquire essential 21st Century Skills and improve their communication abilities.

To sum up, the main problem of the study is whether artificial intelligence can take the place of an interior designer in the field of interior design. In this study, we only focus on text to image AI tools and only used in the conceptual phase in design. We understood that AI can only be a tool like Autocad, Photoshop, 3ds Max, or any other digital tool which helps the designer in drawing or visualizing. It appears that there won't be a suitable interior design project without the designers' comprehension of the style of the space from the conceptual image generated via AI. We should integrate AI into the curriculum in the same way that we integrate digital modeling and drawing tools to give students the 21st Century Skills they need to succeed.

This study aimed to create a spatial concept image that is created by prompts via AI tools. Since this method does not always produce satisfactory results for the users, hybrid methodologies in AI should also be compared for further studies like the ‘imagine’ tool which is writing a prompt, ‘blend’ tool which give the AI some images to blend them or the mixed usage of these tools.

Furthermore, AI tools are rapidly evolving. When this study is repeated with the same methodology in the future, the results will be different. Last but not least, in this study, we only focus on verbal communication to create image-based AI tools. AI tools of various types may have a significant impact on the interior design profession. As a result, it is critical to research them as well.

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The article complies with national and international research and publication ethics. Ethics Committee approval was not required for the study.

Conflict of Interest Statement

The authors of the study declare that there is no financial or other substantive conflict of interest that could influence the results or interpretations of this work.

Author Contribution

The authors stated that M.U.K contributed 40%, Y.Ş., M.D. and F.K. each contributed 20% to the article.

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