THE IMPACT OF AI ON ARCHITECTURAL CREATIVITY: A COMPARATIVE ANALYSIS OF CREATIVITY LEVELS

Mine Batal Mirkan[1], Lütfiye Yılmaz[2]
[1] İstanbul Yeni Yüzyıl Üniversitesi, Mühendislik Mimarlık Fakültesi, Mimarlık Bölümü, İstanbul, Türkiye
[1] mine.batal@yeniyuzyil.edu.tr
[2] İstanbul Yeni Yüzyıl Üniversitesi, Mühendislik Mimarlık Fakültesi, Mimarlık Bölümü, İstanbul, Türkiye
[2] lutfiye.yilmaz@yeniyuzyil.edu.tr

ABSTRACT

Design, traditionally considered a process based on human creativity, is now being reshaped with the integration of AI-supported tools. Especially in dealing with ill-defined problems, the architectural design process, traditionally relying on human intuition and creative thinking, gains a new dimension through the automation and data power provided by AI. Numerous studies explore the role of artificial intelligence in creative disciplines, addressing both the advantages and disadvantages of AI. However, the interaction between human intuition and the data richness provided by AI, and how this interaction changes according to individual creativity levels, has not yet been fully investigated. This study examines the impact of AI-supported design tools on architectural creativity through a comparative analysis, contrasting them with traditional sketching methods based on different creativity levels. The study's primary hypothesis is that AI-supported design tools affect the creative process in ways that differ from traditional sketching methods, and that the extent to which AI-supported design tools make the design process more efficient and creative may be related to the creativity levels of individuals. Furthermore, it is hypothesized that AI-supported design may have different effects on creativity parameters (originality, appropriateness, and aesthetic value) compared to traditional sketching methods. To determine participants' initial creative potential, George Land's Creativity Test was used, and Amabile's Consensual Assessment Technique (CAT) was employed to evaluate design outputs. Participants, who were balanced according to their creativity scores, were divided into two groups and completed two different design tasks using traditional sketching and AI-supported design methods.

The findings revealed that students with lower creativity scores performed better in AI-supported design, but no direct correlation was found between the creativity test scores and the design tool used. The study also showed that AI-supported design increased originality but scored lower on appropriateness compared to traditional sketching methods. No significant difference was found between the two methods in terms of aesthetic value. This research highlights the advantages and limitations of integrating AI into the architectural design process, offering valuable insights into how the creative process is shaped. The results provide important information on how AI-supported design can be used more effectively in educational and professional contexts in the future.

Keywords: Creativity, DALL-E, assisted creation tools, artificial intelligence, design education.

1. INTRODUCTION

Architectural practice is a dynamic field that continuously evolves with technological advancements. Traditionally regarded as a process based on human creativity, design is now being reshaped through the integration of artificial intelligence (AI)-assisted tools.

Particularly in dealing with ill-defined problems, the architectural design process, which has traditionally relied on human intuition and creative thinking, has gained a new dimension with the automation and data power provided by AI (Oxman, 2017).

There are various perspectives on the role of AI in creative disciplines. Some researchers argue that AI-based design tools may limit creative thinking and threaten the originality of designers (Gero & Maher, 1993; Boden, 1998), while others assert that these technologies accelerate the design process, increase productivity, and foster creative discoveries (Kowaltowski et al., 2010; McCormack & d'Inverno, 2014). In particular, the wide range of alternatives offered by AI in the early stages of design has become a new source of inspiration for architecture students and professionals. However, the interaction between human intuition in creativity and the data richness offered by AI, and how this interaction varies based on individual creativity levels, has yet to be thoroughly explored. The central hypothesis of this study is that AI-assisted design tools affect creative processes in different ways compared to traditional sketching methods, and that while AI-supported design tools make the design process more efficient and creative for individuals with low creativity levels, they do not provide a significant advantage for individuals with high creativity levels or may even limit the creative process.

Boden (2004) has approached creativity through combinatorial, exploratory, and transformational processes. The Geneplore model developed by Finke, Ward, and Smith (1992) posits that the creative process consists of exploratory and generative phases. In this context, it is suggested that AI tools, particularly for individuals with lower levels of creativity, can enhance cognitive expansion during the exploratory phase, thus increasing creative potential (Sarkar & Chakrabarti, 2008). However, it is also argued that for highly creative individuals, these tools may restrict their originality due to excessive external guidance (Candy & Edmonds, 2002; Biskjaer et al., 2019). Based on this, it is hypothesized that highly creative individuals will not experience any change, or even a negative effect, on the creativity of their designs when working with AI support, while individuals with lower creativity levels may produce more creative results with the aid of AI.

This study will explore whether there are significant differences between traditional sketching methods and AI-assisted design processes and will evaluate which method yields more creative and productive results based on designers' creativity levels. Sketching is considered a cognitive tool in the architectural design process, playing a crucial role in problem discovery and solution development (Goldschmidt, 1991; Suwa & Tversky, 1997). Therefore, both traditional sketching methods and the use of AI in conjunction with sketching will be assessed. This research aims to contribute to understanding how AI affects the creative process in architectural design. By examining how individuals with varying levels of creativity interact with AI-assisted tools and the impact on design outcomes, the study will provide a new perspective on how AI technologies can be positioned in architectural design education and professional practice.

2. LITERATURE REVIEW

Sketching is a fundamental human activity widely used to generate conceptual and creative ideas and overcome complex design obstacles (Goldschmidt, 1991, 2017). Sketching, being open-ended and intuitive, creates an opportunity for architects to unleash their

creativity, leading to the organic and natural emergence of spontaneous ideas and concepts. According to Dorst, sketching allows for a clearer understanding of complex design problems through both conscious and unconscious processes (Dorst & Cross, 2001). Designers can better define the boundaries of the problem and simultaneously explore solutions through sketching. Similarly, Donald Schön introduces the concept of "Reflection-in-action" in design thinking (Schön, 1983). Sketching enables the designer to think about the drawing while drawing it. This situation supports the iterative nature of the creative process by turning it into a dialogue. Goldschmidt's concepts of "Seeing as" (imagination and visual thinking-perception) and "Seeing that" (analytical and critical perception) also reveal the creative and analytical dimensions of the design process (Goldschmidt, 1991). These concepts provide a critical framework for understanding how designers think, perceive, and solve problems, especially while sketching. The dynamic interaction of these two mechanisms in the design process leads to the emergence of innovative and functional designs.

With the development of artificial intelligence, assisted creation tools that have emerged and found their place in architectural practice have become popular among designers. However, the widespread use of these tools has not entirely replaced traditional sketching, as it brings several advantages and disadvantages.

AI applications, especially in the concept phase, offer a wide range of design ideas, allowing designers to develop new strategies (Zhou, 2021). However, these systems may sometimes fail to adequately understand the contextual and human dimensions of design problems (Zhang, 2023) and may produce surreal outcomes. It also brings dangers such as restricting the designer's thinking and stifling creativity. Since the acts of drawing and thinking cannot occur simultaneously, an iterative dialogue does not form.

While sketching offers the possibility to define and solve undefined problems simultaneously, digital design methods often require a well-defined problem. This can limit the exploration process. Sketching is a method that people have consciously or unconsciously used since childhood, whereas digital design methods are directly related to individuals' usage capacity. In relation to all these, researchers examining more recent developments argue that sketch-based AI can contribute to achieving inspiring design outcomes (Römer, 2001). In this context, sketch-based AI design produces content through hand-drawn sketches, combining the two tools.

Table 1. Advantages and difficulties of sketch and ai

	Advantages	**Difficulties**
Sketch	*Assisting creativity and intuition (Robertson vd., 2007; Van Elsas & Vergeest, 1998; Verstijnen vd., 1998)	*Being inadequate when dealing with complex issues (Lin, 2003).
	Rapid idea generation (Utterback vd., 2006)	
AI	*Providing users with a wide range of design ideas (Zhou, 2021)	*Inadequacy in understanding technical terms (Zhang's, 2023)

	*Helping designers identify potential strategies (Zhang, 2023)	* Sometimes it can produce surreal images (Zhang, 2023)
	* Providing conceptual sketches in the early design stage (Zhou, 2021)	

The integration of AI-assisted design tools with traditional sketching in architectural practice facilitates a dynamic design process that enhances creativity and problem-solving capabilities. While digital tools contribute to the modernization of the design process, traditional sketching continues to hold significant value, particularly during the early conceptual phases. Consequently, in the context of this study, sketching is regarded as a permanent element of the design process and is examined as an integral part of the AI-assisted design methodology.

Creativity is defined as the process of generating new and original ideas, and two fundamental cognitive thinking styles stand out in this process: divergent thinking and convergent thinking (Guilford, 1956). These two concepts play complementary roles in problem-solving and design processes. Divergent thinking is a cognitive process that allows an individual to generate many different solutions to a problem or issue (Runco, 2014). Divergent thinking is often supported by methods such as brainstorming, free association, and looking from different perspectives. Its characteristics can be summarized as follows: Flexibility (developing multiple perspectives), Fluency (speed and quantity of idea generation, Originality (finding unique and unconventional solutions) and Elaboration (developing and diversifying ideas).

Divergent thinking is at the heart of creative processes, especially in the fields of design, art, and architecture (Finke, Ward & Smith, 1992). For architects, this process is directly related to generating different solutions, developing new concepts, and creating original forms when faced with a design problem. Therefore, in order to analyse the effects of using artificial intelligence on the design process within the scope of this study, George Land's creativity test, which measures creativity levels through divergent thinking skills, was administered to the participants. George Land’s Creativity Test was originally developed for NASA in 1968 and was later expanded to assess creativity in education and business fields (Land & Jarman, 1992). The test focuses on individuals’ ability to generate divergent and original solutions (Runco & Acar, 2012). In this context, when examining the impact of artificial intelligence on the design process, Land’s test parameters provide a framework for evaluating how creative thinking skills are influenced. Land’s test includes eight key parameters for assessing creativity (Land & Jarman, 1992) (Table 2).

Table 2. Parameters of George Land’s Creativity Assessment (Land&Jarman,1992)

Parameter	**Description**
Abstraction	The ability to simplify complex ideas and identify their fundamental elements.
Connection	The capacity to establish relationships between seemingly unrelated concepts or objects.

Perspective	The ability to approach problems or situations from different angles.
Curiosity	A strong desire to acquire new knowledge and explore possibilities.
Boldness	The willingness to take risks and embrace uncertainty in creative processes.
Paradox	The ability to recognize and reconcile contradictory ideas.
Complexity	The skill to think in multi-dimensional and intricate ways.
Persistence	The determination to pursue a goal despite obstacles and setbacks.

To evaluate the creativity levels of the designed products, Teresa M. Amabile's Consensual Assessment Technique (CAT) model was used. CAT is a method for evaluating creative works based on the collective judgment of expert jurors (Amabile, 1982). This method suggests that creativity cannot be objectively measured but rather assessed through expert evaluations. In the context of this study, CAT provides a structured framework for evaluating the differences between AI-assisted and traditional sketch-based design processes among architecture students. Creativity is inherently subjective, but Amabile's model ensures reliable measurement by correlating the independent assessments of multiple jurors (Hennessey et al., 2011). Since this research aims to compare design outputs generated with and without AI support, CAT serves as an essential evaluation tool by determining which designs are perceived as more creative by experts. Amabile's model is based on three fundamental parameters for evaluating creative outputs (Amabile, 1982).

Table 3. Parameters of CAT (Amabile,1982)

Parameter	**Definition**
Originality	The degree to which a design is novel, unique, and creative.
Appropriateness	The extent to which the design meets functional and contextual criteria.
Aesthetic Value	The visual and artistic impact of the design.

By integrating these parameters, the study will be able to analyse how AI influences creativity in architectural design and compare the expert evaluations of both AI-assisted and traditional sketch-based projects. Creativity assessment in the design process relies on different methodological approaches to measure specific aspects of creative thinking. George Land's Creativity Test evaluates individuals' divergent thinking abilities, while Amabile's Consensual Assessment Technique (CAT) determines how a design output is perceived by experts in terms of creativity, appropriateness, and aesthetic value. The integration of these two models in this study allows for a comprehensive analysis of creativity from both an individual cognitive perspective and an external evaluative standpoint. While Land's test measures the creative potential of designers, CAT assesses the perceived creative value of their design outputs based on expert opinions. This dual approach highlights that creativity is not only an internal cognitive process but also shaped

by contextual evaluations of the final design outcomes. This enables a more comprehensive understanding of whether AI-assisted design processes enhance creativity and how this enhancement is reflected in the final design outputs.

2. METHODOLOGY

This study employs a mixed-methods approach to evaluate the impact of AI-assisted design tools on creativity in architectural design. The methodology consists of five key stages, integrating Land's Creativity Test and Amabile's Consensual Assessment Technique (CAT) to assess both individual creative potential and expert-evaluated creative outcomes (Table 4). To test the hypothesis, 9 architecture students from different classes were selected since design habits and methods were not yet fully developed. All of these students volunteered to participate in the study.

Table 4. Five key stages, integrating Land's Creativity Test and Amabile's Consensual Assessment Technique (CAT)

Stages			**Explanations**
Stage 1	Measuring the creativity levels of participants with the Creativity Test		Participants' creative thinking skills and total divergent thinking score are measured with George Land's Creativity Test.
Stage 2	Introduction of DALL-E 2.0 as AI application		Students are trained on the use of DALL-E 2.0, an artificial intelligence application.
Stage 3	Design Applications		Participants are divided into two groups, ensuring a balanced distribution based on their creativity levels, and are subsequently referred to as Group 1 and Group 2.
		Task 1	Group 1 is asked to design a dog kennel using only the traditional sketching method, while Group 2 is asked to design a dog kennel with AI support.
		Task 2	Group 2 is asked to design a work capsule using only the traditional sketching method, while Group 1 is asked to design a work capsule with AI support.
Stage 4	Expert Evaluation Using CAT		Designs are evaluated by expert juries using Amabile's Consensual Assessment Technique (CAT) based on three main creativity parameters: Originality, Appropriateness and Aesthetic Appeal.
Stage 5	Comparative Analysis of Creativity Scores		A comparison of creativity testing and expert assessments (CAT scores) is performed. This allows comparing the creative effects of AI-assisted and traditional sketching methods. The relationship between participants' test results and their designs is analysed.

2.1. Creativity Test for Initial Assessment

To establish a baseline for participants' creative potential, George Land's Creativity Test (Land & Jarman, 1992) is administered. This test assesses divergent thinking abilities, which are essential for generating multiple innovative solutions in design (Runco, 2014). The results of this test serve as a comparative measure when analysing AI-assisted and traditional sketch-based design processes.

2.2. Introduction of DALL-E

DALL-E 2.0, one of the generative artificial intelligence tools, was chosen to be used in the design process due to its easy membership creation process, the right to create 10 prompts at first use, and the ease of interface. In the second stage, students were introduced to DALL-E 2.0 and were trained on the use of basic level commands such as creating prompts, determining variations, and making regional changes. It was preferred that participants had not previously used DALL-E, as prior use of the program was considered an advantage.

2.2. Design Applications

Following the creativity test, participants are randomly divided into two groups, ensuring an even distribution of creativity levels based on the test results: Group 1 and Group 2. This grouping allows for a controlled comparison between traditional sketch and AI-assisted design methods. Given that the context-based capabilities of AI are not yet sufficiently developed, and to ensure that the students' prior knowledge of the place does not influence the study, two context-free spatial designs were selected as case studies: dog kennel and the work capsule. Participants were allotted 15 minutes for each spatial design.

1. As the case study was conducted in the same workshop, Group 1 was instructed to design a doghouse using only traditional sketching method, while Group 2 was tasked with designing a doghouse with AI assistance. This approach was used to prevent students from pre-conceptualizing the other group's design problem before moving on to the next stage."

2. In the second phase, Group 2 is asked to design a work capsule using only the traditional sketching method, while Group 1 is asked to design a work capsule with AI support.

Traditional sketching method aligns with Schön's (1983) "reflection in action" framework, which emphasizes how sketching enables iterative creative thinking. The use of traditional sketching alone encourages conceptual exploration and problem-solving (Goldschmidt, 1991). In AI-assisted design method, sketching is not completely excluded; instead, its use with sketching is evaluated to examine how these two approaches interact. This study aims to investigate the advantages and disadvantages that AI brings to the design process, not by eliminating sketches, but by understanding how human-AI collaboration shapes the creative process. Previous research suggests that AI can expand design alternatives but also limit the active cognitive participation of the designer (Zhou, 2021; Zhang, 2023).

2.4. Expert Evaluation Using CAT

All design outputs, both traditional sketch based and AI-assisted designs, are evaluated by **three** expert jurors using Amabile's Consensual Assessment Technique (CAT) (Amabile, 1982). The evaluation is based on three key creativity parameters: Originality (The novelty and uniqueness of the design), Appropriateness (How well the design meets functional and contextual criteria) and Aesthetic Value (The visual and artistic appeal of the design).

2.5. Comparative Analysis of Creativity Scores

The final stage involves comparing: Participants' initial creativity test scores (Land's test) and expert evaluations of their traditional sketch-based and AI-assisted designs (CAT scores). This comparison reveals whether AI assistance enhances or constrains creativity, and whether individual creative potential (as measured by the test) correlates with expert-assessed creative output. Such comparative approaches have been used in previous studies examining the relationship between cognitive creativity and external design evaluation (Finke, Ward & Smith, 1992; Römer, 2001).

Table 5. Comparative analysis of Creativity Scores

		Student	S1	S2	S3	S4	S5	S6	S7	S8	S9	Average
George Land's Parameter		Score	83.6	80.2	75.7	72.6	67.3	67.1	60.9	60.7	59.4	69.7
		Abstraction	60	60	55	50	40	45	40	50	40	48.8
		Connection	55	55	50	45	40	55	35	40	45	46.6
		Perspective	50	50	40	50	45	45	45	45	35	45
		Curiosity	80	80	80	75	55	60	70	65	55	68.8
		Boldness	85	65	85	65	55	50	45	50	55	61.6
		Paradox	80	80	60	70	70	70	45	50	45	63.3
		Complexity	75	65	60	65	65	65	55	55	45	61.1
		Persistence	55	50	50	35	50	35	30	25	35	40.5
Originality	Originality (Traditional Sketch Based Design)	J1	80	90	75	90	90	70	50	80	60	76.1
		J2	80	75	70	65	90	65	50	90	65	72.2
		J3	85	70	90	90	75	70	50	80	90	77.7
		Average	81.6	78.3	78.3	81.6	85	68.3	50	83.3	71.6	67.5
	Originality (AI Assisted Design)	J1	80	85	90	55	90	70	65	90	75	77.7
		J2	95	65	90	50	90	55	60	85	75	73.8
		J3	100	70	100	70	90	80	70	90	90	84.4
		Average	91.6	73.3	93.3	58.3	90	68.3	65	88.3	80	78.3
Appropriateness	Appropriateness (Traditional Sketch Based)	J1	95	70	70	70	90	90	80	80	65	78.8
		J2	85	75	80	60	80	50	60	80	70	71.1
		J3	80	50	90	80	80	80	50	80	70	73.3

		Average	86.6	65	80	70	83.3	73.3	63.3	80	68.3	73.7
	Appropriateness (AI Assisted)	**J1**	95	50	90	65	70	50	85	50	80	70.5
		J2	95	45	85	40	80	40	70	40	70	62.7
		J3	90	60	100	60	90	60	60	80	85	76.1
		Average	93.3	51.6	91.6	55	80	50	71.6	56.6	78.3	61.6
Aesthetic Appeal	**Aesthetic Appeal (Traditional Sketch Based Design)**	**J1**	80	65	75	75	90	60	40	60	60	67.2
		J2	80	65	70	55	90	50	50	70	70	66.6
		J3	85	60	80	85	85	70	55	90	85	77.2
		Average	81.6	63.3	75	71.6	88.3	60	48.3	73.3	71.6	67.5
	Aesthetic Appeal (AI Assisted)	**J1**	80	55	90	55	80	50	55	40	80	65
		J2	90	45	90	40	80	50	60	40	70	62.7
		J3	100	60	90	75	90	85	50	70	85	78.3
		Average	90	53.3	90	56.6	83.3	61.6	55	50	78.3	71.2
AVERAGE SUCCESS OF TRADITIONAL SKETCH BASED DESIGN			83.2	65.5	77.7	74.4	82.7	67.7	53.8	63.9	73.8	71.4
AVERAGE SUCCESS OF AI ASSISTED DESIGN			91.6	62.7	91.6	56.6	87.2	62.7	63.8	70.5	78.8	73.9

No correlation was found indicating that the creativity scores obtained by students from George Land's creativity test affected the design tool with which they were more creative. Although the design tools used by students with high creativity scores varied, it was observed that as creativity scores decreased, success in AI-assisted designs increased. The number of observed students is quite low to make a generalization, but it has the potential to provide foresight for future studies.

Out of 9 students, only 2 produced more original designs with traditional sketch-based design, while 7 did so with AI-assisted design. AI helps students create more innovative designs. No significant correlation was found between the design tools and other evaluation criteria.

When analysing students' average performance in each design criterion, the originality score for AI-assisted design is 78, while for traditional sketch-based design it is 67. AI's use of a vast database gives it an advantage in creating innovative designs. The appropriateness score is 61 for AI-assisted design and 74 for traditional sketch-based design. The much higher level of detail in the sketches of traditional sketch-based designs compared to AI-assisted design drawings confirms the results. The system thinking in designs created with Dall-e is gradually weakening.

When the scores obtained from the jury members are examined along with George Land's creativity parameters, a positive relationship is observed especially between the boldness feature and AI-assisted design scores. Students who are bolder in changing norms may have been more comfortable thinking outside the box while expressing themselves through words on the AI platform.

3. CONCLUSION AND EVALUATION

This study examines the impact of AI-assisted design tools and traditional sketching methods on the design processes of architecture students based on their creativity levels. The findings indicate that students' overall creativity scores are not directly correlated with the design tool in which they perform more creatively. However, students with lower creative thinking abilities were observed to achieve better results in AI-assisted design processes. This suggests that AI can serve as a supportive tool for individuals with lower creative thinking skills.

From the perspective of originality, the majority of students produced more innovative and unique results in the AI-assisted design process. This finding aligns with previous research, supporting the notion that AI can foster creativity by offering a broad range of design alternatives (Zhang, 2023). However, in terms of appropriateness, traditional sketching was observed to support systematic thinking and problem definition more effectively while also facilitating a more refined approach to contextual and functional design elements. Goldschmidt's "seeing as, seeing that" dynamic highlights the significance of interactive processes in design, which AI struggles to fully support, particularly in relation to systematic thinking. In addition to this, no significant correlation was found between the two methods in terms of aesthetic value (Goldschmidt,1991).

Moreover, among the students who participated in the study, those with higher boldness levels exhibited a tendency to produce more creative designs in AI-assisted design processes compared to traditional sketching. This finding suggests that design students may feel more liberated and inclined to take bolder design decisions when expressing their ideas through verbal prompts on AI platforms. This highlights that AI tools may assume different functions for designers with varying individual characteristics.

The findings of this research provide significant insights into how AI-assisted design tools should be positioned in architectural education. AI can be utilized as a support mechanism in the design process for students with lower creativity levels. However, a balanced integration of traditional sketching and AI-assisted tools may contribute to enhancing students' cognitive flexibility and fostering more comprehensive design skills.

The conclusions of this study are based on a limited sample, and expanding the participant group in future studies could improve the generalizability of the findings. Further research could explore the long-term effects of AI-assisted design on architectural practice by including architecture students at different levels as well as professional architects. Additionally, future studies could investigate different ways of integrating AI tools into the design process and examine their varying impacts on creativity.

In conclusion, this study demonstrates the impact of AI-assisted design on creative processes and provides valuable insights into how human-AI collaboration may evolve in the future. While AI tools accelerate the creative visualization process, they may also weaken systematic thinking. Therefore, further research is needed to explore how AI tools can be more effectively utilized in design education and how they can be further developed to support creative processes in architectural practice.

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