SCIENTIFIC CULTURE
www.sci-cult.com

SCIENTIFIC CULTURE, Vol. 12, No. 2.1, (2026), pp. 13714-13743
Open Access. Online & Print

DOI: 10.5281/zenodo.20462372

# THE IMPACT OF EMPLOYING ARTIFICIAL INTELLIGENCE TOOLS ON THE DESIGN IDEATION PROCESS: AN ANALYTICAL STUDY OF INTERIOR DESIGN PROJECTS AMONG FEMALE STUDENTS IN THE INTERIOR DESIGN DEPARTMENT AT KING ABDULAZIZ UNIVERSITY

**Mona Manahi Al-Balawi, and Hadeel Diaa El-Din Ayoub**

*[1]Master's student in the Department of Interior Design and Furniture*
*King Abdulaziz University, Jeddah, Saudi Arabia malbalawi0071@stu.kau.edu.sa*
*ORCID id: 0009-0007-7352-025X*
*[2]Assistant Professor in the Department of Interior Design*
*King Abdulaziz University, Jeddah, Saudi Arabia. hayyoub@kau.edu.sa*
*ORCID id: 0009-0005-6451-673X*

*Received: 04/04/2026*
*Accepted: 20/05/2026*

*Corresponding Author: Mona Manahi Al-Balawi e (malbalawi0071@stu.kau.edu.sa)*

## ABSTRACT

*This study aimed to analyze the impact of employing artificial intelligence tools on the process of design ideation among female students in the Interior Design and Furniture Department at King Abdulaziz University. It compared traditional ideation methods with AI-supported ideation and examined changes in the quality of design ideas in terms of originality, innovation, user-centeredness, and feasibility. The study also explored the challenges associated with the use of these tools within an educational context. The study adopted an applied descriptive approach using a qualitative methodology. It was conducted on a purposive sample of 29 students enrolled in the "Studio 5" course. A case study approach was employed by tracking the development of students' design ideas across two consecutive stages: the traditional ideation stage, which relied on conventional methods without artificial intelligence tools, and the AI-supported ideation stage, which utilized artificial intelligence tools to support and expand the development of design concepts. The outputs of both stages were systematically documented and analyzed to identify shifts in thinking patterns, approaches to problem-solving, and the qualitative differences in design outcomes. The findings indicated that the use of artificial intelligence tools contributed to expanding the scope of visual inspiration, accelerating the generation of design alternatives, and enhancing innovation as well as the reformulation of the design problem. A noticeable improvement was also observed in the clarity, coherence, and originality of design ideas. User-centeredness remained weak across both phases and was not meaningfully improved by AI tool use. However, the results revealed several challenges, including the risk of over-reliance on generated outputs, a diminished human and cultural dimension in some concepts, and the need for critical digital skills among students. The study recommended the systematic and well-structured integration of artificial intelligence tools into interior*

***design curricula, with emphasis on the designer's role as an active agent in guiding the creative process. It also highlighted the importance of developing guidelines and clear evaluation criteria for using these tools during the ideation phase. Future research was suggested to examine the impact of artificial intelligence on other stages of the design process.***

**KEYWORDS:** Design Inspiration, Generative Artificial Intelligence Tools, Design Ideation, Interior Design.

## 1. INTRODUCTION

In an era marked by accelerated knowledge transformations and the growing convergence between human creativity and machine capabilities, interior design is no longer a purely formal practice limited to organizing or beautifying spaces. Rather, it has evolved into profound intellectual practice that reshapes the relationship between humans and their environments. At the core of this practice lies the moment of design ideation, which serves as the initial spark from which the design vision emerges and through which the dimensions of meaning, function, and aesthetics are formed. With the emergence of artificial intelligence tools as a new partner in the creative process, designers now stand at a critical crossroads: between human intuition rooted in experience and awareness, and algorithms capable of generating endless alternatives within a short time. This dynamic intersection opens unprecedented horizons for creativity, while simultaneously raising fundamental questions regarding the nature of inspiration, the boundaries of originality, and the role of the designer in an era where ideas are no longer solely products of the human mind, but rather the outcome of an ongoing dialogue between humans and technology.

Over recent decades, rapid technological advancements have significantly influenced how interior design is practiced. Regardless of the field of application—whether residential or commercial—designers are now required to integrate traditional design skills (such as a harmonious sense of décor and color, knowledge of furniture styles and window treatments, and the ability to produce sketches) with proficiency in advanced visualization and project management software. Programs such as SketchUp, AutoCAD, and Revit enable designers to quickly produce realistic two- and three-dimensional representations, allowing clients to better visualize spaces and products. Furthermore, computer technologies enhance design development and project management efficiency by providing a shared communication platform among clients, design teams, and contractors.

The design process has also become increasingly collaborative, allowing for greater accuracy in solutions and minimizing errors, while involving clients in decision-making at every stage. Web-based applications such as Pinterest, along with AI-powered platforms, enable designers and clients to collaboratively develop inspiring aesthetic visions for future spaces through the creation of mood boards and digital collections that include furniture elements, color palettes, patterns, fabrics, accessories, and architectural features. These technological advancements in data collection and management, combined with synchronous video conferencing, have facilitated the emergence of e-design practices, where services are delivered entirely online. Such practices became particularly widespread during the pandemic.

According to industry experts, e-design represents a long-term trend with the potential to become one of the most profitable business models. The rise of the do-it-yourself (DIY) consumer, shifts in purchasing behaviors and preferences, and the widespread accessibility of lifestyle retail stores such as RH (formerly Restoration Hardware), Room & Board, and Williams Sonoma, in addition to online-exclusive platforms like Wayfair, have contributed to significant transformations in the traditional interior design business model. These changes extend to service delivery mechanisms and designer compensation structures, particularly regarding finishing materials and furniture procurement—trends discussed in detail in Chapter 12 (Chen et al., 2023).

Inspiration constitutes the essence of the creative process across various design disciplines and serves as the primary driver for generating ideas and transforming them into innovative and feasible design solutions. It is defined as a motivational mental state that stimulates creativity and innovation, fostering the generation of new ideas and guiding design thinking (Oxford, 2025). Within the context of interior design, inspiration is not merely a fleeting moment but a continuous and systematic process based on the interaction between the designer's prior experiences and external stimuli, whether tangible or intangible (Gomes et al., 2006; Dazkir et al., 2013).

Sources of inspiration play a central role in shaping the conceptual framework of design, helping designers situate their ideas within a clear visual and semantic context while directing the creative process toward achieving deliberate aesthetic and functional outcomes. Through exploring and interpreting these sources, designers generate visual tools such as mood boards, color palettes, and design vocabularies that stimulate creativity and facilitate visual communication of design ideas (Setchi & Bouchard, 2010). Moreover, design thinking models indicate that the design process continuously shifts between analytical and synthetic phases, transitioning from research and discovery to innovation and practical implementation within a dynamic cycle that integrates theoretical and practical domains (Beckman & Barry, 2007).

The importance of inspiration becomes even more pronounced within contemporary competitive environments, where possessing technical skills and knowledge alone is no longer sufficient to achieve distinction. Instead, inspiration emerges as a critical factor in motivating individuals to transcend conventional constraints and transform ideas into tangible realities (Buheji et al., 2014). Multiple studies have confirmed that inspiration represents a positive motivational state that drives creative achievement and is closely associated with the quality and innovativeness of ideas (Thrash et al., 2010). In the field of interior design, sources of inspiration contribute to defining the fundamental characteristics of new designs and guide designers toward developing solutions that integrate uniqueness with functionality, particularly in the early stages of the design process (Malik & Azhar, 2015).

In parallel, the field of interior design has undergone a fundamental transformation in recent decades due to rapid advancements in digital technologies, culminating in the emergence of artificial intelligence as one of the most influential tools in reshaping design practices. Artificial intelligence, as a set of technologies that enable machines to simulate aspects of human intelligence, has introduced unprecedented capabilities for data analysis, pattern exploration, and the rapid and efficient generation of innovative design alternatives (Floridi, 2020; Agrawal et al., 2017). With the advancement of machine learning, neural networks, and generative design techniques, artificial intelligence has become an effective tool in supporting the ideation and conceptualization stages in interior design (Yanhua, 2024).

Generative artificial intelligence tools, such as text-to-image and text-to-text systems, have further expanded the horizons of design thinking by providing visual and verbal stimuli that enable designers to explore unconventional solutions and iteratively develop their ideas (Gozalo-Brizuela & Garrido-Merchan, 2023; Aboushall, 2024). Artificial intelligence is no longer merely a supportive technical tool; it has evolved into a creative partner that contributes to idea generation and the reinterpretation of design patterns, particularly among designers and students in early educational stages (Doshi & Hauser, 2024).

Despite these extensive capabilities, several challenges accompany the integration of artificial intelligence into design practices. These include concerns about over-reliance on algorithmic outputs, the potential decline of intuitive human input, as well as issues related to bias, intellectual property, and the limited representation of cultural and social dimensions in some design outputs (Popescu & Schut, 2023; Al-Tkhayneh et al., 2023). Some studies also emphasize that, despite its ability to enhance divergent thinking and generate multiple alternatives, artificial intelligence lacks the self-awareness and emotional depth that are fundamental to human creativity (Dorst, 2015).

In light of these developments, it is evident that a fundamental shift has occurred in the nature of the design ideation process. Inspiration is no longer confined to traditional sources but has become a dynamic and interactive process that integrates human expertise with artificial intelligence tools in a complementary relationship that enhances creativity rather than replacing it. Accordingly, the significance of the present study lies in analyzing the impact of employing artificial intelligence tools on the ideation process among female students in the Interior Design Department at King Abdulaziz University. This is achieved by comparing design outputs before and after the use of these tools, examining their influence on the quality of design ideas, and identifying the associated challenges within the educational context.

Despite the central importance of ideation in shaping design concepts within the field of interior design, and the emphasis in the literature on the role of inspiration in stimulating creativity, guiding design thinking, and generating innovative solutions (Thrash et al., 2010; Oleynick et al., 2014), rapid technological transformations—particularly the increasing development of artificial intelligence tools—have introduced a new reality to both design practice and education. Artificial intelligence has enabled unprecedented capabilities in data analysis, pattern recognition, and the rapid generation of multiple design alternatives, thereby reshaping workflows within design studios (Agrawal et al., 2017; Floridi, 2020).

A number of studies have examined inspiration in design as an independent creative concept, focusing on its sources, mechanisms, and role in fostering creative thinking and transforming ideas into design solutions, without addressing the influence of modern intelligent technologies at this early stage of the design process (Gomes et al., 2006; Dazkir et al., 2013; Gonçalves et al., 2014). Other studies have explored visual sources of inspiration and their role in supporting design thinking, highlighting that images and visual media are among the most influential stimuli in generating creative ideas (Malaga, 2000; Casakin, 2005). In contrast, a body of recent research has focused on the application of

artificial intelligence in interior design and architecture, examining its role in improving operational efficiency, accelerating design processes, supporting decision-making, and generating design alternatives through generative design algorithms and machine learning (Yanhua, 2024; He, 2024). Additionally, some studies have highlighted the evolution of artificial intelligence from a purely technical tool to a creative partner capable of reinterpreting design patterns and expanding divergent thinking, particularly in educational settings (Doshi & Hauser, 2024; Wang et al., 2025).

However, despite their significance, these studies have largely focused on the technical and operational aspects of design or on advanced stages of the design process. They have not directly and analytically examined the impact of employing artificial intelligence tools on the mechanisms of early-stage design ideation, nor have they measured the changes that may occur in the quality of design ideas—such as originality, innovation, user-centeredness, and feasibility—as a result of such integration (Popescu & Schut, 2023; Al-Tkhayneh et al., 2023). Furthermore, some studies have pointed to ethical and cognitive challenges associated with increasing reliance on algorithms, including the potential decline of intuitive and human-centered contributions within the creative process (Dorst, 2015; Vinuesa et al., 2020).

According to the researcher's knowledge and within the limits of the review of both Arabic and international literature, no studies have directly and comparatively examined the impact of employing artificial intelligence tools on the process of design ideation, particularly in the field of interior design and within the university educational context. This research gap represents a clear shortcoming in the literature and necessitates an analytical study aimed at investigating the influence of these tools on design thinking among female students in the Interior Design Department at King Abdulaziz University. The study also seeks to compare the outputs of traditional ideation with those supported by artificial intelligence, in addition to exploring the challenges associated with such integration.

Accordingly, the research problem is articulated through the following questions:

### *1.1. Research Questions*

- How does the ideation of design ideas and concepts generated through the use of artificial intelligence tools differ from those produced through traditional methods among female students of the Interior Design and Furniture Department at King Abdulaziz University?
- What is the impact of using artificial intelligence tools on the initial design ideation of interior design projects among female students of the Interior Design and Furniture Department at King Abdulaziz University?
- What challenges do female students of the Interior Design and Furniture Department at King Abdulaziz University face when using artificial intelligence tools for the ideation of initial design ideas and concepts?

### *1.2. Research Objectives*

- To examine the extent to which design ideas and concepts generated using artificial intelligence tools differ from those produced through traditional methods among interior design students.
- To identify the impact of employing artificial intelligence tools during the ideation process of interior design projects among students at King Abdulaziz University.
- To explore the challenges faced by interior design students when employing artificial intelligence tools during the design ideation process.

### *1.3. Significance of the Study*

The significance of this study lies in both its theoretical and practical contributions, offering an integrated scientific and applied addition.

From a theoretical perspective, the study contributes to enriching the literature in the fields of interior design and artificial intelligence by analyzing the relationship between design ideation and the use of intelligent tools. It advances the understanding of design inspiration within the context of digital transformation and addresses a research gap concerning the impact of artificial intelligence on early-stage idea generation, particularly in educational settings. Furthermore, it deepens the discourse on the role of artificial intelligence as either a tool or a creative partner and its implications for the concepts of originality and innovation.

From a practical perspective, the study is associated with the development of teaching practices in interior design studios by providing applied indicators for integrating artificial intelligence tools in a manner that supports creativity while preserving the designer's role. It also assists students in understanding the opportunities and challenges associated with these tools and in developing more conscious ideation strategies. Additionally, the study supports curriculum

development and proposes instructional mechanisms and evaluation criteria that enhance critical and creative thinking within the educational environment.

## 2. THEORETICAL FRAMEWORK

### *2.1. Inspiration in Interior Design*

Inspiration in interior design is considered a motivating mental state that drives designers toward creativity and innovation. It plays a crucial role in guiding thinking processes and generating new ideas within a clear design context (Oxford, 2025; Setchi & Bouchard, 2010). The design process is fundamentally based on the interaction between two core phases: analysis (research and discovery) and synthesis (innovation and implementation), with continuous transitions between theoretical and practical dimensions (Beckman & Barry, 2007).

Inspiration relies on the designer's personal experiences as well as external stimuli, such as previous products, nature, and artistic works. These sources expand the scope of thinking and enhance creative diversity (Gomes et al., 2006; Dazkir et al., 2013). Its importance lies in its role as a driving force that transforms ideas into tangible realities, contributing to defining design characteristics and guiding early stages of the process, while enhancing the ability to produce innovative solutions that integrate aesthetics and functionality (Thrash et al., 2010; Malik & Azhar, 2015).

Sources of inspiration vary to include visual, conceptual, and environmental elements, and their integration represents a fundamental feature of the design process. Designers employ mechanisms such as selection, adaptation, and transformation to reinterpret these sources within a new vision (Eckert & Stacey, 2000; Petre et al., 2006). Nature, in particular, serves as a rich source of rhythms and visual relationships, emphasizing that inspiration is not based on imitation but on intellectual and aesthetic reconstruction (Qanini, 2006; Ismail, 2001).

Inspiration directly influences the formation of design ideas through stimulation, transcendence, and motivation, thereby enhancing the quality of creative outputs (Oleynick et al., 2014). Ultimately, the initial spark of inspiration evolves into actionable ideas through systematic stages that include research, analysis, and application, ensuring the production of integrated and innovative design outcomes (Gonçalves et al., 2014).

### *2.2. Artificial Intelligence in Interior Design as a Supportive Tool for Inspiration*

Artificial intelligence serves as a supportive and stimulating tool for inspiration in interior design. It is defined as a set of technologies that enable machines to perform tasks typically requiring human intelligence, such as machine learning and generative design (Floridi, 2020; Yanhua, 2024). Its role has evolved from a purely computational tool to a creative partner capable of analyzing large datasets, identifying patterns, and generating innovative design alternatives, thereby enhancing both the efficiency and quality of the design process (Agrawal et al., 2017; Yanhua, 2024).

Forms of interaction with artificial intelligence have diversified, particularly with the emergence of generative models that enable the transformation of text into images, models, or even design concepts. This development has opened new horizons for both visual and conceptual inspiration (Gozalo-Brizuela & Garrido-Merchan, 2023; Aboushall, 2024). These tools have transformed artificial intelligence from a technical intermediary into an active partner in idea generation, especially within collaborative creative systems that facilitate continuous interaction between humans and machines (Kim & Maher, 2023; Davis et al., 2019).

Artificial intelligence plays a significant role in stimulating inspiration by generating visual representations, supporting user empathy, and enhancing design interaction (Figoli et al., 2022). It also contributes to the development of ideation processes through tools based on analogical reasoning and cognitive inference, enabling designers to explore new solutions within the design space (Jia et al., 2020; Han et al., 2020).

Despite these advantages, several challenges arise, including bias in outputs, intellectual property concerns, and the risk of over-reliance on intelligent systems (Popescu & Schut, 2023). Nevertheless, research indicates that the integration of human intelligence and artificial intelligence redefines the creative process. Artificial intelligence enhances divergent thinking, while humans retain control over final decisions, leading to improved design quality and efficiency (Wang et al., 2025; Liu, 2025).

### *2.3. Prompt-Based Artificial Intelligence Tools in Generating Design Images*

Text-to-image generation represents one of the most prominent applications of modern generative models, enabling the transformation of linguistic descriptions into coherent and semantically accurate

visual outputs (Radford et al., 2021; Zhang et al., 2023). The development of these models has progressed from Generative Adversarial Networks (GANs) to autoregressive models and, more recently, to diffusion models, which are currently the most advanced in terms of visual quality and stability (Rombach et al., 2022).

These systems rely on conditional models that integrate textual input with visual representations, as seen in models such as DALL·E, Stable Diffusion, and Imagen. In such systems, text functions as a guiding signal that controls the image generation process by transforming noise into a coherent visual representation (Ramesh et al., 2022; Saharia et al., 2022). Within this context, prompts have become a central design element, determining image characteristics such as style, composition, lighting, and materials. Consequently, "prompt engineering" has emerged as a critical skill for improving output quality (Liu & Chilton, 2022; Bansal, 2024).

These tools significantly contribute to the design ideation phase by enabling the rapid generation of diverse visual concepts. This enhances creative thinking, expands the scope of design exploration, and improves workflow efficiency (Eastwood, 2024; Gindert, 2024). They also function as cognitive stimuli that support brainstorming and facilitate interaction between humans and machines (Kulkarni et al., 2023).

However, these tools face limitations related to their statistical nature, as they lack deep conceptual understanding and may tend to produce repetitive or conventional solutions (Zhang et al., 2023; Doshi & Hauser, 2024). Additionally, over-reliance on such tools may lead to design fixation and reduced creative diversity (Wadinambiarachchi et al., 2024). The quality of outputs remains highly dependent on the designer's ability to formulate effective prompts and guide the system, reinforcing the notion that artificial intelligence serves as a supportive tool rather than a substitute for human expertise in design.

## 3. RESEARCH METHODOLOGY

The study adopted a qualitative approach through the use of an experimental case study design to analyze the impact of employing artificial intelligence tools on design ideation during the early conceptual stages of interior design. A repeated-measures design was applied to the same group of students, who underwent two conditions: the first using traditional methods and the second using artificial intelligence tools. This approach enabled accurate comparison while minimizing the influence of individual differences.

The data were analyzed using comparative thematic analysis to identify patterns related to the quality of inspiration, creative processes, and associated challenges, with a direct comparison between the two phases. Ethical considerations were observed, including voluntary participation, data confidentiality, and the use of data solely for scientific research purposes.

### *3.1. Research Sample*

The research sample consisted of 29 female students from the Interior Design and Furniture Department at the College of Human Sciences and Design, King Abdulaziz University, who were enrolled in the "Studio 5" course during the semester of implementation. The sample was selected purposively (intentionally) in accordance with the nature of qualitative research and the case study methodology.

Selection criteria ensured alignment with the study objectives and included students who were at an advanced academic level, actively engaged in an interior design project as part of course requirements, and capable of using artificial intelligence tools during the ideation phase. This sample represents a group capable of independently engaging in the design process and possessing foundational knowledge of modern technologies, making it suitable for examining the impact of artificial intelligence on design inspiration.

Although the sample size is relatively limited, it aligns with qualitative research requirements, which emphasize depth and richness of data over broad quantitative representation. Participants were accessed through formal coordination with the academic department and collaboration with course instructors, providing an appropriate applied environment within the design studio and facilitating the implementation of the study and data collection.

### *3.2. Research Instruments*

#### *3.2.1. Case Study*

The study relied on a primary qualitative instrument: the case study, to analyze the impact of artificial intelligence tools on the development of design ideas. This instrument was applied by tracking the performance of a group of interior design students while executing a single project within the "Studio 5" course across two phases:

- The first phase used traditional methods without artificial intelligence.
- The second phase involved the open use of

artificial intelligence tools.

This structure enabled a direct comparison between the two approaches.

The case study instrument was systematically designed based on the theoretical framework and previous literature to develop an analytical model for assessing the quality of design ideas using a set of qualitative criteria. These criteria included: idea translation, feasibility, originality, user-centeredness, idea reformulation, and innovation.

These criteria were organized within a comparative analytical table using a five-point evaluative scale, contributing to standardizing the evaluation process and enhancing objectivity in analyzing outputs. The instrument demonstrated its effectiveness in providing an in-depth understanding of real-world experiences within an applied educational environment. It enabled the observation of transformations in design thinking and ideation processes, as well as the analysis of differences between traditional and AI-supported work.

The instrument also relied on comprehensive documentation of project outputs, including sketches, mood boards, and generated images. Accordingly, the case study facilitated the analysis of qualitative changes in the quality of design ideas and explored the role of artificial intelligence in enhancing creativity, while emphasizing its function as a supportive tool that requires informed human guidance to achieve optimal outcomes.

### *3.2.2. Validity of Research*

Qualitative research seeks to ensure the quality of its findings through the concept of trustworthiness rather than the traditional notions of validity and reliability used in quantitative research, following the framework of Lincoln and Guba. Trustworthiness is established through several key criteria:

- Credibility: Reflects the study's ability to accurately represent reality and authentically convey participants' experiences. This was enhanced through triangulation using multiple data collection methods, including the case study and analysis of design outputs across both traditional and digital phases.
- Dependability: Refers to the clarity and traceability of research procedures. This was achieved through detailed documentation of the research problem, objectives, methodology, sample, and instruments, in addition to clearly outlining the processes of data collection and analysis.
- Confirmability: Ensures that findings are grounded in actual data rather than researcher bias. This was maintained through systematic documentation and adherence to predefined analytical criteria.

Together, these criteria contribute to enhancing the rigor, credibility, and overall trustworthiness of the qualitative research findings.

### *3.3. Designing the Comparative Analytical Table for Students' Outputs*

At this stage, a comparative analytical table was designed to systematically organize the analysis of students' outputs, enabling an accurate comparison between the results of each stage of the design process. The development of this table was based on the qualitative criteria derived from the theoretical framework in the previous stage. Six main indicators were adopted to measure the quality and development of the design idea: idea translation, feasibility, originality, responsiveness to user needs, idea development and reformulation, and the extent to which the idea incorporated new elements or innovative solutions. This table contributed to standardizing the evaluation mechanism across both the traditional and digital stages, thereby enabling an organized analysis of transformations in students' design thinking and supporting qualitative comparison and accurate interpretation of findings.

The following table presents the analytical evaluation model developed to systematically organize the analysis of students' outputs in a comparable manner, based on the qualitative criteria extracted from the study's theoretical framework. The table aims to provide a unified analytical tool that enables the evaluation of the quality of the design idea across the two stages of the design process (traditional and digital using artificial intelligence tools) through a set of indicators measuring the dimensions of idea development and its level of design maturity. The use of a graduated rating scale also allows for accurate comparison between outputs, supporting the analysis of transformations in students' design thinking and contributing to deriving precise qualitative findings regarding the impact of employing artificial intelligence tools in developing the design idea.

***Table 1: Comparative Analytical Evaluation Model for Students' Outputs According to Design Idea Quality Criteria.***

| No. | Criterion | Description | Rating (1–5) |
|---|---|---|---|
| 1 | Idea Translation (Initial Idea Formulation) | The extent to which the designer can transform the idea or inspiration into a tangible and visually clear form that effectively expresses it. | ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 |
| 2 | Feasibility of the Idea | The extent to which the idea can be implemented technically, functionally, and economically in reality. | ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 |
| 3 | Originality | The extent to which the idea is unique, non-repetitive, and contains surprising or novel elements. | ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 |
| 4 | User-Centeredness | The extent to which the idea responds to users' needs and expectations and reflects an understanding of user experience. | ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 |
| 5 | Idea Reformulation and Development | The designer's ability to understand the idea from new perspectives and reframe it in ways that enhance creative solutions. | ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 |
| 6 | Innovation | The extent to which the idea includes new elements or unconventional solutions that add real value. | ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 |

The following table illustrates the design idea evaluation criteria adopted in this study, which were developed based on qualitative indicators derived from the theoretical framework to provide a clear and organized evaluation tool for measuring the quality of design outputs. These criteria were constructed according to a five-point rating scale ranging from "Very Poor" to "Excellent," allowing for the accurate determination of the level of development of the design idea across several key dimensions, including idea translation, feasibility, originality, user-centeredness, idea reformulation and development, and innovation. This model contributes to standardizing the evaluation process and achieving a greater degree of objectivity when analyzing students' outputs. It also supports a systematic qualitative comparison for monitoring transformations in design thinking resulting from the use of artificial intelligence tools and measuring their reflection on the quality of creative outputs.

***Table 2: Design Idea Evaluation Criteria According to the Five-Point Rating Scale.***

| **Criterion** | **5 Excellent** | **4 Very Good** | **3 Acceptable** | **2 Poor** | **1 Very Poor** |
|---|---|---|---|---|---|
| Idea Translation (Initial Idea Formulation) | The concept or inspiration was translated into a clear and tangible visual design form that accurately and creatively reflects the meaning. | The translation is good and clear, with some gaps in the visual expression of the idea. | The idea was expressed tangibly, but the visual translation is limited or inconsistent. | The translation is unclear or superficial, with weak connection between form and meaning. | There is no actual translation of the idea, or the form is completely unrelated to the concept. |
| Feasibility of the Idea | The idea is realistically implementable from technical, economic, and functional perspectives. | The idea is feasible with some minor improvements or modifications. | The idea can be implemented with difficulty or at high cost. | The idea is impractical in the current context or requires unavailable technologies. | The idea is entirely infeasible from all perspectives. |

| | | | | | |
|---|---|---|---|---|---|
| Originality / Uniqueness | The idea is entirely new, innovative, and non-repetitive, containing surprising or unconventional elements. | The idea includes some innovative aspects but resembles previous ideas. | The idea is partially conventional with a slight innovative touch. | The idea is repetitive or derived from known models without development. | The idea is completely copied and lacks any originality. |
| User-Centeredness | The design deeply responds to user needs and reflects a comprehensive understanding of user experience and context. | The design clearly considers the user but lacks some details. | The user was considered generally but was not central to the idea. | User focus is weak or unsupported by clear evidence. | No consideration or study of user needs is evident. |
| Idea Reformulation and Development | The idea was reformulated from an innovative perspective with clear analysis of its roots. | The idea was presented well with an attempt to view it from a new perspective. | The idea was presented conventionally with slight indications of alternative perspectives. | The idea was not reformulated and was handled superficially. | The idea was ignored or formulated incorrectly and unclearly. |
| Innovation | The idea contains entirely new solutions that add real value to the user or market. | The idea includes good innovative elements with potential for further development. | The idea demonstrates some aspects of innovation, but they are limited. | The idea lacks innovation or presents repetitive solutions. | There is no clear innovative element in the idea. |

This model was used to qualitatively analyze the case study in order to monitor transformations in design thinking resulting from the use of artificial intelligence tools and to examine their impact on the quality of students' creative outputs.

### *3.4. Evaluation process*

The evaluation process was conducted by a panel consisting of four evaluators, including three faculty members from the Interior Design and Furniture Department at King Abdulaziz University—two faculty members holding doctoral degrees and one lecturer—in addition to the researcher. All faculty evaluators were originally teaching the "Studio 5" course during the semester in which the study was conducted. Official approval and coordination were obtained in accordance with the course plan, and the evaluation sessions were scheduled during regular class hours to ensure that all participating students were assessed at the same required stage of the design process. The assessment took place after each group presented and explained its design concept. This was followed by a discussion session among the evaluators and the researcher before assigning the evaluation scores. The evaluation process relied on collective discussion and consensual judgment among the evaluators rather than on isolated individual scoring. However, no formal inter-rater reliability coefficient was calculated, which may be considered one of the methodological limitations of the study.

### *3.5. Case Study Results Analysis*

This section presents the results of the case study by examining two contrasting groups: the group that received the lowest evaluation and the group that achieved the highest evaluation.

Results of the First Group (Lowest Evaluation)

In the traditional phase (First Concept: total score = 4/30), the results indicated a low level of design idea quality. The concept was characterized by a lack of clarity and difficulty in practical implementation. The student did not demonstrate a deep understanding of user needs or the functional requirements of the project.

The criterion of user-centeredness was entirely absent, and the idea did not exhibit realistic feasibility. Additionally, the visual translation of the concept was weak, and there was no coherent conceptual foundation supporting the design direction. These limitations were clearly reflected in the overall low evaluation of the output at this stage.

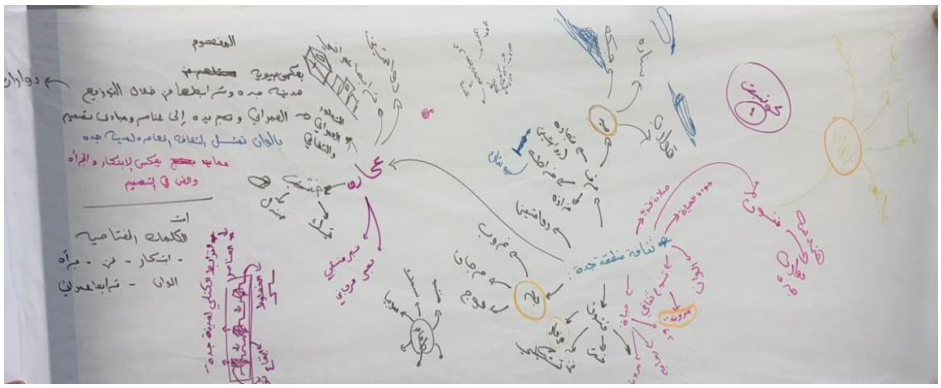


***Figure (1): Traditional Phase – First Group Design***

Figure (1) illustrates the traditional phase output of the first group, which received the lowest evaluation score (4/30). The low score reflects several deficiencies according to the adopted evaluation criteria. The design idea lacked a clear conceptual foundation, and the proposed direction did not demonstrate practical feasibility or responsiveness to user needs. The criterion of user-centeredness was largely absent, and the design process did not show evidence of systematic idea development or reformulation. Furthermore, the concept displayed limited originality and weak innovation, as the visual elements were assembled without presenting a distinctive or functionally integrated design solution. These observations collectively explain the low evaluation assigned to the project during the traditional phase.

In the second phase, using artificial intelligence tools, both the first and second design concepts achieved a total score of (16) each, reflecting a significant improvement compared to the traditional phase, where the score did not exceed (4). These results indicate that the student benefited from artificial intelligence tools in refining the formulation of the idea and enhancing its visual representation, which contributed to improving the overall presentation quality and clarifying the design outputs more effectively.

Despite this substantial improvement in evaluation scores, the criterion of user-centeredness remained absent. This suggests that the use of artificial intelligence did not contribute to a deeper understanding of the end user's needs or to their integration into the design decision-making process.

Accordingly, it can be observed that the role of artificial intelligence was primarily limited to enhancing the formal and organizational aspects of the outputs, without achieving a corresponding development in the core analytical dimensions related to design thinking and user understanding.


*Figure (2): Second Phase Using Artificial Intelligence – First and Second Concepts of the First Group*

Translation of the text in fig 2:

**AI – First Concept**

**Light and Shadow**

The hotel design draws inspiration from the identity of Jeddah as a coastal city immersed in light. Light and shadow become the two primary elements shaping the space instead of physical materials. The design relies on reflective and dynamic surfaces that change in harmony with the movement of the sun, inspired by the reflections of the sea and the details of the traditional rowshan in a contemporary style. Light flows through the space and creates constantly changing visual rhythms. The result is a hotel that breathes with light, resembling an interactive artwork that reflects the evolving spirit of Jeddah between the sea, the sun, and life.

Contrast – Repetition – Gradation – Shadow – Light

**AI – Second Concept**

**The Movement of Jeddah**

The movement of the corniche and the flow of the sea waves are translated into a human-centered design language based on curved lines and interconnected spaces that reflect continuity and smooth transition from one area to another, as if the space has no clear boundaries. The visual identity emerges through the use of soft materials and reflective surfaces inspired by the shimmer of the sea, along with shell and teak wood textures representing the warmth of Jeddah. Subtle touches of blue suggest the city's renewed energy. The goal is to create a hotel experience that resembles movement within Jeddah itself: continuous motion, vibrant social encounters, freedom, and interaction with light and shadow.

**Flow – Continuity – Rhythm – Motion**

**Reflection – Ripple – Fluid Lines**

**Curved Lines – Soft Edges – Organic Forms**

The outputs presented in Figure (2) demonstrate a noticeable improvement in the visual quality and conceptual presentation during the artificial intelligence phase compared with the traditional phase. The first and second concepts show stronger visual coherence, clearer thematic direction, and more refined aesthetic relationships through the use of lighting effects, reflections, movement, and fluid forms. The AI-generated mood boards also reveal progress in idea translation, originality, and visual innovation, contributing to a more immersive and stylistically unified design language.

Despite these visual improvements, the criterion of user-centeredness remained weakly represented within the design process. The presented concepts focused primarily on atmosphere, formal expression, and aesthetic experience without clearly demonstrating how the proposed spaces respond to users' functional needs, movement patterns, comfort,

accessibility, or practical interaction with the environment. The absence of explicit user analysis or evidence of functional problem-solving indicates that the design development was largely visual rather than user-oriented.

## 4. RESULTS OF THE SEVENTH GROUP (HIGHEST EVALUATION).

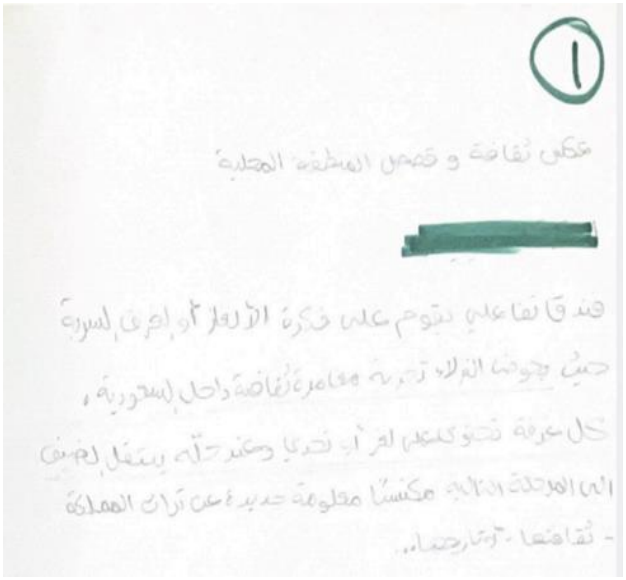


***Figure (3): First Phase (Traditional) – Seventh Group, First Concept***

### *4.1. The First Design Concept*

Translation of the text in fig 3: An interactive hotel based on the idea of puzzles and secret rooms, where visitors undergo a cultural adventure experience within Saudi Arabia. Each room contains a puzzle or challenge, and upon solving it, the guest moves to the next stage, gaining new information about heritage, culture, or local history.

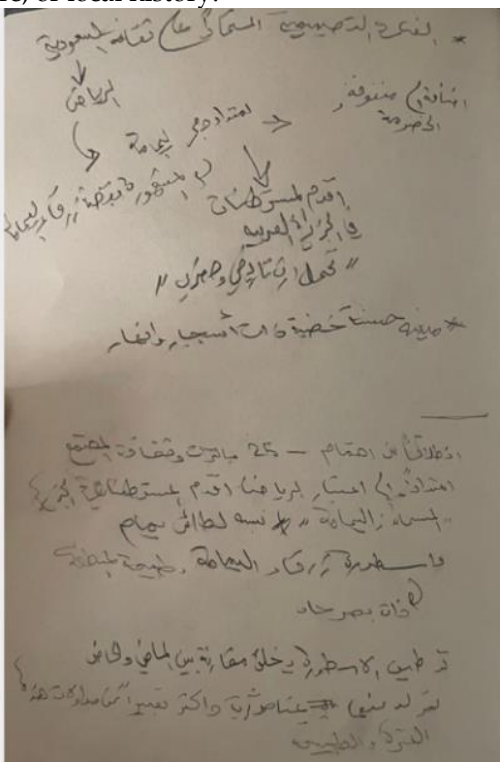


***Figure (4): First Phase (Traditional) – Seventh Group, Second Concept***

In the first (traditional) phase, Group Seven demonstrated an exceptionally strong performance. The first idea received an overall score of 28 points, while the second idea achieved 27 points, reflecting a high level of quality and a strong similarity between the two concepts. Both ideas showed clear strength in translating the concept into design, feasibility of implementation, and originality, in addition to a strong emphasis on user-centeredness, indicating an advanced understanding of the fundamentals of the design process. Despite this close similarity, the first idea outperformed the second by only one point due to its superior ability to reinterpret and further develop the concept, which gave it a greater level of design maturity and integration.


*Figure (5): Second Phase Using Artificial Intelligence – First Concept of the Seventh Group*

### *4.2. Translation of the text in Fig 5*

### *4.2.1. The First Design Concept – AI*

The concept is inspired by the transformation that characterizes the city of Riyadh, balancing between its authentic desert past and its modern urban future. The hotel reflects this contrast by blending the warmth and calmness of the desert with the vitality and vibrancy of the city lights, creating an experience that represents the spirit of modern Riyadh while preserving its deep-rooted heritage at the same time. The goal is for visitors to feel that they are experiencing Riyadh's journey itself — from the desert to the city skyline, from the past to the future.



*Figure (6): Second Phase Using Artificial Intelligence Second Concept of the Seventh Group*

Translation of the text in fig (6)

### *4.3. The Second Design Concept – AI*

### *4.3.1. Caravan of Curiosities*

The concept is based on the idea that the hotel is not merely a place to stay, but rather a "caravan" that has finally settled in the oasis of Riyadh. The hotel represents a meeting point for modern travelers, combining the spirit of ancient trade routes with future innovations, and recreating the atmosphere of a magical moment when a great caravan arrived carrying treasures of knowledge and culture from historic trade routes. In this way, the hotel becomes the "first destination," embodying the spirit of travel and discovery in the heart of the Arab world.

The design aims to create an immersive experience in which the guest transforms from a visitor into an explorer, and from a resident into a traveler on a journey through time that reflects the values of hospitality.

- Traditional Aspect: Each floor is dedicated to a historic trade caravan route (the Incense Route, the

Silk Road, the Pilgrimage Route). The design of the rooms and corridors varies according to the theme of each floor.

- Curiosity and Authenticity: Every room includes a "Caravan Box," a wooden chest containing samples of scents from the route (frankincense, spices, sandalwood) along with a vintage-style route map.
- Social Element: The hotel lobby is designed as a "Caravan Market," not merely a seating area, but an interactive mini-market featuring local artisans at specific times and spaces for tasting coffee from different regions along the trade routes.
- Innovation: A large interactive digital wall in the lobby artistically displays the movement of ancient caravans and interacts with guests' daily movement throughout the hotel.

In the second phase, using artificial intelligence tools, the evaluation results revealed a significant disparity between the two concepts. The first concept received a low total score of (9), indicating clear weaknesses across most evaluation criteria, with only a moderate level observed in feasibility. The concept did not demonstrate effective utilization of artificial intelligence tools, nor did it show noticeable development compared to the previous phase. Additionally, the absence of user-centeredness negatively impacted its overall design value.

In contrast, the second concept achieved a high score of (27), making it one of the strongest ideas in this phase. It successfully demonstrated a well-balanced integration of innovation, originality, and feasibility, along with a clear presence of user-centered design. This reflects an effective and mature use of artificial intelligence tools in supporting the design process.

### *4.4. Case Study Results*

#### *4.4.1. Results of Phase One – Studio 5 (Traditional Phase)*

The projects were implemented without the use of artificial intelligence tools, and the students relied on traditional sources of inspiration such as websites and personal experience. The results showed clear variation in the quality of outputs across the different groups.

***Table (3): Overall Results of the Traditional Phase.***

| Group | Concept | Idea Translation (Initial Formulation) | Feasibility | Originality | User-Centeredness | Idea Reformulation & Development | Innovation | Total |
|---|---|---|---|---|---|---|---|---|
| Group 1 | Concept 1 | 1 | **NA** | 2 | **NA** | 2 | 1 | 4 |
| Group 2 | Concept 1 | 2 | **NA** | 4 | **NA** | 4 | 4 | 14 |
| | Concept 2 | 3 | **NA** | 4 | **NA** | 3 | 1 | 11 |
| Group 3 | Concept 1 | 2 | **NA** | 2 | **NA** | 2 | 2 | 8 |
| Group 4 | Concept 1 | 4 | **NA** | 5 | **NA** | 4 | 4 | 17 |
| | Concept 2 | 3 | **NA** | 3 | **NA** | 3 | 3 | 12 |
| Group 5 | Concept 1 | 5 | 5 | 4 | – | 4 | 4 | 22 |
| | Concept 2 | 4 | 5 | 4 | 5 | 4 | 4 | 26 |
| Group 6 | Concept 1 | 3 | 4 | 4 | 3 | 3 | 3 | 20 |
| | Concept 2 | 3 | 4 | 4 | 3 | 3 | 3 | 20 |
| Group 7 | Concept 1 | 5 | 5 | 5 | 5 | 4 | 4 | 28 |
| | Concept 2 | 5 | 5 | 5 | 5 | 3 | 4 | 27 |
| Group 8 | Concept 1 | 4 | 3 | 4 | 1 | 3 | 4 | 19 |
| | Concept 2 | 3 | 3 | 3 | 1 | 2 | 3 | 15 |
| Group 9 | Concept 1 | 4 | 5 | 4 | 2 | 3 | 3 | 21 |
| | Concept 2 | 3 | 3 | 3 | 2 | 2 | 2 | 15 |

**Total number of concepts: 16**

A total of 16 design concepts distributed across nine groups were evaluated according to six main criteria. The results revealed clear variation in the extent to which these criteria were achieved across the submitted ideas.

### *4.4.2. Detailed Analysis by Criterion*

### *Idea Translation (Initial Concept Formulation)*

The criterion of idea translation (initial formulation) was achieved across all concepts, with a fulfillment rate of 100%. The evaluation scores ranged from 1 to 5, with the first concept of Group 1 receiving the lowest score (1), while the highest score (5) appeared in four different concepts. The overall mean score reached 3.4 out of 5, indicating a performance level ranging from moderate to very good. This reflects the students' ability to transform abstract concepts and ideas into initial visual formulations that clearly express the design direction at a preliminary level.

### *4.4.3. Feasibility of the Idea*

The evaluation of the feasibility criterion showed that it was achieved in 10 out of 16 concepts (62.5%), while it was absent in 6 concepts (37.5%), indicating a noticeable shortcoming in addressing practical and implementation aspects in some design projects. The highest score (5) was achieved in five concepts, while the lowest score (3) appeared in three concepts. The overall mean score was 4.2 out of 5, reflecting a very good level of realism and practical applicability among the concepts evaluated under this criterion. Despite the relatively high average, the absence of feasibility in more than one-third of the projects highlights a clear need to strengthen practical and technical thinking during the ideation stage. It also underscores the importance of guiding students to consider real-world implementation aspects before progressing to subsequent stages of design development.

### *4.4.4. Originality of the Idea*

The originality criterion was achieved in 100% of the concepts, reflecting a clear emphasis on creativity and the students' efforts to present distinctive design proposals. However, the distribution of scores revealed notable variation in the level of originality across projects. The highest score (5) was achieved in three concepts, while the lowest score (2) appeared in two cases. The overall mean score reached 3.75 out of 5, indicating a very good level of originality overall, with more than half of the concepts receiving high evaluations between 4 and 5. Nevertheless, the presence of lower scores (2 and 3) suggests that some students relied on conventional solutions or limited innovation. This highlights the need to further promote creative thinking practices and expand sources of inspiration to support the development of more distinctive and innovative ideas.

**User-Centeredness**

The evaluation of the user-centeredness criterion showed that it was achieved in 9 out of 16 concepts (56.25%), while it was absent in 7 concepts (43.75%), indicating a noticeable weakness in incorporating the end-user perspective during the traditional design phase. Scores ranged from 1 to 5, with the highest score (5) achieved in three concepts, while the lowest score (1) appeared in two cases. The overall mean score was 3.0 out of 5, indicating a moderate level of attention to user needs. This average reflects partial attempts by some students to consider user experience. However, the absence of this criterion in a significant number of projects points to a gap in recognizing the importance of user-centered design. This emphasizes the need to strengthen students' awareness of integrating user understanding and context into early stages of design thinking, thereby supporting the development of more effective and human-centered solutions.

### *4.5. Idea Reformulation and Development*

The evaluation of the idea reformulation and development criterion showed that it was achieved in all concepts (100%), indicating a general awareness among students of the importance of refining and improving design ideas by reconsidering them from multiple perspectives. Scores ranged between 2 and 4, with the highest score (4) achieved in five concepts, while the lowest score (2) appeared in four cases. The overall mean score was 3.06 out of 5, reflecting a moderate to good level in students' ability to develop their design ideas. This average suggests that most students made acceptable efforts to refine their ideas. However, the absence of the highest score (5) indicates limitations in deep analytical development or in presenting fully innovative design solutions. Additionally, lower scores in some cases reflect the presentation of ideas at an initial stage without sufficient refinement or diversification of proposed solutions. Accordingly, there is a need to encourage students to explore multiple perspectives in addressing design ideas and to strengthen practices of experimentation and continuous development throughout the design thinking process.

### *4.5.1. Innovation*

The innovation criterion was achieved in all 16 concepts (100%), indicating a general effort among students to present new or unconventional design proposals. However, the evaluation results revealed considerable variation in the level of innovation across projects. The highest score (4) was achieved in six concepts, while the lowest score (1) appeared in

two cases. The overall mean score was 3.06 out of 5, indicating a moderate to good level of innovation. This average reflects the presence of innovative attempts in most concepts. However, the absence of the highest score (5) and the presence of lower evaluations in some cases indicate limitations in the depth of originality and uniqueness. In several projects, innovation was confined to superficial modifications or the reuse of existing ideas rather than the development of deeply creative solutions. Therefore, there is a clear need to activate creative thinking strategies and encourage students to move beyond conventional design approaches, contributing to the production of more innovative solutions with meaningful added value.

### *4.6. Summary of Phase One Results*

The results of the first phase, which was implemented using traditional methods without the use of artificial intelligence tools, provide a comprehensive picture of the level of design thinking among students within a conventional learning environment. A total of 16 design concepts distributed across nine groups were evaluated according to six main criteria: idea translation, feasibility, originality, user-centeredness, idea reformulation and development, and innovation. The findings revealed clear variation in the quality of outputs across groups, reflecting differences in experience levels and the design thinking approaches adopted by the students. The idea translation criterion was fully achieved across all projects, with an average score of 3.4 out of 5, indicating a generally good ability among students to transform abstract concepts into initial visual representations, despite variations in individual performance. The feasibility criterion was achieved in only 62.5% of the concepts, although it recorded a relatively high average of 4.2 out of 5. This suggests that ideas which incorporated practical considerations were highly realistic and implementable. However, a considerable number of projects neglected practical thinking at the early stages of ideation. Regarding originality, the criterion was achieved in all projects, with an average of 3.75 out of 5, reflecting a general tendency toward creative distinction. Nevertheless, variations in scores indicate that some students relied on conventional solutions with limited innovation. The user-centeredness criterion showed the weakest relative performance, being achieved in only 56.25% of the concepts, with an average of 3.0 out of 5. This indicates a limited adoption of user-centered design approaches during the traditional phase, with a stronger focus on formal or conceptual aspects rather than a deep analysis of user needs. Similarly, the idea reformulation and development criterion was achieved across all projects, with an average of 3.06 out of 5, suggesting moderate efforts in refining ideas. However, these efforts tended toward incremental improvements rather than deep conceptual transformations.

The innovation criterion also achieved a full fulfillment rate, with an average of 3.06 out of 5, reflecting an overall inclination toward novelty. However, in many cases, innovation was limited to superficial modifications or the reuse of existing ideas rather than the generation of fundamentally innovative design solutions. Overall, the results indicate that the traditional phase enabled students to develop acceptable design ideas in terms of formulation and initial originality. At the same time, it revealed clear gaps in integrating creative and functional aspects, particularly in relation to user analysis and in-depth idea development. The substantial variation between the highest total score (28) and the lowest (4) highlights sharp differences in the level of design thinking across groups. The overall mean performance score reached 19.31, indicating an acceptable general level with significant room for improvement. These findings suggest that reliance on traditional methods alone may support the initial formation of design ideas; however, it requires complementary tools and approaches to enhance analytical depth, expand innovation, and more systematically connect design outcomes to real-world contexts and user needs.

Phase Two (AI-Supported Phase)

In this phase, students were given the freedom to use artificial intelligence tools to develop their ideas, such as image-generation tools and tools for creating color schemes and material palettes. This phase aimed to explore the extent to which artificial intelligence influences the quality of design ideas.

***Table 4: Overall Results of the AI-Supported Phase.***

| Group | Concept | Idea Translation (Initial Formulation) | Feasibility | Originality | User-Centeredness | Idea Reformulation & Development | Innovation | Total |
|---|---|---|---|---|---|---|---|---|
| **Group 1** | **Concept 1** | **3** | **4** | **3** | **NA** | **3** | **3** | **16** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Concept 2** | **3** | **3** | **4** | **NA** | **3** | **3** | **16** |
| **Group 2** | **Concept 1** | **3** | **3** | **4** | **NA** | **4** | **4** | **18** |
| | **Concept 2** | **2** | **3** | **2** | **NA** | **2** | **2** | **11** |
| | **Concept 3** | **3** | **3** | **4** | **NA** | **3** | **3** | **16** |
| **Group 3** | **Concept 1** | **1** | **1** | **1** | **NA** | **1** | **1** | **5** |
| | **Concept 2** | **1** | **1** | **1** | **NA** | **1** | **1** | **5** |
| **Group 4** | **Concept 1** | **3** | **2** | **4** | **NA** | **3** | **3** | **15** |
| | **Concept 2** | **3** | **4** | **2** | **NA** | **3** | **3** | **15** |
| **Group 5** | **Concept 1** | **4** | **5** | **4** | **4** | **5** | **4** | **26** |
| | **Concept 2** | **2** | **2** | **2** | **1** | **2** | **4** | **13** |
| **Group 6** | **Concept 1** | **2** | **1** | **4** | **1** | **1** | **4** | **13** |
| | **Concept 2** | **2** | **1** | **4** | **1** | **1** | **4** | **13** |
| **Group 7** | **Concept 1** | **2** | **3** | **1** | **1** | **1** | **1** | **9** |
| | **Concept 2** | **5** | **5** | **5** | **5** | **3** | **4** | **27** |
| **Group 8** | **Concept 1** | **3** | **3** | **2** | **1** | **2** | **2** | **13** |
| | **Concept 2** | **5** | **5** | **5** | **4** | **4** | **5** | **28** |
| | **Concept 3** | **4** | **4** | **5** | **1** | **3** | **4** | **21** |
| **Group 9** | **Concept 1** | **3** | **3** | **2** | **1** | **1** | **3** | **13** |
| | **Concept 2** | **5** | **4** | **5** | **1** | **4** | **4** | **23** |

Total number of concepts: 20

A total of 20 design concepts distributed across nine groups were evaluated according to six main criteria. The results revealed clear variation in the extent to which these criteria were achieved across the submitted ideas.

A detailed analysis of performance by each criterion is presented as follows:

Idea Translation (Initial Concept Formulation)

The evaluation of the idea translation criterion (initial formulation) showed that it was achieved in 100% of the concepts, indicating a general awareness among students of the importance of transforming design concepts into clear and visually interpretable initial formulations. Scores ranged from 1 to 5, with three concepts achieving the highest score (5), while only two concepts received the lowest score (1).

Most evaluations were concentrated around scores 2 and 3, reflecting a moderate level of performance across the majority of groups. The overall mean score was 3.0 out of 5, indicating an acceptable ability to translate ideas into initial visual representations. It is notable that the use of artificial intelligence tools contributed to enhancing the visual formulation of ideas for some students. However, the variation in results suggests that not all students were able to utilize these tools effectively, as reflected in the presence of lower scores in some cases.

### *4.7. Feasibility of the Idea*

The feasibility criterion was achieved in all concepts (100%), indicating that all students attempted to demonstrate the practical applicability of their ideas. Scores ranged from 1 to 5, with three concepts achieving the highest score (5) and four concepts receiving the lowest score (1).

Most evaluations were concentrated between 3 and 4, reflecting a performance level ranging from acceptable to good among a significant portion of the groups. The overall mean score was 3.25 out of 5, indicating a relatively good level of practical thinking compared to the traditional phase.

It is evident that some students benefited from artificial intelligence tools in enhancing feasibility through simulation and visual modeling, which helped clarify implementation aspects. However, the presence of lower scores in several projects highlights the need for additional training focused on analyzing real-world feasibility and linking design ideas to available resources and practical constraints.

### *4.7.1. Originality*

The originality criterion was achieved in all concepts (100%), reflecting a general awareness among students of the importance of presenting novel ideas or adopting unconventional design

approaches. Scores ranged from 1 to 5, with four concepts achieving the highest score (5) and three concepts receiving the lowest score (1). Additionally, a score of 4 appeared in five concepts, indicating a good level of distinctiveness and innovation in a considerable number of projects. The overall mean score reached 3.25 out of 5, reflecting a good level of originality across the design outputs. This improvement can be partially attributed to the use of artificial intelligence tools, which helped some students move beyond conventional patterns and explore new design alternatives. However, lower scores in certain cases suggest that achieving originality still requires deeper intellectual guidance and the reinforcement of creativity based on analysis and critical thinking, rather than reliance on technological tools alone.

### *4.7.2. User-Centeredness*

The user-centeredness criterion was achieved in 11 out of 20 concepts (55%), while it was absent in 9 concepts (45%), indicating a noticeable weakness in integrating user needs into the design and thinking process. Scores for the concepts that met this criterion ranged from 1 to 5, with only one concept achieving the highest score (5), while five concepts received the lowest score (1). This reflects an almost complete absence of user experience considerations in a substantial number of projects. The overall mean score was 2.11 out of 5, representing a weak level of user consideration in the development of design ideas. This result indicates a clear decline in attention to end-user needs, even with the use of artificial intelligence tools, which are expected to support user experience visualization and analysis. This finding suggests that artificial intelligence tools were not optimally utilized in this aspect, emphasizing the need to strengthen human-centered design principles and to activate the role of intelligent tools in simulating and improving user experience as a fundamental component of the design process, rather than a secondary or supportive element.

### *4.7.3. Idea Reformulation and Development*

The evaluation of the idea reformulation and development criterion showed that it was achieved in all 20 concepts (100%), indicating that all groups attempted to revisit or refine their ideas at some stage of the project.

Scores ranged from 1 to 5, with only one concept achieving the highest score (5), while five concepts received the lowest score (1), suggesting the absence of substantial development in some cases and reliance on superficial reformulation without meaningful transformation of the idea.

Most evaluations were concentrated between 2 and 4, reflecting significant variation in the quality of development processes across groups. The overall mean score was 2.55 out of 5, indicating a performance level ranging from weak to moderate in students' ability to systematically develop their ideas.

This average suggests that idea reformulation was not sufficiently effective in many projects, as development often remained limited to surface-level adjustments without deeper analysis or reconstruction of the design approach. This highlights the need to strengthen skills related to critical evaluation of ideas and structured, stage-based thinking to support progressive and well-informed design development.

### *4.7.4. Innovation*

The innovation criterion was achieved in all 20 concepts (100%), indicating that all groups attempted to incorporate elements of novelty into their design proposals. Scores ranged from 1 to 5, with only one concept achieving the highest score (5) and three concepts receiving the lowest score (1), reflecting limited originality or lack of unconventional solutions in some projects. In contrast, a score of 4 appeared in seven concepts, representing a relatively strong proportion and indicating clear efforts to move beyond conventional patterns. The overall mean score was 3.2 out of 5, suggesting a good level of innovation across the projects.

This average reflects noticeable efforts by several groups to present innovative ideas and move beyond traditional models through relatively new solutions. However, some projects still exhibited simplicity or repetition, which affected the overall level of innovation achieved. Accordingly, it is recommended to enhance skills related to exploration and creative experimentation, and to promote design practices that support the generation of unique ideas based on in-depth analysis of user needs and design context, rather than relying solely on formal or technical treatments.

### *4.8. Summary of Phase Two Results – Studio 5 (AI-Supported Phase)*

The results of the second phase, in which artificial intelligence tools were employed in the process of idea generation and development, revealed several notable shifts in students' performance compared to the traditional phase. A total of 20 design concepts distributed across nine groups were evaluated according to six main criteria: idea translation,

feasibility, originality, user-centeredness, idea reformulation and development, and innovation.

The findings indicate partial improvement in aspects related to formulation, organization, and visual representation, alongside the persistence of challenges associated with deeper design thinking and user analysis.

The idea translation criterion was fully achieved across all concepts (100%) with an average of 3.0 out of 5, indicating an acceptable ability among students to convert concepts into clear initial representations. Artificial intelligence tools contributed to enhancing visual formulation and structuring ideas for some students. However, the concentration of scores at moderate levels reflects variability in the effective use of these tools, as not all participants benefited equally.

The feasibility criterion was also achieved in all projects (100%) with an average of 3.25 out of 5, representing a relative improvement compared to the traditional phase. Artificial intelligence tools helped some students better visualize implementation aspects through simulation and the generation of alternative solutions, thereby supporting practical thinking. Nevertheless, the presence of lower scores indicates the continued need to strengthen the connection between design ideas and real-world constraints.

Regarding originality, the criterion achieved a good level with an average of 3.25 out of 5, and was fulfilled in all concepts. This reflects the role of AI tools in expanding the scope of exploration and providing multiple design alternatives, enabling some students to move beyond conventional patterns. However, variability in results suggests that originality was not always the outcome of deep creative thinking, but was sometimes linked to the tool's ability to generate diverse suggestions without sufficient analytical development by the student.

In contrast, user-centeredness remained the weakest-performing criterion, achieved in only 55% of the concepts, with a low average of 2.11 out of 5. This indicates that the use of artificial intelligence tools did not effectively enhance user-centered design. Many projects remained focused on formal or conceptual aspects rather than on actual user experience, revealing a gap between the available technological capabilities and their application in human-centered analysis.

The idea reformulation and development criterion was achieved in all projects, with an average of 2.55 out of 5, indicating a weak to moderate level of performance. This suggests that development processes were often limited to partial or superficial improvements rather than deep restructuring of design concepts. It also highlights that the availability of digital tools does not necessarily lead to systematic idea development unless accompanied by strong critical and analytical skills.

As for innovation, the criterion was achieved in all concepts, with an average of 3.2 out of 5, representing a relatively good level. Artificial intelligence tools contributed to proposing new and varied ideas, supporting attempts to move beyond conventional solutions. However, the limited number of top scores and the presence of lower evaluations indicate that innovation varied in depth and was often confined to formal enhancements rather than substantive, context-driven design innovation.

Overall, the results of the second phase demonstrate that the use of artificial intelligence tools contributed to improving organizational and visual aspects and accelerating the ideation process. It also supported practical thinking and originality to a certain extent. However, it did not produce a comparable improvement in deeper cognitive dimensions, particularly in understanding user needs and systematically developing design ideas.

These findings suggest that artificial intelligence functions as a supportive and enabling tool within the design process, but it does not replace critical design thinking or analytical expertise, which remain the decisive factors in determining the quality of design outcomes.

### *4.9. Discussion of Case Study Results*

The findings of the case study present a multidimensional perspective on the impact of artificial intelligence tools during the design ideation phase. The results indicate that this impact was not uniform across all groups; rather, it was closely associated with the students' level of design thinking and their possession of analytical and methodological skills required to effectively employ these tools. Accordingly, the results can be discussed through several interpretive dimensions that clarify the nature and limits of this impact.

First, the results indicate that artificial intelligence contributed significantly to improving the visual and organizational aspects of design ideas. An increase in scores was observed in several groups during the second phase compared to the traditional phase. For example, the first group moved from a very low level to a moderate level, while the second group showed noticeable improvement in some concepts. This can be attributed to the ability of AI tools to support visual formulation, generate multiple alternatives, and facilitate clearer presentation of ideas. However,

in many cases, this improvement remained limited to the level of "presentation" without extending to the conceptual depth or analytical substance of the design idea.

Second, the findings demonstrate that the quality of design outputs remained fundamentally dependent on the student's capabilities rather than the tool itself. High-performing groups in the traditional phase—such as Groups Five and Seven—continued to achieve strong results when using artificial intelligence, particularly when it was applied thoughtfully, as reflected in high scores (e.g., 26 and 28). In contrast, lower-performing groups—such as Group Three—did not show improvement with the use of AI, maintaining weak performance levels. This suggests that artificial intelligence tools do not compensate for weak design thinking or the absence of a structured methodology.

Third, the results reveal the continued weakness of user-centeredness as a core issue across both phases. This criterion remained the least achieved, with a fulfillment rate of only 55% in the AI-supported phase and a low average score. This indicates that the use of artificial intelligence did not significantly enhance students' understanding of user needs or their integration into the design process. Instead, many projects remained focused on formal or conceptual aspects. This finding confirms that user-centered design does not emerge automatically through the use of technological tools; rather, it requires methodological awareness and targeted training.

Fourth, the findings highlight variability in the impact of artificial intelligence even within the same group. Some concepts showed significant improvement, while others declined or remained unchanged, as observed in Groups Seven and Eight. This variation reflects that the effectiveness of AI tools depends on how they are used, the quality of inputs, and the student's ability to critically guide the outputs. Therefore, the tool itself is not the determining factor; rather, it is the manner in which it is integrated into a conscious design process.

Fifth, some results indicate that unstructured use of artificial intelligence may lead to a decline in performance. This was evident in Group Six and in certain concepts within Group Seven, where evaluation scores decreased compared to the traditional phase. This can be explained by the reliance on AI tools without sufficient understanding, which may result in superficial or fragmented ideas, or reduce the analytical effort exerted by the student, thereby negatively affecting the overall quality of outputs.

Sixth, the findings suggest that artificial intelligence enhances exploratory aspects more than analytical ones. It contributed to expanding the range of alternatives, relatively improving originality, and supporting feasibility considerations, as reflected in higher average scores for these criteria in the second phase. However, criteria such as idea reformulation and development, as well as user-related analysis, did not experience similar improvement. This indicates that AI tools are more effective in supporting the "initiation" of ideas rather than their deep development or systematic refinement.

Seventh, the results point to a transformation in the role of the designer within the design process. The designer is no longer solely responsible for generating ideas but also assumes the role of guiding and evaluating the outputs of digital tools. This shift requires the acquisition of new skills, including the ability to formulate effective inputs, assess the quality of outputs, and distinguish between superficial and in-depth solutions—skills that were not equally developed among all students.

In conclusion, the use of artificial intelligence in the design ideation phase offers significant potential in supporting exploration, enhancing visual representation, and accelerating the design process. However, its effectiveness remains contingent upon a strong foundation in design thinking. The results confirm that these tools cannot replace deep human understanding or systematic analysis, particularly in the development of user-centered solutions. Therefore, integrating human capabilities with intelligent technologies represents the most effective approach to enhancing the quality of the design process within educational contexts.

### *4.10. Answering the study's questions*

**Answer to the First Research Question**

Research Question 1:

How does the ideation of design ideas and concepts generated using artificial intelligence tools differ from those produced through traditional methods among interior design students?

The findings of the present study align with a number of previous studies addressing the nature of design inspiration and the role of digital tools and artificial intelligence in the stages of idea generation and development. The results indicate that traditional ideation is more closely associated with the formation of the initial concept and the establishment of a creative foundation. This is consistent with the work of Eckert & Stacey (2000) and Gonçalves et al. (2014), who emphasized that human sources of inspiration rely heavily on the

designer's cognitive experience and mental representations, thereby enhancing originality in the early stages of design thinking. This perspective is further supported by Cross (2001), who highlighted the cognitive nature of the design process, asserting that design solutions primarily emerge from internal thinking processes rather than from the tools themselves.

In contrast, the results demonstrate that the use of artificial intelligence tools contributed to improving visual clarity, organizing ideas, and accelerating the development of design solutions. This finding is consistent with studies on generative artificial intelligence in design, which confirm that such tools function as supportive mediators in the visualization stage rather than as substitutes for the creative process itself. For example, Awashra et al. (2025) highlighted the role of generative imaging in enhancing visual communication of design ideas, while Chen et al. (2019) demonstrated the ability of AI-based systems to support idea generation and expand the design solution space.

These findings also align with the concept of co-creativity, as discussed by Davis et al. (2015) and Kim & Maher (2021), where artificial intelligence is viewed as a creative partner that supports and stimulates the designer rather than replacing them. This is further reinforced by studies such as Georgieva (2025) and Lee (2025), which examined the use of generative AI in design education and found improvements in student productivity and the visual quality of outputs, while the depth of critical thinking remained dependent on the learner's own skills.

On the other hand, the persistent weakness in the user-centeredness criterion across both traditional and AI-supported phases aligns with the framework of design empathy proposed by Kouprie & Visser (2009), which emphasizes that understanding users is a deep cognitive and human-centered process that cannot be achieved automatically through technological tools. This is further supported by Buxton (2010), who argued that the quality of user experience depends primarily on design methodology rather than on visual representation tools.

Moreover, the variation in the impact of artificial intelligence across groups, and the observed decline in performance in some cases where methodological clarity was lacking, is consistent with findings by Bansal (2024) and Liu & Chilton (2022), who emphasized the importance of prompt engineering skills in determining the quality of AI-generated outputs. The effectiveness of these tools depends largely on the user's ability to guide them systematically.

This interpretation is also supported by Doshi & Hauser (2024), who found that while artificial intelligence can enhance individual creativity, it does not necessarily guarantee depth of thinking or diversity of solutions without conscious human intervention.

Overall, the findings of the present study reinforce conclusions from recent literature on AI-supported design, which conceptualize these technologies as augmentation tools within the design process rather than replacements for human design thinking. This perspective aligns with the framework proposed by Liao et al. (2020) on AI-augmented design, which emphasizes that the decisive factor in the quality of design ideas remains the designer's expertise and analytical capability.

**Answer to the Second Research Question**

What is the impact of using artificial intelligence tools on the initial design ideation of interior design projects among female students at King Abdulaziz University?

First: Translating the Idea into a Clear Visual Representation

The criterion of translating the idea into a clear visual representation is a fundamental indicator of a student's ability to convert a design concept into a comprehensible visual form that can effectively communicate with the viewer. Design literature emphasizes that visual representation serves as a core cognitive medium for conveying and developing design ideas (Buxton, 2010; Leblebici-Başar & Altarriba, 2013).

The evaluation results across both the traditional and AI-supported phases revealed noticeable differences in performance within this criterion. The use of artificial intelligence tools enabled several students to produce clearer and more coherent visual representations aligned with their design concepts, which positively influenced their evaluation scores in the second phase. This finding aligns with studies on AI-supported design, which highlight the role of generative systems in enhancing visual ideation and accelerating design visualization processes (Awashra et al., 2025; Chen et al., 2019).

For instance, in Group One, the evaluation improved from 4/30 in the traditional phase to 16/30 after using AI tools. This improvement can be attributed to the ability of digital tools to generate visual representations and rapid simulations, enabling the student to express her idea more convincingly. This supports the concept of human–AI co-creativity (Davis et al., 2015).

Similarly, Group Eight achieved a distinguished

level, where the second concept scored 5/5 due to presenting a well-integrated and coherent visual representation.

However, improvement was not consistent across all cases. Group Three, for example, did not demonstrate noticeable progress, maintaining a low score (5/30). This indicates that the quality of visual translation depends not only on the tool itself but also on the student's conceptual understanding and ability to use the technology with design awareness. This finding is consistent with guidelines on interacting with generative AI systems, which emphasize the importance of user skill in directing outputs (Liu & Chilton, 2022).

**Second: Feasibility of the Idea**

The evaluation results revealed clear variation in the feasibility of ideas across groups in both the traditional and AI-supported phases. In some cases, artificial intelligence tools contributed to enhancing the clarity of practical aspects of the design idea.

For example, in Group Two, the evaluation of the first concept improved from 14 to 18, due to a clearer representation of spatial distribution and functional elements, making the design more realistic. This aligns with the framework of AI-augmented design, which suggests that digital tools support the exploration of solutions and enhance practical visualization (Liao et al., 2020).

Similarly, Group Five achieved a high-performance score of 26/30, where digital tools supported the presentation of detailed plans and implementation aspects, strengthening the feasibility of the design.

In contrast, improvement was not universal. In Group Four, the evaluation decreased from 17 to 15, indicating that artificial intelligence was used primarily to enhance visual presentation without adequately addressing practical and functional dimensions. This observation aligns with warnings in the literature regarding over-reliance on visual outputs without deepening design thinking (Zhang et al., 2021).

Furthermore, Group Three maintained a low performance level (5/30), reflecting a lack of integration between conceptual ideas and practical application.

**Third: Originality of the Idea and Avoidance of Repetition**

The results revealed noticeable improvement in the originality of ideas after the use of artificial intelligence in several cases. Digital tools helped expand the creative thinking space for some students, which aligns with the findings of Doshi & Hauser (2024), who highlighted the ability of generative AI to enhance individual creativity by broadening the design solution space.

For instance, Group Five improved from 22 to 26, indicating a more innovative reformulation of the idea. Similarly, Group Eight achieved 28/30, reflecting an effective integration of conceptual depth with strong visual treatment, consistent with the concept of creative synthesis in design (Taura & Nagai, 2013). Group Two also showed improvement, with its first concept increasing from 14 to 18.

Conversely, repetition persisted in some cases. Group Nine experienced a decline from 21 to 13, suggesting over-reliance on ready-made outputs without sufficient personal development. This aligns with recent studies highlighting the risk of design fixation associated with AI use (Wadinambiarachchi et al., 2024). Group Three maintained a low score (5/30), and Group Four did not demonstrate clear improvement in originality, reinforcing that tools alone do not generate creativity without conscious and critical application (Jagtap, 2019).

**Fourth: User-Centeredness and Responsiveness to User Needs**

The analysis showed that user-centeredness was among the weakest-performing criteria in both the traditional and AI-supported phases, with most scores ranging between 1 and 2 out of 5. No substantial improvement was observed after the use of artificial intelligence.

This indicates that AI tools were primarily used to produce visual and aesthetic outputs rather than to conduct meaningful analysis of user needs or behaviors. This finding is consistent with the design empathy framework, which emphasizes that understanding users is a deeply human and cognitive process that cannot be fully automated (Kouprie & Visser, 2009).

For example, Group One continued to lack user-centeredness despite notable visual improvement. Group Seven demonstrated strong visual and innovative performance without a corresponding enhancement in the human-centered dimension. Meanwhile, Group Three maintained weak performance linked to a lack of user understanding.

This limitation can be attributed to insufficient use of AI tools in user analysis, as well as limited integration of human-centered design methodologies (Razzouk & Shute, 2012).

**Fifth: Idea Reformulation and Development**

Some groups showed clear improvement in reformulating and developing ideas when using artificial intelligence tools. These tools supported better organization, conceptual clarity, and visual expression, reinforcing the notion of AI as a

collaborative partner in reshaping ideas within the design process (Kim & Maher, 2021).

In Group Two, the score increased from 14 to 18, reflecting the student's ability to rethink and refine the design structure. Group Eight achieved 4/5 in this criterion by developing the idea and presenting multiple design alternatives, consistent with iterative idea-generation models in creative design (Gero & Kannengiesser, 2004).

However, genuine development was not achieved in all cases. Group Three remained at a low score (5/30), indicating no substantial transformation in the conceptual structure despite the use of digital tools. This suggests that while AI can support development, it does not replace deep design thinking.

### Sixth: Innovation and Design Value

The results indicate that artificial intelligence contributed to enhancing innovation in some groups by enabling more experimental and flexible solutions. This aligns with findings from AI-enhanced design education studies, which emphasize its role in expanding creative exploration among students (Georgieva, 2025; Lee, 2025).

For example, Group Eight achieved the highest possible score (5/5) in innovation by effectively using AI tools to explore unconventional design possibilities. Group Five also demonstrated strong performance (26/30) by balancing innovation with practical feasibility.

However, improvement was not universal. Group Four achieved a moderate score (15/30), indicating that the use of AI without a clear design vision may lead to conventional outcomes. This is consistent with literature suggesting that the effectiveness of technological tools depends on the designer's expertise and cognitive strategy (Dalsgaard, 2017).

Overall, the findings suggest that artificial intelligence contributed—at varying levels—to improving the visual and organizational aspects of design ideas. However, its impact remained limited in deeper dimensions, particularly in user analysis and the achievement of meaningful innovation. This variation is closely linked to students' awareness of design thinking methodologies and their ability to effectively integrate technological tools within the creative process.

### Answer to the Third Research Question

What challenges do female students in the Interior Design and Furniture Department at King Abdulaziz University face in using artificial intelligence tools to inspire initial design ideas and concepts?

Despite the growing role of artificial intelligence in supporting creativity and accelerating design processes, its integration into interior design education and practice is associated with several important challenges. One major challenge is prompt bias, where the wording and structure of prompts directly influence the generated outputs. As a result, AI systems may reproduce repetitive or predictable patterns instead of generating genuinely innovative solutions. This bias is often difficult to detect because users may perceive AI outputs as objective, while they actually reflect assumptions embedded within the prompts themselves. In addition, concerns related to intellectual property and hybrid authorship create ethical and legal ambiguity regarding ownership of AI-assisted creative work (Popescu & Schut, 2023).

Another significant challenge is the limited ability of AI systems to understand the human sensory and emotional experience within interior spaces. Although generative AI tools can quickly produce visually appealing concepts, they often fail to represent the multisensory and contextual dimensions of spatial design. Consequently, some AI-generated proposals may appear unrealistic, impractical, or disconnected from the functional requirements of the project. This creates a gap between visually attractive outputs and actual user needs, requiring continuous human intervention to interpret client expectations and ensure design feasibility (El Moussaoui, 2025; Lin et al., 2026).

The study findings also revealed concerns regarding repetitive and superficial ideas generated by AI systems. Several students reported that AI tools frequently reproduced similar concepts with only minor variations, limiting creative diversity and reducing the originality of design solutions. This reliance on commonly repeated patterns may contribute to visual homogenization, where design outputs become increasingly similar due to dependence on shared training data. As a result, excessive reliance on AI tools may weaken the uniqueness and individuality of creative work (Doshi & Hauser, 2024; Wadinambiarachchi et al., 2024; Shao, 2024).

A further challenge relates to the limited focus of AI systems on user-centered design principles. Some students observed that AI-generated concepts often emphasized aesthetic appearance rather than functional, emotional, or human-centered aspects connected to end users. Since empathy and understanding user experiences are fundamentally human cognitive processes, AI tools cannot fully replace the designer's role in interpreting social, cultural, and behavioral dimensions within interior environments (Kouprie & Visser, 2009; Razzouk &

Shute, 2012).

Students also expressed concerns about the impact of excessive dependence on artificial intelligence on independent thinking and creative development. Intensive use of AI tools may reduce self-directed research and encourage designers to adopt generated ideas without sufficient critical evaluation or personal development. This may negatively affect the designer's ability to develop original concepts and independent problem-solving skills over time (Zhang et al., 2021; Figoli et al., 2022).

In addition, the effectiveness of AI tools depends heavily on the user's expertise in directing the system and formulating prompts accurately. Studies have shown that the quality of generated outputs is strongly influenced by the designer's ability to control parameters, customize models, and critically evaluate results. Therefore, AI should be considered a supportive tool that enhances exploration and visualization rather than a substitute for human creativity and professional expertise (Bansal, 2024; Liu & Chilton, 2022).

Finally, some students identified technical and contextual limitations associated with AI-generated outputs. These included weak understanding of local cultural contexts, linguistic difficulties, and increased cognitive load caused by the large number of generated alternatives. Without a clear design methodology, the abundance of AI-generated recommendations may distract the design process rather than support it. Accordingly, the primary challenge does not lie in the technological capabilities of AI itself, but in achieving effective integration between AI systems and human-centered design thinking while preserving creativity, contextual understanding, and the human dimension of interior design practice (Lin et al., 2026; Herath et al., 2026; Naqvi et al., 2025.

## 5. CONCLUSIONS OF THE STUDY

This study is considered an exploratory investigation limited to the educational context and sample under examination, as it was confined to a group of students enrolled in the "Studio 5" course within the Interior Design and Furniture Department at King Abdulaziz University. Accordingly, the findings and conclusions presented reflect this specific context and are not intended to be generalized absolutely to all educational environments or interior design practices. Nevertheless, the study provides preliminary insights that contribute to understanding the nature of employing artificial intelligence tools during the design ideation stage and opens the way for broader and more diverse studies to further examine these findings across different educational and institutional contexts.

Based on the analysis of design outputs, several conclusions can be drawn regarding the impact of artificial intelligence tools on the process of design ideation within the examined design education environment:

1. Artificial intelligence enhanced the visual and organizational aspects of design ideas. The use of intelligent tools demonstrated a clear ability to accelerate the generation of initial concepts and improve the formulation and presentation of ideas compared to traditional methods.
2. Within the context of this study, artificial intelligence did not necessarily lead to a comparable improvement in deeper design thinking processes. Limited development was observed in criteria related to conceptual analysis, particularly user-centeredness and idea reformulation, suggesting that technological support alone may not substitute for fundamental design skills and reflective thinking.
3. User-centered design remained the weakest-performing criterion in both phases. This highlights a potential educational gap related to integrating user needs into the early stages of design ideation.
4. The effectiveness of artificial intelligence appeared to depend largely on students' awareness and guidance strategies. Some groups achieved notable improvement through conscious and critical use, while others showed limited benefit due to superficial engagement or weak prompt formulation skills.
5. Artificial intelligence functioned primarily as a supportive and enabling tool rather than an independent generator of creativity. The core concepts generally originated from the designer, while the role of the tool was often associated with organization, expansion, visualization, or reformulation.
6. The use of artificial intelligence contributed to reshaping the designer's role within the educational process. Students shifted from solely generating ideas to managing digital knowledge, directing outputs, and critically evaluating results.
7. Traditional inspiration methods appeared to retain greater cognitive and emotional depth in this educational setting. Despite the efficiency and speed offered by AI-supported ideation,

conventional approaches continued to provide richer conceptual grounding and stronger reflective engagement.

### *5.1. General Recommendations*

Based on the findings of this study and within the limits of the examined sample and educational context, the following recommendations are proposed:

1. Integrate artificial intelligence tools systematically into interior design curricula, rather than treating them as unstructured supplementary tools, while ensuring their use within a clearly defined educational framework.
2. Strengthen user-centered design education by incorporating user analysis and needs assessment as essential stages prior to employing artificial intelligence tools.
3. Develop training programs for students focusing on:

- Prompt engineering skills.
- Critical evaluation of AI-generated outputs.
- Effective integration of AI tools within a comprehensive design process.

4. Encourage a balanced approach between traditional and digital inspiration to help maintain the depth of human creativity and reflective design thinking.
5. Guide students to use artificial intelligence at specific stages of the design process, particularly for:

- Expanding design alternatives.
- Testing visual representations.
- Enhancing conceptual presentation.

6. Develop teaching strategies that prioritize analytical and critical thinking before relying on generative tools, as the findings of this study suggest that AI support alone may not necessarily enhance deeper design thinking processes within similar educational settings.
7. Strengthen students' critical thinking skills when engaging with AI-generated outputs to reduce over-reliance on automatically generated solutions.
8. Integrate user needs analysis training within the ideation stages to reinforce the relationship between design decisions and user requirements.
9. Emphasize the student's role as an active designer and critical thinker, rather than a passive recipient of generated outputs.
10. Enhance students' ability to precisely guide generative tools in order to produce more customized and contextually relevant design outcomes.

### *5.2. Suggestions for Future Research*

In light of the study findings and its limitations, the researcher proposes the following directions for future research:

1. Investigating the impact of artificial intelligence on the long-term development of design thinking skills among interior design students.
2. Comparing the effects of artificial intelligence tools across different educational levels (beginner – intermediate – professional).
3. Examining the role of artificial intelligence in enhancing user-centered design through user experience simulation models.
4. Analyzing the relationship between prompt engineering skills and the quality of design outputs.
5. Conducting longitudinal experimental studies comparing:

- Traditional ideation,
- Digital ideation,
- Hybrid ideation.

6. Exploring the impact of artificial intelligence on the designer's individual creative identity within both educational and professional contexts.
7. Developing educational models that integrate artificial intelligence with critical thinking in design studios.

**Conflict of Interest:** The authors declare that there is no conflict of interest regarding the publication of this study.
**Ethical Approval:** This study did not require ethical approval.
**Funding:** The authors received no financial support for the research, authorship, and/or publication of this article.

## REFERENCES

Aboushall, D. (2024). The effect of artificial intelligence on developing the interior designer's performance in interior architecture. International Journal of Multidisciplinary Studies in Art and Technology. Advance online publication. https://doi.org/10.21608/ijmsat.2024.260018.1019

Al-Abdulkarim, Rashed Hussein. (2011). Qualitative Research in Education. Riyadh: King Saud University Press.

Al-Tkhayneh, K., Alghazo, E., & Tahat, D. (2023). The advantages and disadvantages of using artificial intelligence in education. Journal of Educational and Social Research, 13(4), 105–114. https://doi.org/10.36941/jesr-2023-0094

Al-Zahrani, Mohammed. (2020). Criteria for Evaluating the Quality of Qualitative Research in the Humanities. International Journal of Educational and Psychological Studies, 8(3), 605–622. https://doi.org/10.31559/EPS2020.8.3.4

Awashra, I., et al. (2025). Generative AI visualization for participatory design communication. Landscape and Urban Planning.

Bansal, P. (2024). Prompt engineering: Importance and applicability with generative artificial intelligence. Journal of Computer and Communications, 12(3), 45–58.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), 77–101.

Buxton, Bill. 2010. Sketching User Experiences: Getting the Design Right and the Right Design. Toronto, Canada: Morgan Kaufmann.

Chen, J., Shao, Z., & Hu, B. (2023). Generating Interior Design from Text: A New Diffusion Model-Based Method for Efficient Creative Design. Buildings, 13(7), 1861. https://doi.org/10.3390/buildings13071861

Chen, L., Wang, P., Dong, H., Shi, F., Han, J., Guo, Y., Childs, P. R., Xiao, J., & Wu, C. (2019). An artificial intelligence based data-driven approach for design ideation. Journal of Visual Communication and Image Representation, 61, 10–22. https://doi.org/10.1016/j.jvcir.2019.02.009

Chen, W., Hu, H., Saharia, C., & Cohen, W. W. (2023). Re-Imagen: Retrieval-augmented text-to-image generation. arXiv preprint arXiv:2302.11382.

Creswell, J. W. (2007). Qualitative inquiry and research design: Choosing among five approaches (2nd ed.). Thousand Oaks, CA: Sage Publications.

Creswell, J. W. (2009). Research design: Qualitative, quantitative, and mixed methods approaches. Thousand Oaks, CA: Sage Publications.

Cross, N. (2001). Design cognition: Results from protocol and other empirical studies of design activity. In Design knowing and learning: Cognition in design education (pp. 79–103). Elsevier.

Dalsgaard, Peter. 2017. "Instruments of Inquiry: Understanding the Nature and Role of Tools in Design." International Journal of Design 11 (1): 21–33.

Daly, S. R., Yilmaz, S., Christian, J. L., Seifert, C. M., & Gonzalez, R. (2012). Design heuristics in engineering concept generation. Journal of Engineering Education, 101(4), 601–629. https://doi.org/10.1002/j.2168-9830.2012.tb01121.x

Davis, N., Hsiao, C. P., Singh, K. Y., Li, L., Moningi, S., & Magerko, B. (2015). Drawing Apprentice: An enactive co-creative agent for artistic collaboration. Proceedings of the 2015 ACM SIGCHI Conference on Creativity and Cognition, 185–186.

Davis, N., Siddiqui, S., Karimi, P., Maher, M. L., & Grace, K. (2019). Creative sketching partner: A co-creative sketching tool to inspire design creativity. Proceedings of the 10th International Conference on Computational Creativity, 358–359.

Dazkir, Sibel, Jennifer Mower, Kelly Reddy-Best, and Elaine Pedersen. 2013. "An Exploration of Design Students' Inspiration Process." College Student Journal 47 (2): 394–404.

Doshi, A. R., & Hauser, O. P. (2024). Generative artificial intelligence enhances individual creativity but reduces collective diversity. Science Advances, 10(28), eadn5290. https://doi.org/10.1126/sciadv.adn5290

Eckert, Claudia, and Martin Stacey. 2000. "Sources of Inspiration: A Language of Design." Design Studies 21 (5): 523–538. https://doi.org/10.1016/S0142-694X(00)00022-3.

Figoli, F. A., Mattioli, F., & Rampino, L. (2022). Artificial intelligence in the design process: The impact on creativity and team collaboration. FrancoAngeli.

Ge, W., & Hou, G. (2024). The effects of generative AI model type and visual stimuli type on design creativity. International Journal of Art & Design Education, 43(2), 456–472. https://doi.org/10.1111/jade.12540

Georgieva, I. (2025). Exploring the use of generative text AI in design creativity education. Smart Learning Environments, 12(1). Springer Nature. https://doi.org/10.1186/s40561-025-00289-3

Gero, J. S. (1990). Design prototypes: A knowledge representation schema for design. AI Magazine, 11(4), 26–36.

Gero, J. S., & Kannengiesser, U. (2004). The situated function–behaviour–structure framework. Design Studies, 25(4), 373–391. https://doi.org/10.1016/j.destud.2003.10.010

Goel, A. K. (1997). Design, analogy, and creativity. IEEE Expert, 12(3), 62–70. https://doi.org/10.1109/64.590078

Gonçalves, Milene, Carlos Cardoso, and Petra Badke-Schaub. 2014. "What Inspires Designers? Preferences on Inspirational Approaches during Idea Generation." Design Studies 35 (1): 29–53. https://doi.org/10.1016/j.destud.2013.09.001.

Gosciniak, Małgorzata, and Krystyna Januszkiewicz. 2019. "Architecture Inspired by Nature. Human Body in Santiago Calatrava's Works. Sophisticated Approach to Architectural Design." IOP Conference Series: Materials Science and Engineering 471 (8): 471. https://doi.org/10.1088/1757-899X/471/8/082041.

Han, J., Hua, M., Park, D., Wang, P., & Childs, P. R. N. (2020). Computational conceptual distances in combinational creativity. Proceedings of the DESIGN Conference, 177–186.

Han, J., Shi, F., Chen, L., & Childs, P. R. (2018a). A computational tool for creative idea generation. AI EDAM, 32(4), 462–477.

Han, J., Shi, F., Chen, L., & Childs, P. R. (2018b). The Combinator. Design Science, 4, e11.

Herath, S., Bashardoust, A., Bole, Y., & Shrestha, Y. R. (2026). Design principles for text-to-image generative artificial intelligence creativity support tools for visual design. European Journal of Information Systems. Advance online publication. https://doi.org/10.1080/0960085X.2026.2616042

https://www.academia.edu/6004764/Conducting_semi_structured_interviews

Jagtap, S. (2019). Design creativity. International Journal of Design Creativity and Innovation, 7(1–2), 99–115.

Jia, L., Becattini, N., Cascini, G., & Tan, R. (2020). Testing ideation performance. International Journal of Design Creativity and Innovation, 8(1), 31–45.

Kang, Y., Sun, Z., Wang, S., Huang, Z., Wu, Z., & Ma, X. (2021). MetaMap. CHI 2021 Proceedings, 1–15.

Karimi, P., Rezwana, J., Siddiqui, S., Maher, M. L., & Dehbozorgi, N. (2020). Creative sketching partner. IUI 2020 Proceedings, 221–230.

Kim, J., & Maher, M. L. (2021). Evaluating the effect of co-creative systems on design ideation. ICCC 2021 Proceedings, 440–443.

Kouprie, M., & Visser, F. S. (2009). A framework for empathy in design: stepping into and out of the user's life. Journal of Engineering Design, 20(5), 437-448.

Leblebici-Başar, D., & Altarriba, J. (2013). The role of imagery and emotion in the translation of concepts into product form. The Design Journal, 16(3), 295-314.

Lee, C. W. (2025). Application of generative artificial intelligence in visual design education to enhance creativity. Engineering Proceedings, 98(1), 29. MDPI. https://doi.org/10.3390/engproc2025098029

Liao, J., Hansen, P., & Chai, C. (2020). A framework of artificial intelligence augmented design support. Human–Computer Interaction, 35(5–6), 511–544 z.

Lin, Y., Guo, J., Chen, Y., Yao, C., & Ying, F. (2020). Collaborative ideation with a co-creative robot. In Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems (pp. 1–14). Association for Computing Machinery. https://doi.org/10.1145/3313831.3376798

Lincoln, Y. S., & Guba, E. G. (1985). Naturalistic inquiry. Newbury Park, CA: Sage Publications.

Liu, V., & Chilton, L. B. (2022). Design guidelines for prompt engineering text-to-image generative models. In Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems (pp. 1–23). Association for Computing Machinery. https://doi.org/10.1145/3491102.3501825

Luo, J., Sarica, S., & Wood, K. L. (2019). InnoGPS. IDETC-CIE Proceedings.

Medel-Vera, C. (2025). An exploration of the role of generative AI in fostering creativity in architectural education. Developments in the Built Environment, 13, 100196. Elsevier. https://doi.org/10.1016/j.dibe.2025.100196

Naqvi, S. M., Ren, X., Kim, J., et al. (2025). A cross-level perspective on the role of generative AI in design practice and education. In Proceedings of the CHI Conference on Human Factors in Computing Systems (CHI '25). Association for Computing Machinery. https://doi.org/10.1145/3613904.3642345

Oxford University Press. (2025). Oxford English Dictionary. Retrieved May 11, 2026, from https://www.oed.com

Petre, Marian, Helen Sharp, and Jeffrey Johnson. 2006. "Complexity through Combination: An Account of Knitwear Design." Design Studies 27 (2): 183–222. https://doi.org/10.1016/j.destud.2005.07.003.

Qanini, Abdelkader. (2006). Nature (1st ed.). Morocco–Lebanon: Arab Cultural Center.

Radford, A., Kim, J. W., Hallacy, C., Ramesh, A., Goh, G., Agarwal, S., Sastry, G., Askell, A., Mishkin, P., Clark, J., Krueger, G., & Sutskever, I. (2021). Learning transferable visual models from natural language

supervision. Proceedings of the International Conference on Machine Learning (ICML).

Razzouk, R., & Shute, V. (2012). What is design thinking and why is it important? Review of educational research, 82(3), 330-348.

Rombach, R., Blattmann, A., Lorenz, D., Esser, P., & Ommer, B. (2022). High-resolution image synthesis with latent diffusion models. In Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR) (pp. 10684–10695). https://doi.org/10.1109/CVPR52688.2022.01042

Saharia, C., Chan, W., Saxena, S., Li, L., Whang, J., Denton, E., Seyed Ghasemipour, S. K., Ayan, B. K., Mahdavi, S. S., Lopes, R. G., Salimans, T., Ho, J., Fleet, D. J., & Norouzi, M. (2022). Photorealistic text-to-image diffusion models with deep language understanding. Advances in Neural Information Processing Systems (NeurIPS).

Shao, G. (2024). Manufacturing digital twin standards. In Proceedings of the ACM/IEEE 27th International Conference on Model Driven Engineering Languages and Systems (pp. 370–377). Association for Computing Machinery. https://doi.org/10.1145/3652620.3688250

Taura, T., & Nagai, Y. (2013). A systematized theory of creative concept generation. Research in Engineering Design, 24(2), 185–199.

Taura, T., Nagai, Y., & Tanaka, S. (2005). Design space blending. ICED 2005 Proceedings.

Taylor, D. W., Berry, P. C., & Block, C. H. (1958). Does group participation facilitate creative thinking? Administrative Science Quarterly, 3(1), 23–47.

Walsh, M. (2019). Conducting semi-structured interviews. Oxfam Research Guidelines.

Yin, R. K. (2018). Case study research and applications: Design and methods (6th ed.). SAGE Publications.

Yu, J., Xu, Y., Koh, J. Y., Luong, T., Baid, G., Wang, Z., Vasudevan, V., Ku, A., Yang, Y., Ayan, B. K., Hutchinson, B., Han, W., Parekh, Z., Li, X., Zhang, H., Baldridge, J., & Wu, Y. (2022). Scaling autoregressive models for content-rich text-to-image generation. Transactions on Machine Learning Research.

Yun, G. (2022). Ideasquares: Utilizing generative text as a source of design inspiration. In Proceedings of the Design Research Society Conference 2022. Design Research Society. https://doi.org/10.21606/drs.2022.1030

Zhang, C., Zhang, C., Zhang, M., & Kweon, I. S. (2023). Text-to-image diffusion models in generative AI: A survey. arXiv preprint arXiv:2303.07909.

Zhang, G., Raina, A., Cagan, J., & McComb, C. (2021). A cautionary tale about the impact of AI on human design teams. Design Studies, 72, 100990.

Zhang, H., Xu, T., Li, H., Zhang, S., Wang, X., Huang, X., & Metaxas, D. (2017). StackGAN: Text to photo-realistic image synthesis with stacked generative adversarial networks. Proceedings of the IEEE International Conference on Computer Vision (ICCV).

Zuo, H., Jing, Q., Song, T., Liu, H., Sun, L., Childs, P., & Chen, L. (2022). WikiLink. ArXiv preprint arXiv:2208.14349.