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Interactive Digital Design: Synergy between Artificial Intelligence, Art, Design and Architecture

Jessica Anahí Roude* and Federico Del Giorgio Solfa*†

Faculty of Arts [National University of La Plata] - Argentina

Abstract

This paper examines the intersection of Artificial Intelligence (AI) and interactive 3D digital design technologies within the domains of art, design, and architecture in Latin America. It explores how these technologies not only optimize creative processes but also serve as co-creators, reshaping interactions between professionals, creations, clients, and work environments. Grounded in frameworks such as boundary objects and Actor-Network Theory, the study investigates AI platforms' role in fostering collaboration between human and non-human actors, mediating aesthetic and functional decisions in creative projects. Through case studies from Brazil, Colombia, Uruguay, and Argentina, this research highlights opportunities for innovation in sustainability, urban design, and immersive experiences, alongside challenges such as economic constraints, inadequate infrastructure, and limited professional training. The findings suggest that while AI and 3D technologies unlock significant creative potential, their effective adoption requires addressing these systemic barriers.

Keywords: Artificial Intelligence, Interactive digital design, Co-creation technology, Virtuality, Methodology

* Speaker.

† Corresponding author: delgiorgio@fba.unlp.edu.ar

Introduction

The adoption of interactive technologies in Latin America is progressing along a challenging, yet promising path. As design professionals in the region explore the potential of Artificial Intelligence (AI) and 3D Interactive Digital Design, new collaborative synergies are emerging that aim to break through traditional barriers to creative production. These tools offer unprecedented access to advanced methodologies and resources, allowing designers, architects, and artists to engage in creative practices that were previously inaccessible or limited by technological constraints. For instance, AI platforms enable rapid prototyping, conceptualization, and visualization, while 3D modeling and rendering technologies provide immersive environments for experimentation and real-time collaboration. These innovations are not only transforming the creative process but are also reshaping the professional landscape in the fields of design, architecture, and the arts (Schwab, 2016).

However, integrating such technologies into local workflows presents a set of complex challenges, particularly in Latin America. The region's socio-economic realities, coupled with varying levels of technological infrastructure, limit equitable access to these transformative tools. While urban centers may have some access to AI and advanced design platforms, rural areas often lack the necessary resources, creating a significant digital divide. Moreover, the region's educational institutions face challenges in providing the technical training required to fully integrate these technologies into creative workflows. Thus, despite the immense potential of AI and 3D technologies, their adoption and effective use remain constrained by socio-economic and educational barriers (Nonaka & Takeuchi, 1995; CENIA, 2024).

This paper seeks to investigate the interaction between AI and 3D technologies within design disciplines in Latin America, with a focus on art, architecture, and urbanism. It will provide a theoretical framework for understanding the convergence of the digital and biological realms in creative practices, drawing on concepts such as Actor-Network Theory (Latour, 2005) and boundary objects (Star & Griesemer, 1989). AI's role as a co-creator in design processes will be explored, examining how it influences creative decisions, optimizes technical tasks, and introduces new conceptual and aesthetic perspectives. Through an analysis of specific case studies from across the region—such as the Museum of Tomorrow in Brazil, the Santalaia Building in Colombia, and the +Colonia smart city project in Uruguay—this paper will highlight both the opportunities and limitations of these technologies. It will examine how these cases demonstrate the potential for AI and 3D technologies to foster innovation in sustainable design, urban planning, and digital art, while also identifying the significant challenges that arise in their implementation.

The paper will also explore how AI platforms serve as boundary objects that mediate communication and collaboration between designers, clients, and stakeholders (Latour, 2005; Star & Griesemer, 1989). Finally, this research will address the broader implications of adopting these tools in Latin America, discussing the opportunities for global integration in design practices and the need for targeted investments in infrastructure and professional training to overcome

existing barriers. While the promise of AI and 3D technologies is undeniable, realizing their full potential in Latin America requires addressing critical issues related to access, education, and infrastructure. By exploring these challenges, this paper will offer valuable insights into the transformative impact of AI and digital design technologies in the region, contributing to the ongoing discourse on technological innovation in creative industries.

Convergences and Conceptual Approach

The Fourth Industrial Revolution has ushered in a remarkable convergence of digital, biological, and physical spheres, reshaping not only what we do but also who we are as human beings. Schwab (2016) suggests that this revolution blurs the boundaries between humanity and technology, creating a new era where the two are increasingly interdependent. In design disciplines, this convergence is exemplified by the integration of AI technologies, extended realities (XR), and other digital tools that allow designers, architects, artists, engineers, and developers to create, visualize, and interact with their projects in innovative ways that were previously unimaginable. This synergy between humans and technology transforms the creative process, allowing for new forms of expression, problem-solving, and collaboration.

AI, in particular, has emerged as a powerful co-creator in this environment. Traditionally, design processes have been linear and human-centered, where the designer drives the creation, making decisions based on their expertise and intuition. However, AI disrupts this model by not only optimizing technical tasks, such as rendering or calculating complex architectural variables, but also by introducing new visual and conceptual perspectives. For example, AI platforms like MidJourney or DALL-E enable designers to generate novel visual interpretations from textual descriptions, allowing them to explore design concepts quickly and dynamically. This departure from traditional design processes fosters a more expansive and experimental approach to creativity, where designers can iterate and refine ideas at an accelerated pace.

The convergence of AI and design also aligns with the principles of Actor-Network Theory (Latour, 2005), which emphasizes the interconnectedness of both human and non-human entities in shaping social and creative realities. In this framework, AI and rendering platforms are not passive tools but active agents within the creative process. They participate in and influence design decisions, acting as collaborators that introduce new possibilities and challenge existing assumptions. For example, AI-generated images or designs can suggest aesthetic variations that a human designer might not have considered, thus expanding the range of creative solutions. This shift highlights the active role of technology in co-creating alongside human designers, rather than simply executing predetermined commands.

This concept is further enriched by the notion of boundary objects (Star & Griesemer, 1989), which refers to tools, artifacts, or technologies that serve as points of negotiation between different stakeholders with varying perspectives. In the context of AI and digital design, these platforms act as boundary objects,

facilitating communication and collaboration between designers, architects, engineers, and clients. While they enable the sharing of visual and conceptual models, they also create tensions when the interpretations or expectations of the various actors are misaligned. For instance, an AI-generated design may suggest innovative ideas that challenge the client's initial brief, leading to friction in the design process. These tensions, however, are not necessarily negative; they can stimulate dialogue and lead to more refined and collaborative solutions.

In Latin America, the adoption of AI and 3D technologies faces additional challenges, particularly in terms of access and education. While these technologies offer the potential to democratize design by making advanced tools available online, their adoption is hindered by regional disparities in technological infrastructure and technical training. Nonaka and Takeuchi (1995) argue that organizational learning is essential for the effective integration of new technologies into workflows. This process involves the conversion of tacit knowledge—intuitive, experience-based understanding—into explicit knowledge, which can then be taught and applied across teams or organizations. In this regard, learning to work with AI and 3D technologies requires a shift in both mindset and skillset, as well as a willingness to experiment and adapt.

In Latin America, where access to advanced technologies can be uneven, the ability to engage in this process of organizational learning is critical. Many design professionals in the region face limitations in terms of both access to high-end technology and the formal training needed to integrate these tools into their practices. AI and 3D modeling platforms, however, are often accessible via the internet, allowing practitioners from diverse locations to engage with these tools remotely. This can potentially reduce the barrier of access, enabling creative professionals in under-resourced areas to incorporate these advanced technologies into their workflows. At the same time, it underscores the importance of educational initiatives that provide training on how to use these tools effectively, empowering professionals across the region to fully leverage the potential of AI and digital design in their practices.

The convergence of AI and 3D technologies offers immense opportunities for innovation in Latin America, but the region must overcome significant obstacles related to access, education, and infrastructure. By fostering organizational learning and providing greater access to training and resources, the full potential of these technologies can be realized. In this way, AI and digital design platforms can become not only tools for creativity but also catalysts for broader socio-economic and technological advancement in the region.

Generative AI Platforms

Generative AI platforms are playing a key role in design disciplines such as architecture, design, and art by offering new ways of visualization, conceptualization, and collaboration. The most widely used platforms are explored below, highlighting their features (Table 1).

MidJourney, for instance, allows the generation of images from textual descriptions, which proves useful for visual and conceptual exploration in these

fields. Its primary advantages include the speed with which it produces results and the wide range of aesthetic options it provides, although it has the drawback of not allowing precise control over the details of the generated images.

Similarly, Rendair.ai provides interactive online rendering of 3D models, facilitating immersive visualization of projects and real-time collaboration with clients, although its use depends on a reliable Internet connection and specialized hardware.

DALL-E, like MidJourney, generates images from textual descriptions, but its ability to offer rapid aesthetic variations makes it a valuable tool for quick visualizations in design and architectural projects. However, its limitations in terms of precision and complexity make it less suitable for advanced tasks requiring greater technical detail. In summary, these generative AI platforms provide powerful tools that are transforming design practices, although technical challenges remain, which professionals must navigate to maximize their potential.

Finally, ChatGPT focuses on generating textual content based on instructions, making it a useful tool for drafting documents, conceptualizing ideas, and creating creative scripts. However, it requires human intervention to refine the results and ensure the accuracy of the generated content.

Table 1

Comparison of Generative AI Platforms in Design Disciplines

Platform	Key Features	Applications in Design Disciplines	Advantages	Challenges Barriers
Mid Journey	Image generation from textual descriptions	Visual and conceptual exploration in art, design, and architecture	Easy to use, fast and varied results, wide range of aesthetic options	Lack of precise control over image details
Rendair.ai	Interactive online rendering of 3D models	Immersive visualization of architecture and design projects	Remote accessibility, real-time collaboration with clients	Dependent on internet connection and specialized hardware
Chat GPT	Text generation from instructions and prompts	Support for idea conceptualization, document drafting, and creative scriptwriting	Ability to generate multiple textual alternatives, remote accessibility	Requires human intervention to refine results and ensure accuracy
DALL-E	Image generation from textual descriptions, similar to MidJourney	Quick visualization for design and architectural projects	Ability to generate aesthetic variations rapidly	Limited precision and complexity compared to specialized software

Note: Own elaboration

AI in Art, Design, and Architecture in Latin America

The implementation of AI technologies in creative disciplines is rapidly growing in Latin America (Table 2). This section highlights key cases that illustrate the expanding use of these tools in the region. Both opportunities and challenges are examined to provide a practical understanding of how AI is being integrated into art, design, and architecture.

Table 2

Cases of AI and Convergent Technologies Implementation

Project / Organization	Country	Applied Technology	Description	Impact on Professional Practice	Discipline(s)
Museo del Mañana	Brazil	Artificial Intelligence and Augmented Reality	The Museum of Tomorrow in Rio de Janeiro uses AI and AR to create interactive experiences about possible futures through simulations and educational projections.	Transforms the way science, art, and culture are communicated, enhancing the digital skills of professionals in museum and educational experience design.	Art, Design, Science
Edificio Santalaia	Colombia	3D BIM Modeling and Artificial Intelligence	The design of the Santalaia Building in Bogotá, the world's largest vertical garden, used BIM and AI to optimize energy efficiency and environmental sustainability.	Enhances the skills of architects and engineers in using advanced tools for sustainable architectural projects.	Architecture, Design
+ Colonia	Uruguay	3D BIM Modeling, Artificial Intelligence, Online Interactive 3D	A smart city project that uses AI, 3D modeling, and BIM for urban planning and the integration of advanced technologies into the daily lives of its residents.	Promotes urban innovation and creates a knowledge-based economy ecosystem, attracting tech startups and fostering sustainable urban development. Revolutionizes contemporary art by combining immersive technologies with digital design, expanding creative possibilities, and offering new forms of artistic interaction.	Architecture, Design, Urbanism
UX Art LAB Museum	Argentina	Artificial Intelligence, Augmented Reality, Metaverse	Creates interactive digital and physical experiences that blend art with advanced technology, focusing on the metaverse and digital art platforms.		Art, Digital Design

Note: Own elaboration based on the selected cases.

Analysis of Opportunities and Challenges in the Cases

The integration of artificial intelligence (AI) and 3D interactive digital design technologies into the creative sectors of Latin America offers a wide array of opportunities, particularly in fields such as art, architecture, and industrial design. By streamlining technical tasks and providing new avenues for creativity, AI is enabling designers and artists to push the boundaries of their craft in ways previously unimagined. This is particularly evident in landmark projects like Brazil's Museum of Tomorrow, which uses AI and extended realities (XR) to create immersive, interactive environments that engage visitors in novel and impactful ways. Similarly, the UXArt LAB in Argentina showcases how these tools can open up new possibilities for creating digital art and design that are more interactive and engaging, giving Latin American creators the chance to connect with global audiences in dynamic, innovative ways. These technological advancements also have a democratizing effect, making sophisticated design tools and creative resources more accessible, thereby empowering local talent to compete on a global stage (Schwab, 2017; Metro 95.1, 2024).

In the field of architecture, AI has already proven its potential to drive significant improvements in sustainability and operational efficiency. The Santalalía Building in Colombia, which combines AI with 3D modeling to optimize the use of materials and energy, serves as an excellent example of how technology can enhance eco-friendly design practices. Similarly, the +Colonia smart city project in Uruguay, which leverages AI to create intelligent urban infrastructure, underscores the importance of integrating technology into urban planning. These initiatives help to reduce environmental impacts and promote the creation of smart, sustainable cities, offering Latin America a unique opportunity to contribute meaningfully to global discussions on urban innovation and development (Moreno Canosa, 2020; Forbes, 2022; Telenoche, 2023).

Despite these promising advancements, there are significant challenges in fully adopting these technologies in the region. One of the primary obstacles is the lack of robust technological infrastructure and the deepening digital divide, particularly in rural areas. While major urban centers may be more prepared to integrate AI and 3D technologies, many regions in Latin America still face limited access to high-speed internet, advanced computing resources, and cutting-edge software. This disparity hinders the ability of designers, artists, and architects in less developed areas to harness the potential of these innovations. Furthermore, many educational institutions across the region struggle to keep pace with the rapidly evolving demands of the digital economy. Insufficient funding, a lack of specialized technical training, and outdated curricula in many schools create a skills gap, limiting the ability of future professionals to effectively integrate AI and 3D modeling into their creative practices (Nonaka & Takeuchi, 1995; CENIA, 2024).

The high initial costs associated with acquiring the necessary technology and infrastructure also present a significant barrier to entry for many professionals and institutions. Although AI and 3D design tools have the potential to reduce long-term costs by optimizing processes and resource use, the upfront financial investment required for both software and hardware can be prohibitive. This

challenge is exacerbated by the limited availability of venture capital and investment in technology startups within many Latin American countries, making it harder for smaller firms and independent creators to access these advanced tools (Star & Griesemer, 1989).

In order to overcome these hurdles, it is essential for the region to adopt a holistic strategy that incorporates both public and private investment in technological infrastructure and education. The +Colonia smart city project in Uruguay is a prime example of how government and private sector collaboration can drive the widespread adoption of AI and 3D design technologies. By creating partnerships between governments, universities, and technology companies, Latin American countries can help to bridge the technological divide and create a more inclusive environment for innovation. Additionally, expanding access to cloud-based platforms, which allow for the use of advanced design tools without the need for expensive on-site infrastructure, could help make these technologies more accessible to a broader range of creative professionals across the region (Nonaka & Takeuchi, 1995). In the long run, such initiatives can foster a thriving digital ecosystem that enables Latin American creatives to not only participate in global markets but to shape them as well.

Conclusions

The adoption of artificial intelligence (AI) technologies and interactive 3D modeling in design disciplines—art, design, and architecture—is fundamentally reshaping the way professionals engage with their creations and collaborators. As illustrated in this study, AI not only optimizes technical processes but also functions as a co-creator, offering novel perspectives and aesthetic solutions. Grounded in Actor-Network Theory and the concept of boundary objects, AI platforms mediate interactions between designers, architects, and clients, facilitating communication and collaboration. Nevertheless, these platforms may also generate tensions when the expectations and understandings of the various stakeholders are misaligned.

The analysis of AI platforms within the context of the cases studied in Latin America reveals that these technologies provide powerful tools that are transforming creative practices. They enable rapid visual exploration, foster the creation of aesthetic alternatives in art, design, and architecture, and support interactive 3D model visualization online. Moreover, they are particularly distinguished for facilitating real-time collaboration. As demonstrated by the case studies from countries such as Brazil (Museum of Tomorrow), Colombia (Santalalía Building), Uruguay (+Colonia), and Argentina (UXArt LAB Museum), AI, alongside 3D platforms, is driving advancements in areas such as sustainability, urban innovation, and immersive experiences. However, these implementations also bring to light critical challenges, including unequal access to technological infrastructure and insufficient technical training in the region. These barriers constrain the potential for the widespread adoption of these technologies, underscoring the pressing need for investment in infrastructure and specialized professional training.

In conclusion, AI platforms and 3D visualization technologies are presenting transformative opportunities within design disciplines by fostering a creative synergy between human and non-human actors. Nevertheless, their successful adoption in Latin America hinges on the region's ability to overcome structural obstacles related to technological infrastructure, education, and inequitable access to resources. The establishment of public-private partnerships, coupled with expanded access to digital tools and the development of educational programs, is essential to fully realizing the positive impact of these technologies in the region. As AI platforms continue to evolve, their role in reshaping creative practices will become increasingly pivotal in driving the transformation of architecture, design, and art across Latin America and beyond.

References

- Bahia, S. (Ed.) (2023). *Pode um robô ser racista?: e outras perguntas sobre o futuro da tecnologia*. Museu do Amanhã / IDG.
https://museudoamanha.org.br/sites/default/files/CPA_vol%201_pode%20um%20robo_completo_digital%20%281%29.pdf
- Centro Nacional de Inteligencia Artificial. (2024). *Índice Latinoamericano de Inteligencia Artificial [ILIA 2024]*. CENIA-Colombia.
https://indicelatam.cl/wp-content/uploads/2024/09/ILIA_2024.pdf
- Forbes digital. (2022, May 2). Cómo es el proyecto uruguayo +Colonia que busca seducir a los argentinos. *Forbes Argentina*.
<https://www.forbesargentina.com/innovacion/como-proyecto-uruguayo-colonia-busca-seducir-argentinos-n15541>
- Latour, B. (2005). *Reassembling the Social: An Introduction to Actor-Network-Theory*. Oxford University Press.
- Metro 95.1. (2024, August 15). *Entrevista - Beto Resano, CTO y Cofundador de UXart - El Ojo del Arte*. [Video]. YouTube.
<https://youtu.be/c7zf67rxOQE?si=97pkvChBobiaXjCE>
- Moreno Canosa, A. (2020). *La estética bioclimática. Outputs termodinámicos como elementos formales en el proyecto arquitectónico* [Final Degree Project]. Polytechnic University of Madrid. <https://oa.upm.es/58167/>
- Nonaka, I., & Takeuchi, H. (1995). *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*. Oxford University Press.
- Pinch, T. J., & Bijker, W. E. (1987). The Social Construction of Facts and Artefacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other. *Social Studies of Science*, 14(3), 399-441.

- Rivero, A. (2023, November 9). Una obra colectiva se proyecta sobre la fachada del Palacio Bosch. *Infobae, Cultura*.
<https://www.infobae.com/cultura/2023/11/09/una-obra-colectiva-se-proyecta-sobre-la-fachada-del-palacio-bosch/>
- Schwab, K. (2017). *The Fourth Industrial Revolution*. Crown Currency.
- Star, S. L., & Griesemer, J. R. (1989). Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology. *Social Studies of Science*, 19(3), 387-420.
- Telenoche. (2023, September 3). +Colonia será como Silicon Valley pero con "identidad propia". Telenoche. <https://www.telenoche.com.uy/ciencia-y-tecnologia/colonia-sera-como-silicon-valley-pero-identidad-propia-n5354514>
- Vargas Santiago, L. (2022). *Museums. Trends and Digital Strategies*. Banco Interamericano de Desarrollo. <http://dx.doi.org/10.18235/0004298>