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Technology and Architecture: Impact of Artificial Intelligence and Virtual Reality on the Perception of Architectural Design

Jhanella Katheryn Cañari Rodriguez*, Jeraldin Briguit Arzapalo Yali, Vladimir Simon Montoya Torres

Faculty of Engineering, Universidad Continental, Perú

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Abstract The search for innovation in architecture with new technologies focuses on the convergence between artificial intelligence (AI) and virtual reality (VR) in the field of architectural design, taking into account the perception and sensation of virtual spaces in the shot of architects' decisions in the design process. The study aims to evaluate the level of perception, realism and sensation experienced by sensory characters immersed in architectural virtual spaces designed through comparative technological combination in a 2D environment. An experimental methodology was used based on a diagnosis according to the principles of neuroarchitecture, identifying the considerations related to sensory characters, followed by the grammatical generation of the prompt to obtain 2D images through AI, which were recreated in 3D models through of the Oculus Quest 2. Specific questions were raised that examine the sensations, perception and realism in the spaces created by Artificial Intelligence, collaborating with the virtual virtualization platform. The comparative analysis between the sensations anticipated by the designer, those experienced in the virtual space and the 2D visualization had a favorable impact on the perception and sensation of the virtual space designed using image generators. An innovative perspective for decision-making in architectural design is proposed, concluding that the integration of artificial intelligence image generators with VR suggests significant potential for the application of this technological synergy in the architectural field, which provides new opportunities for the practical application of these technologies in the workplace. These conclusions contribute to the understanding of how these technologies can be used in the design process to improve the quality of architectural spaces and educate future architects in new technologies.

Keywords Artificial Intelligence, Virtual Reality, Sensory Architecture, Architecture, Neuroarchitecture

1. Introduction

After the progress of technology in recent years, considering its innovation, the United Nations (UN) perceives in AI a possible accelerator of the sustainable development goals (SDG) by facilitating collaboration between governments, societies and the UN through effective and predictive responses, which favors developing economies and access to new markets [1]. However, a new digital disparity is generated among professionals from advanced countries in order to obtain the benefits provided by innovative technologies [2]. Likewise, the UN in Colombia experimented with virtual reality (VR) to evoke realistic emotions and explore how emerging technologies can contribute to social visions. Considering the experiences and perspectives of the UN, emerging technologies have the capacity to improve SDG 11 regarding sustainable cities and communities by efficiently addressing urban challenges. Innovative technologies can address urban challenges effectively through the application of collaborative workshops that employ the visual tools acquired by innovative technologies [3]. Similarly, project management also decreases resource consumption. SDG 4, which focuses on educational quality, minimizes the digital gaps that exist among future architects in digital terms.

In relation to the field of architecture, engineering and construction (AEC), it has an impact on social well-being and global economic growth, which represents 6% of global GDP [4]. Consequently, goals are established in the SDGs for sustainable infrastructure and innovative and intelligent urbanization processes. In collaboration with emerging technologies that promote automation and adaptability in various circumstances, these are used from conceptualization to maintenance management, with the ability to span the entire building life cycle. Decision-making begins in the conceptualization of the design through Artificial Intelligence (AI), followed by the prior spatial visualization with Virtual Reality (VR) in the preliminary project, and the management of the project process through the information modeling methodology construction (BIM). Materials automation through machine learning enables prediction of material properties, structural design simulation performed by Digital Twins (GT) for strength and structural performance. 3D printing is for modular system assemblies, building data processing to optimize operability and complete analysis of user needs, as well as augmented reality (AR) simulation on the construction site. With the purpose of carrying out effective projects, reducing delays, cost overruns and optimizing the productivity and precision of the built environment [5], the transition from industry 4.0 to industry 5.0 aims to add value to digitalization by integrating human intelligence with autonomous machines, prioritizing sustainability and process efficiency [6].

However, with the benefits of industry 5.0, not only does applied technology stand out, but architecture begins to design environments that promote human well-being in four dimensions: physical, intellectual, emotional and social, paving the way for the neuroarchitecture that develops guidelines for its implementation in architectural design [7]. There is an approach that considers multisensory interactions and connections to maximize the potential of architectural design in promoting human social, cognitive and emotional development, improving the quality of architectural spaces [8].

In order to achieve excellence in architectural spaces, it is imperative to develop exhaustive concepts that are based on the needs, requirements and experiences of the client. An alliance is contemplated with artificial intelligence (AI), which is defined as the emulation of human intelligence processes by machines, especially computer systems, and is applied in various fields, such as image processing, of natural language, among others [9]. When applying artificial intelligence, methods such as evolutionary computing are used to generate innovative and aesthetically efficient architectural images, which constitute the first decisions in conceptualization and can influence the performance and cost of the project. In addition, genetic algorithms generate the shape of a building or its facades through the application of interfaces that enable initial solutions in the CAD environment [9].

By sharing these new objectives of building sustainable and long-lasting buildings, renowned studios such as Zaha Hadid Analytics + Insights, Foster + Partners, HOK and NBBJ have implemented internal teams specialized in artificial intelligence to optimize decision making in design conceptualization, generating multiple options automatically [10]. The addition of image generators is beginning to redefine the design process. The ability of Artificial Intelligence such as ChatGPT to create conceptualized paragraphs with data obtained by the designer's requests, which are subsequently processed by an image-generating AI, such as MindJourney, in order to convert them into visual images, accelerates the development of conceptualization. Decision making and interaction between architects and clients become more effective. However, the lack of consideration of building regulations represents complex information for Artificial Intelligence, so the designer must modify the design created by AI to comply with regulatory provisions [11].

Virtual reality (VR) also contributes to architectural design by mitigating redoing work in the design, which, according to David Panya [12], mentions the existence of three main axes: redesign, information flow and delivery, which offers an interactive BIM methodology that collaborates with virtual reality (VR) to enable active client participation remotely. Likewise, the Urban Network supports citizen participation in the urban planning of their community, which promotes more effective results [13]. An important aspect to keep in mind about virtual reality (VR) is realism; the multiple display options are capable of simulating highly realistic environments, influencing the emotional experience and perception of the environment. This shows that it can assist in the inclusive design process by improving the architect's understanding of user behavior in the spatial environment [14]. However, cognitive stress has an impact on the professional's performance, according to the study by Mohamed Umair [15]. According to the study by Mohamed Umair [15], the virtual environment contributes to an improvement in work performance by increasing the understanding of the environment, the perception of dimension and spatiality, facilitating the capture of essential aspects of architectural design, such as measurements, materiality and proportion, which contributes to [16]. Results with more human spaces adapted to the changing needs of the user, highlight the importance of education for future architects in the management of new technologies and approaches that promote human well-being from a cognitive and sensory perspective [17].

Considering the opportunities of new technologies in the architectural field, it is evident that the convergence between Artificial Intelligence and Performance in architectural design can assist architects in making decisions more effectively due to their perception and understanding of architectural space, designing designs of spatial excellence.

2. Literary Review

2.1. Previous Study

The analysis of the convergence between Artificial Intelligence and Virtualization in architectural design has been used, with the purpose of evaluating the perception, realism and sensation in virtual spaces. Despite the absence of a specific tool for measuring sensations, previous information from various investigations has been considered.

During the initial stages of building architectural models, R. d. Klerk et al. [18], studies have been carried out on the potential of the VR system to improve its design. The combination of real-time and immersive exploration allows exploring spatial constructions, facilitating the creative process in the early stages of design, and the precedent of M.E.'s contextual work. Portman, A. Natapov and D. Fisher-Gewirtzman [13]. Current opportunities and challenges are presented, examining the use of Virtual Reality (VR) environments as a teaching and research tool in architecture, landscaping and environmental planning, examining their impacts and contributions in each of these disciplines.

The ability of VR to represent inaccessible realities is highlighted and the need to achieve various levels of precision in virtual environments is analyzed, where VR is used in this field for specific purposes. A comprehensive literature review has been compiled that compiles data from case studies or practical examples that demonstrate the effective use of VR in these disciplines, creating a framework for testing the overall validity of architectural designs.

According to H. Li, Q et al. [19], the integration of neural networks and artificial intelligence in architectural design combines machine learning and artificial intelligence algorithms to generate, analyze and optimize designs. This includes the development of innovative shapes, energy efficiency analysis, space optimization, simulation of human behavior and design assisted by artificial intelligence. This research develops an auxiliary model based on artificial intelligence (AI) that improves the reliability of our results. By using artificial intelligence in architectural projects, compliance with the three-dimensional characteristics of the space is guaranteed, based on the analysis of the function and general structure of the design. This is achieved through the processing of data sources, which enables an accurate and objective evaluation of architectural design, in addition to the precedent of the contextual work of Hugo C et al. [16].

The current difficulties and challenges in the investigation of how students acquire and understand architectural space through the senses and emotions that influence shapes, colors and design materials are detailed. A significant difference is observed in the optimization of mental rotation, visualization, orientation and spatial perception. It can be stated that the experimental group obtained greater benefits in the measurements; these results help us to have a clear concept of the importance of VR in perception and sensation.

3. Methodology

According to previous studies, the creation of images through texts contributes to making architectural design intuitive and fast at the beginning.

The primary purpose of this research was to examine the sensory experience in a virtual environment (see Table 1), specifically examining three fundamental aspects.

1. Level of perception: Users perceive and interpret visual and auditory stimuli in the virtual environment in the way that users perceive and interpret visual and auditory stimuli in the virtual environment.

2. Sensation: Users experience emotions and sensations in response to the virtual environment so that users experience emotions and sensations in response to the virtual environment.

3. Realism: Users perceive the authenticity and verisimilitude of the virtual environment in the way they perceive the authenticity and verisimilitude of the virtual environment.

To achieve this objective, the following methodological stages were implemented:

Table 1. Methodology table

STAGES	ITEMS	REFERENCES
DIAGNOSIS	A neuroarchitecture-based analysis was performed to identify and understand sensory character interaction and behavior patterns in virtual environments. This analysis focused on evaluating how the design of virtual spaces had an influence on the sensory experience, perception and behavior of the user.	V. T. Vijayan and M. R. Embi mention by applying principles of neuroarchitecture, they sought to understand how the design of virtual spaces could be optimized to improve the user experience and promote positive behavioral patterns [20].
CREATION OF PROMTS	Grammatical PROMTS were generated to describe architectural images, allowing the creation of a common language for image generation.	PROMPT generation is an effective technique in design, according to V. Paananen and others, as it optimizes clarity, efficiency, creativity, consistency and collaboration in the design process [21].
IMAGE GENERATION	Artificial intelligence tools, such as Lexica, Imgcreator and Open Art IA, were used to transform textual descriptions into images of architectural spaces, facilitating the visualization and communication of ideas.	S. Y. Jang and S. A. Kim demonstrated that artificial intelligence can be used to generate detailed visual representations from descriptive texts, which facilitates the understanding and transmission of concepts in the architectural field [22].
3D DESIGN AND MODELING	Using images generated by artificial intelligence (AI), innovative architectural designs were designed and subsequently modeled in 3D for detailed visualization. This combination of technologies allowed new architectural forms and structures to be explored efficiently and precisely.	H.G, Tone et al. explored how AI imagery was inspired by innovative architectural designs. They then refined with 3D models to create more details. This mix of artificial intelligence and 3D modeling revolutionized the visualization and design of architectural spaces, offering new possibilities [16].
VISUALIZATION	The visualization of architectural buildings in a virtual environment using Oculus Quest 2 allowed an immersive evaluation of the user's perception and sensation, providing a realistic and detailed experience that simulated the interaction with the physical space.	Thanks to technology, H. G, Tone, during the 3D design analysis, they were able to explore lighting, textures and materials, simulate the flow of people, and identify potential design and functionality issues, giving them a more detailed understanding [16].
ANALYSIS	In order to understand user behavior in the immersive environment, a thorough analysis was carried out using quantitative and qualitative methods. Specific surveys were developed to collect valuable data on the user's interaction with the environment, allowing for a greater understanding of their behavior patterns and perceptions.	D. Paes, J. Irrizary and D. Pujoni carried out an analysis of immersive behavior using a multidisciplinary approach. The results provided a deep understanding of user interactions and perceptions [23].

From a neuroarchitecture perspective, we examine the influence of spatial design on our human experience. This multidisciplinary approach reveals how built environments shape our perceptions, emotions and behaviors [24], providing us with opportunities to create environments that foster well-being. Below are the key principles that govern these interactions.

Based on the analysis of how architecture influences the perception and sensations of the individual [29], a literary review of the five principles of neuroarchitecture was carried out, establishing them as fundamental pillars for the design of the modules (see Table 2). In the design of the modules, a solid conceptual framework was created that adjusts to the designer's needs in terms of the perception and feeling expected in each space. Different principles were combined with materials, textures and sensations. (see Table 3).

Table 2. Neuroarchitecture Data Analysis

ITEMS	PERCEPTION	REFERENCES
LIGHTNING	High	Lighting helps you feel good and comfortable, which helps combat stress, fatigue, depression and apathy [25].
	Half	
	Low	
	Natural	
COLOR	Cold	Colors have the ability to evoke psychological and physiological responses in individuals; Its correct application in environments can have a significant impact on the mental and emotional health of individuals [26]
	Warm	
	Black	
	White	
SHAPE	Wide spaces	The temporal distribution in the environments promotes concentration and mental clarity. In places where our senses are not overwhelmed by narrow walls, our minds find the necessary rest [27].
	Confined spaces	
	Spaces with sharp edges	
	Spaces with gentle curves	
HEIGHT	High	According to scientific studies, ceiling height has a significant influence on the concentration and activities of individuals. High ceilings suit more creative tasks, while low ceilings favor more routine work [7].
	Low	
BIOPHILIA	Vegetation	The feeling of being confined produces anxiety and decreases the productivity of those who find themselves in such areas. Green areas help stimulate the mind, stimulate concentration and promote calm [28].

In order to continue the research and obtain the results of creating images through Artificial Intelligence, the text-to-image method [30] was used, based on the theoretical analysis of the previous text (see Table 3). Around 20 grammatical codes called "prompts" were generated, which are the words we use to tell the Artificial Intelligence what we want [21]. After exhaustive efforts, it was found that the following code was adequate to achieve the desired results: *Sensory architectural interior, high lighting, white color, reduced quadrangular space, with height, without vegetation, concrete material, ceramic and metal, rough texture, a photograph was taken from afar, front view, product photography, unreal engine render, Houdini render, cinema 4d rénder, cinematic render, ultra-detailed, micro detailed intricate detailed::6, isometric 45 degrees, photo-realistic, hyper-realistic, reflective, stressful, harsh, aggressive.*

Then, we decided to experiment with Lexica, Imgcreator and OpenArt, AIs specialized in image generation, obtaining a variety of options that were analyzed and selected in accordance with what was required [31].

We continue our progress towards materialization, selecting an alternative from the images produced by Artificial Intelligence. With the aim of materializing from 2D to a three-dimensional space, cutting-edge modeling platforms such as Revit, SketchUp and Rhinoceros are used (see Table 4). In crafting the virtual environment, we carefully evaluated the available options, ultimately selecting Twinmotion for complete immersion and Lumion to capture panoramic views. The conclusive selection of Twinmotion as the visualization method (see Table 5), accompanied by the experimental platform—a Windows 10 system with 32 GB of RAM and 24 GB of VRAM, compatible with the Oculus Quest 2 virtual reality device—was a result of careful deliberation. This procedure was carried out in order to accurately evaluate the perception and sensations of the end user, in order to model the image generated by Artificial Intelligence in a three-dimensional environment. This process allows determining whether an architectural design can be based on the conceptual image generated by artificial intelligence, ensuring that it is consistent with the perception and sensations experienced by an individual in a virtual environment, as well as the capacity for mobility and realism [16], although the 3D modeling process may require a partial loss of visual details. It is intended that, compared to the original 2D image, the three-dimensional representation is as faithful as possible to the image generated by artificial intelligence, allowing an evaluation closer to reality of the sensory and perceptual impact on users. This strategic approach seeks to immerse the user in an enriching and sensory experience, where each architectural aspect is transformed and awakens palpable emotions [32].

Table 3. Textual description of the modules

ITEMS		M01	M02	M03	M04	M05
LIGHTNING	High					
	Half					
	Low					
	Natural					
COLOR	Cold					
	Warm					
	Black					
	White					
SHAPE	Wide spaces					
	Confined spaces					
	Spaces with sharp edges					
	Spaces with gentle curves					
HEIGHT	High					
	Low					
BIOPHILIA	Vegetation					
MATERIALS		Concrete Ceramics	Paint Glass	Wood Glass	Concrete Paint	Wood Glass
TEXTURE		Rough	Rough	Silky	Hard	Gentle
SENSATIONS		Insecurity Stress	Security Tranquility	Productivity Relaxation	Fear Anxiety	Security Energy

Table 4. Images according to the resulting AI

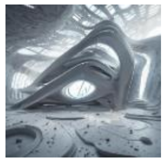
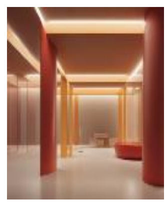
MODULE	IMAGE
M 01	   
M 02	   
M 03	   
M 04	   
M 05	   

Table 5. Images recreated in the virtual environment. (hyperlink in VR column images)

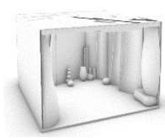
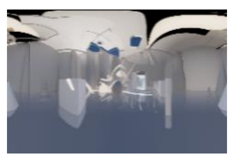
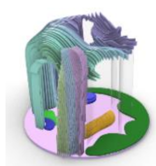
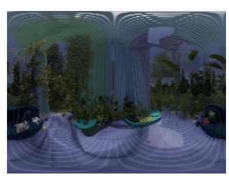
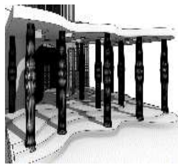
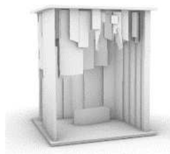
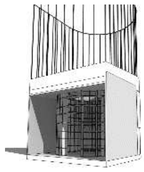
MD	2D	3D	VR
M01			
M02			

Table 5 continued

M03			
M04			
M05			

This experimental study involved 53 participants. It was decided to carry it out in 2 stages: the first stage, images generated by artificial intelligence of one of five modules were viewed and a 12-question survey was completed. The 32 professionals from various disciplines participated in a second stage, divided into architects and other careers. The second stage focuses on immersive experimentation through the use of the Oculus Quest 2 for the visualization of the developed modules in 3D for a period of 10 minutes [33] (see Figure 1). Subsequently, a digital survey of 16 questions is carried out. The purpose of both surveys was to understand the perception, sensations and realism of the end user in relation to architectural design, as well as the development of tacit knowledge in the decision-making of architectural professionals [34].

Figure 1. Experimentation Images

4. Results

Below are the results of the survey on realism, perception and sensation, carried out in two stages with 53 participants. Figure 2 shows the result of perspectives taking important characteristics into account.

The different perspectives that sensory characters have regarding the perception of realism in virtual spaces were evaluated. The perspectives of the characters immersed in the architecture emphasize aspects such as light - shadow and materials, while for other professionals 360 visualization is important (see Figure 2). Taking into account the given perspectives, we obtain results from the students: their perception of realism in the virtual space is at a moderately realistic level in the three aspects (see Figure 3). It gives us a deep understanding of how realism in virtual spaces is perceived by different groups of people highlighting the importance of considering multiple aspects for architectural design decisions to create immersive and compelling virtual [35] Likewise, the level of realism will depend on the program and viewer used for visualization.

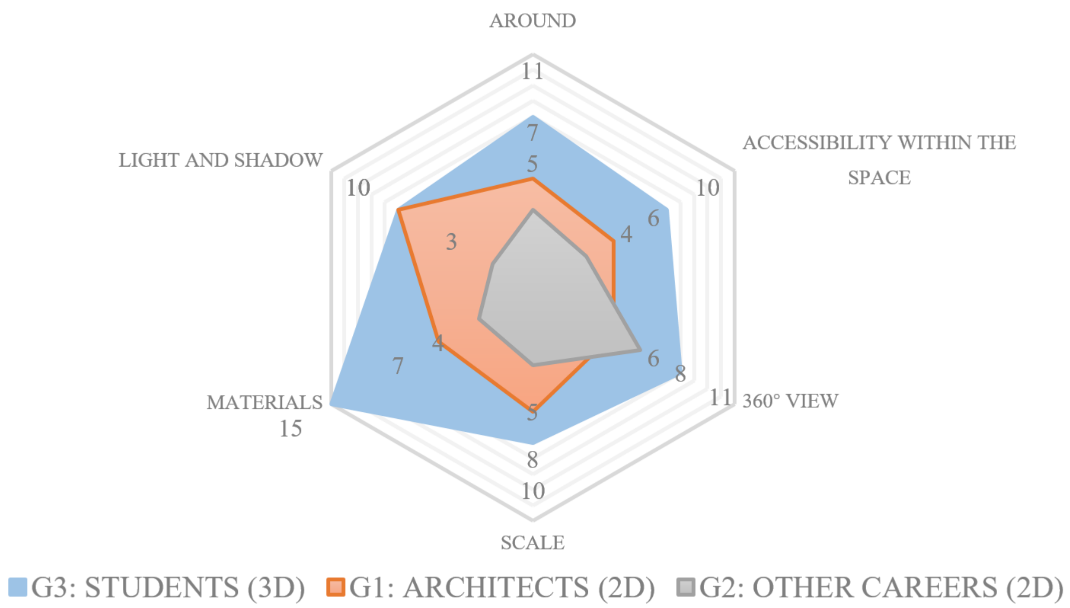


Figure 2. Result of perspectives considering important characteristics of realism within the space according to the user

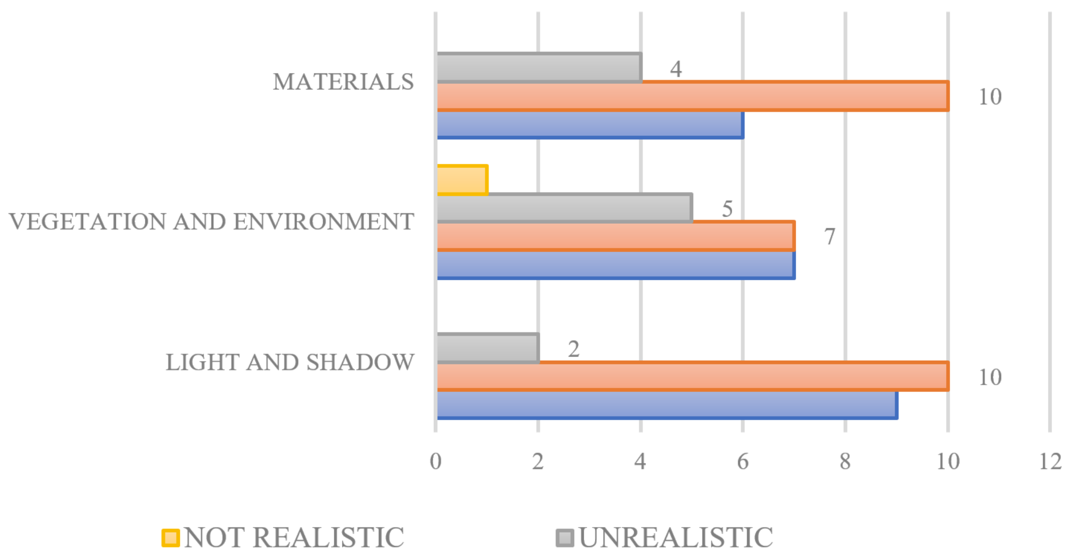


Figure 3. Result of the level of realism by category in the immersive space

Approximately only 14% maintain that the operation of the Oculus Quest 2 is easy to understand in order to mobilize and visualize oneself within the space (see Figure 4). According to the results, there is a need for improved usability and a greater user experience for more intuitive navigation on the Oculus Quest 2 in virtual spaces. Next, it reveals the significant impact that AI and VR have on the perception of architectural design.

The comparison between virtual reality (see Table 5) and 2D images generated by artificial intelligence (see Table 4) reveals differences in design interpretation between groups of architects and other professionals. In module 2, the designer pursues the following characteristics: medium lighting, curved shapes in space, a palette of cold tones, low height and vegetation (see Table 3). The results reveal a difference between the perceptions of architects and other professionals regarding the heights and shape of space in 2D visualization, while the immersive experience conforms to the designer's requirements (see Figure 5). The results of Module 1 are totally different, designed with the following characteristics: white color palette, high height, high lighting, small space shapes and no vegetation (see Table 3). This illustrates the discrepancy in spatial interpretation between the groups that experienced virtual reality (see Table 5) and those that observed 2D images generated by Artificial Intelligence (see Table 4), with greater precision in understanding the virtual environment [23] regarding lighting [36] and the shape of the space (see Figure 6).

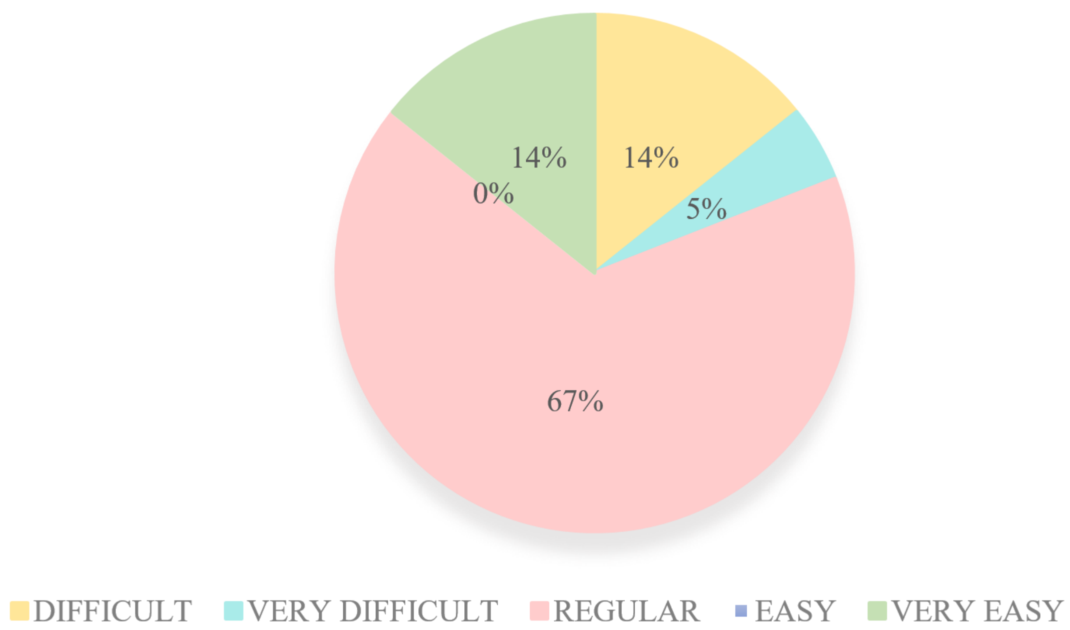


Figure 4. Result of the level of navigation within the virtual space by the respondents

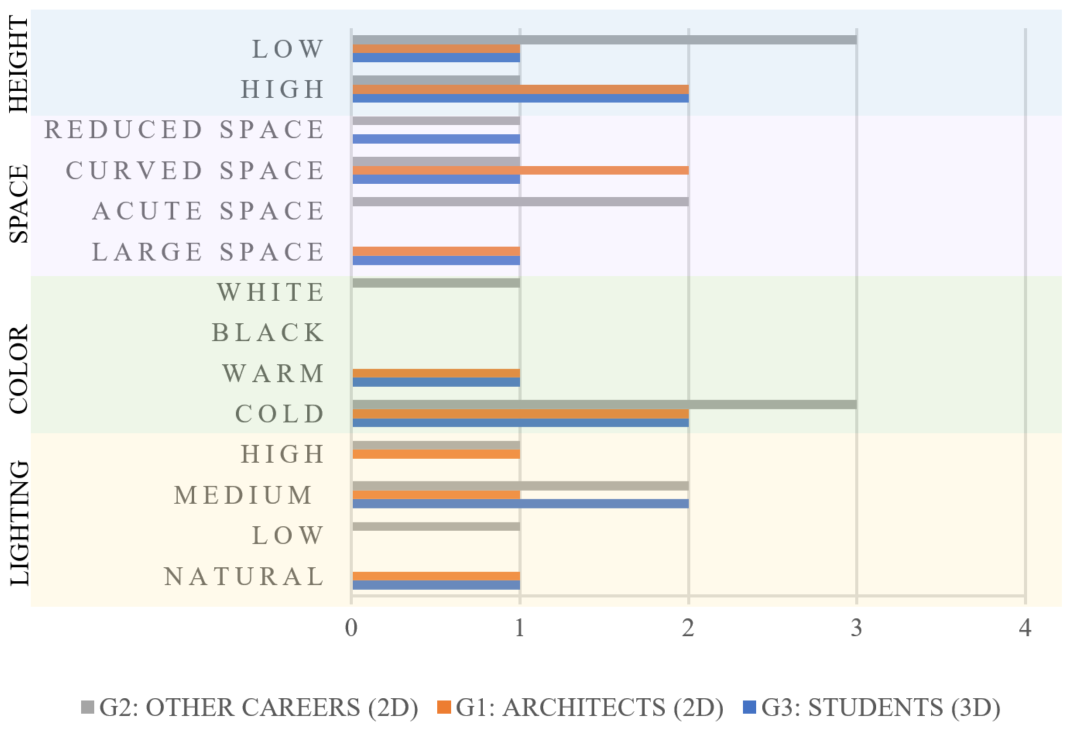


Figure 5. Result of the level of perception of users in the Module 2

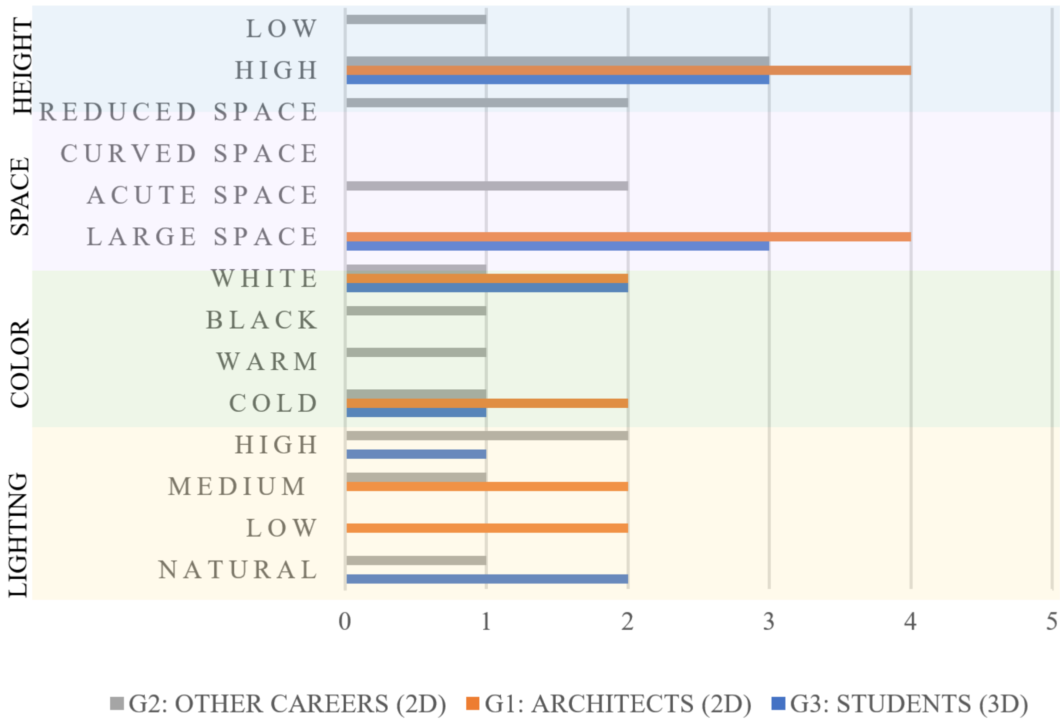


Figure 6. Result of the level of perception of users in Module 1

In both cases, it is suggested that the immersive environment improves the compression of the design perception by interacting lighting and surface [37]; However, it should be taken into account that it may change due to the internal effects of the programs used. Next with artificial intelligence, it highlights a communication gap between the two, resulting in end users having a completely different perception. Examine how these technologies affect the perception of design and their application effectively to improve architectural practice [16].

An analysis was carried out of the sensations associated with the various characteristics of the architectural design, such as lighting, tone, shape and height, considering from a virtual scope.

The study reveals how AI and VR are changing the architectural design process through AI and VR. The complexity of the impact of the conceived space on the sensations of the sensory individual is highlighted. Analysis of various aspects of the environment, such as lighting, shape, color and height, reveals discrepancies between the sensations experienced in 2D and virtual environments. In module 3, conceived with the purpose of promoting tranquility, relaxation, stress and freedom (see Table 3), participants experienced tranquility in the 2D environment, although stressed in the virtual environment (see Figure 8). In module 4, which pursues the induction of tranquility, energy, security and freedom (see Table 3), sensations of tranquility were experienced in the 2D environment, however, feelings of fear in the virtual environment (see Figure 9). In module 5, designed to evoke fear, sadness, anxiety and security, significant discrepancies were found in the perceived sensations, from anxiety to concentration and sadness (see Figure 7).

A disparity is evident in the results in relation to the emotional impact perceived and obtained in the user's virtual environment. This discovery illustrates the professional's decision-making in the first instance when faced with the offer of Artificial Intelligence with the wide variety of conceptual possibilities. Consequently, it highlights the importance of providing feedback to adjust the design according to the user's preference and sensitivities, as well as underscoring the perception of co-creation between humans and artificial intelligence (see Table 4) which suggested the importance of emotional communication. Above are the formal characteristics [38].

In addition, a notable variability between the generated 2D image and its representation in the virtual environment is due to factors such as filters, the effects of the viewing medium or the characteristics of the viewer used. These elements influence the alteration of the sensation and perception of the image in the virtual space. However, variability is not limited only to lighting or color, but also influences shape, scale and height. These factors raise the professional's second decision-making regarding the prediction of the 2D image when modeling in 3D. The objective is to achieve the similarity of the image generated with AI, although there is a percentage of visual loss, which is contrasted with visual interactions such as animated objects, vegetation, artificial lighting, among others perceived in the virtual environment. It is important to highlight the potential of HR Realization (VR) (see Table 5) to evaluate the emotional impact of architectural features in a controlled environment [39].

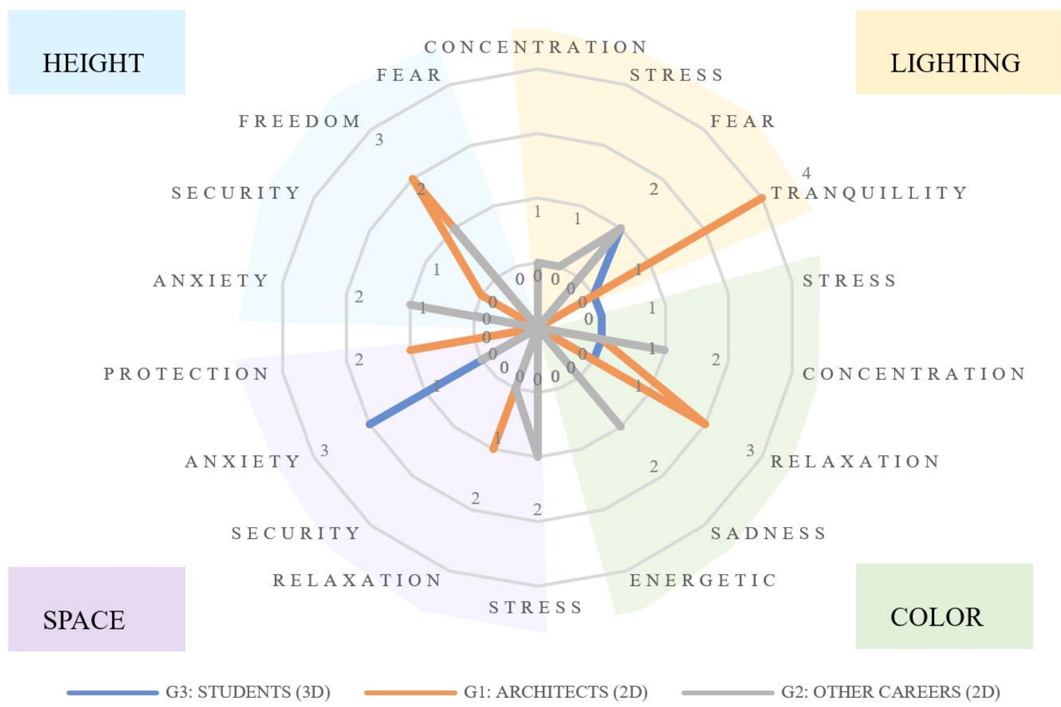


Figure 7. Result of the user sensation level in module 5

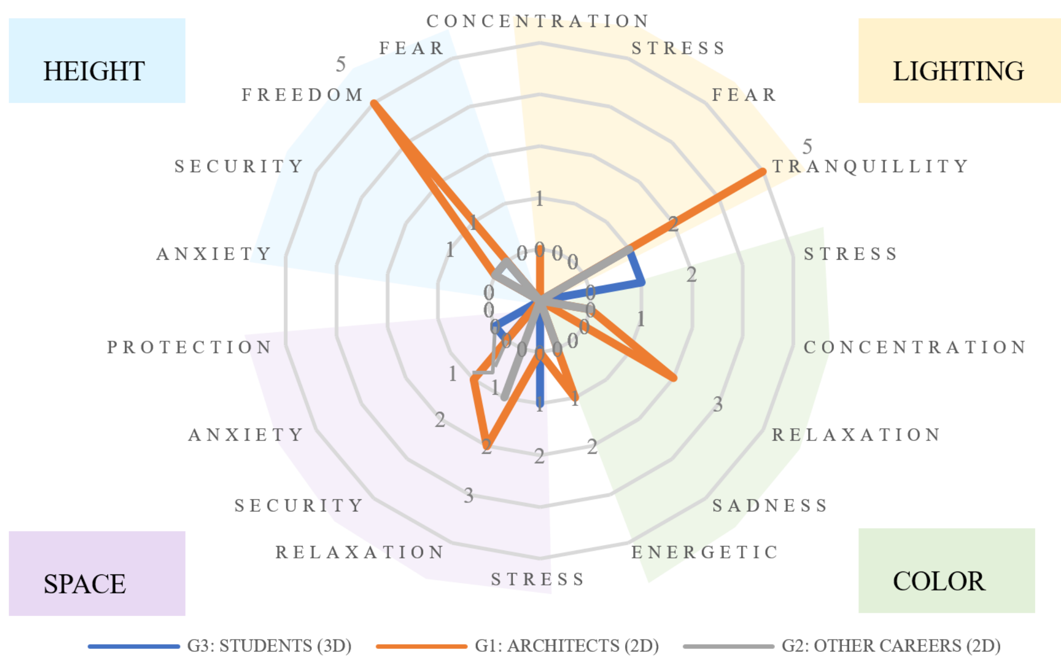


Figure 8. Result of the level of user sensation in module 3.

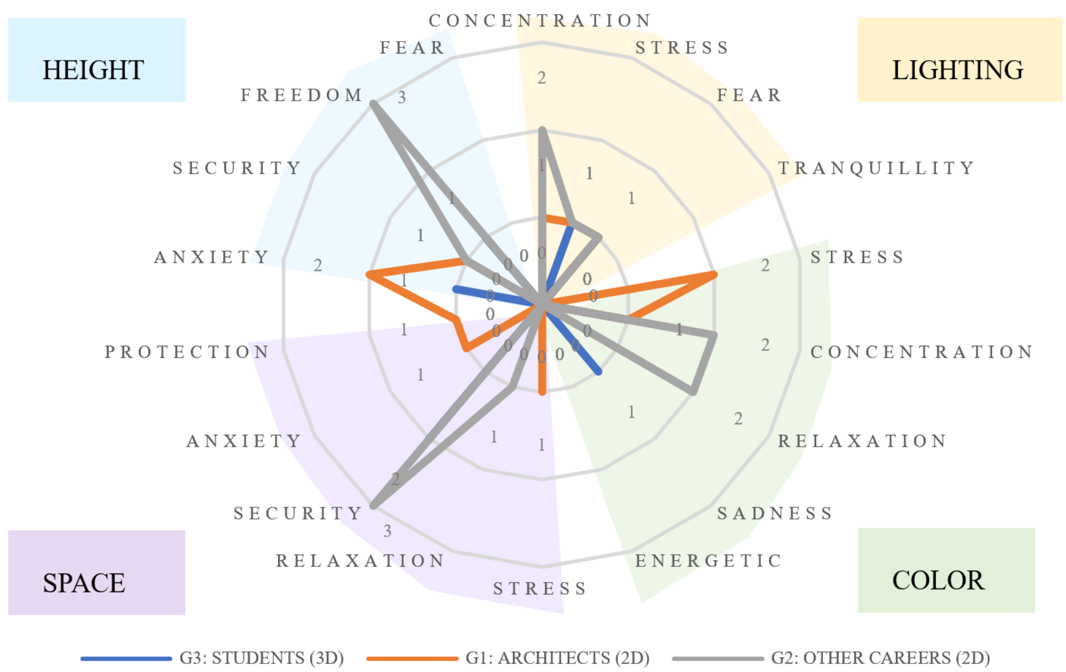


Figure 9. Result of the level of user sensation in the module 4

Likewise, providing this feedback will facilitate decision-making in a more conscious manner that is aligned with the original intentions of the design. Likewise, it is seen that the designer's intentions regarding the user experience to different factors, such as visual, personal experiences, lead the user to have a different perception and sensation, which highlights the capabilities of artificial intelligence and VR to make decisions informed by the user's needs and sensations. By having an approach that could optimize efficiency in the design process, improve user experience, and encourage greater engagement with the built environment [16], efficiency in the design process could be optimized.

5. Discussion

The convergence between Artificial Intelligence and the Artificial Network facilitates the immersive exploration of architectural spaces, facilitating the creative process in the initial phases of design. Through a thorough literature review and experimental study, significant results have been obtained that reveal both the potential and challenges of this convergence. In methodological terms, two methodologies that are used separately were integrated, the first consisting of the use of Artificial Intelligence with the purpose of accelerating decision-making in the conceptualization process, using AI as an image generator [22] (see Table 4). Continuing with the evaluation of the capacity for realism in the virtual environment [40] (see Figure 2). Likewise, the literary analysis of neuroarchitecture was included (see Tables 2 and 3) in order to provide us with the requirements for Artificial Intelligence. However, for an adequate evaluation of emotions, it is chosen to use devices that detect brain waves and heart rate [41].

AI (see Table 4) can create designs based on the principles of neuroarchitecture and sensations desired by the designer, defining that height, shape and lighting are key to the perception of the design, defining that AI can create designs based on desires, knowledge, and architect's techniques. However, Artificial Intelligence can develop designs that are based on the architect's desires and technical knowledge. However, the images provided do not often interpret the required sensations, as does the opinion in various articles that the assertiveness of AI depends on assertiveness [42]. Likewise, the preference of images according to training in architectural education [22] has shown that sensory characters in the perception of realism in VR (see Table 4) were considered among the fundamental characteristics: light - shadow, materials and visualization 360°. In contrast to Gómez's research, accessibility, real scale and 360° visualization contribute to the desired realism [43]. Although the perception of realism depends on the program and viewer used, in the present research, 87% consider regular use of the viewer. However, the experimentation shows a high degree of coincidence with the designer in the virtual realm, similar to the scientific article by Gómez [44]. It is mentioned that the coincidence in the virtual environment is due to the presence that it determines due to immersion and perceived realism, which helps to better understand the virtual space.

Likewise, the sensations experienced were similar to those previously proposed by the designer in the virtual environment, such as concentration in a high, circular space with warm tones, as well as fear when visualizing a narrow, high space with poor lighting in black tones. Later, in a ground floor, with white tones and natural lighting and vegetation, they experienced tranquility. Studies [38] [26] support severity due to the existence of negative emotions generated by narrow spaces, decontextualized architectural forms and relaxing or distressing spaces. Cool tones improved attention and memory performance, while warm tones improved attention and memory performance, unlike warm tones. Natural light in the environment is essential to promote rhythms.

Although the research presents some limitation in terms of the performance of image generation and visualization of the virtual environment, the comparative studies concluded that the new research can obtain more advanced results without having specialized data and training for architects in the related field, by improving efficiency, creativity and understanding of the built environment. Collaborative workshops are encouraged with the active participation of future users and the community, facilitating project management [3].

6. Conclusions

The research results reveal the revolution of artificial intelligence and VR in the 2D architectural design process, as well as in the virtual environment, with collaboration of artificial intelligence and VR, in terms of the way of conceiving, design and manage the architectural project. Our results support the idea that artificial intelligence produces an agile and dynamic design process in the conceptualization stage, largely understanding the demands of the architect as well as the client, which in turn generates an interactive and interactive design experience. Collaborative to the client, facilitating decision making for the architect reduces changes in more advanced phases on the part of the client. On the other hand, it is evident that the experience through the immersive space has a significant impact on the sensory perception of the individual when observing the characteristics of the designed space, stating that the user can effectively understand the designer's intentions through the application of virtualization. Compared to the discrepancy in user perception when viewing only certain 2D views of the space. Likewise, it contributes to a greater understanding of neuroarchitecture and how designed spaces can influence emotions, well-being and the experience of the user. There are new opportunities for creating environments that are not only aesthetically pleasing, but also cognitively and emotionally stimulating.

The comparison between the expected sensations, those observed in the virtual space and the 2D visualization indicates that the design using image generators improves the perception and sensation in the virtual environment. Given technological collaboration, new opportunities are offered for decision-making in architecture.

It is essential to educate architectural professionals in innovative technologies, such as Steam Network, in order to optimize their practice and more effectively understand user needs. The implementation of VR headsets entails optimizing the efficiency and understanding of the immersive space, which reduces the technological disparity in the sector.

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