

# Exploring Landscape Architecture Education: Scoping Review of Innovations, Challenges, and Future Directions

Gabrielle Bartelse<sup>1</sup>, Hannelie du Preez<sup>2</sup>, Raita Steyn<sup>2</sup>

<sup>1</sup>BügelHajema/The Netherlands · G.Bartelse@bugelhajema.nl

<sup>2</sup>University of Pretoria/South Africa

**Abstract:** This review examines the transformative potential of integrating digital technologies in landscape architecture education. Acknowledging the increasing importance of innovative technology in design practice, the review aims to synthesize existing literature, identify gaps in knowledge, and propose recommendations for future research and educational practices. The scope includes exploring trends, challenges, and opportunities in digital integration, emphasizing the role of digital design studios, Research Through Design, and transdisciplinary thinking. Methodologically, an approach is employed to comprehensively survey relevant literature. The review is structured to discuss prominent trends, discrepancies, and gaps in landscape architecture education, followed by implications for theory, practice, and future research. This review serves as the initial step in a broader aimed at transforming landscape architecture education by integrating digital design studios and innovative pedagogical approaches, laying the groundwork for further empirical investigation and practical interventions. While the review provides valuable insights, limitations such as potential biases in literature selection are acknowledged. Overall, this review contributes to advancing knowledge in landscape architecture education and informs efforts to adapt pedagogical practices to meet evolving demands.

**Keywords:** Transdisciplinary thinking, virtual reality (VR), augmented reality (AR), mixed reality (MR), Research Through Design (RTD), digital design studios (DDS)

## 1 Introduction and Background

### 1.1 Foundations and Educational Frameworks in Landscape Architecture

The educational frameworks of landscape architecture are undergoing rapid evolution, driven by the integration of cutting-edge digital technologies. This shift, from conventional sketches to immersive experiences facilitated by Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR), and GIS-based geospatial modeling, holds tremendous promise for reshaping higher academic landscape architecture education (LENZHOLZER et al. 2013, WALLIS & RAHMANN 2016). Scholars are enthusiastic about the untapped potential of these technologies, particularly in landscape visualization, as they have the capability to significantly enhance students' spatial comprehension and transition between 2D and 3D thinking (ELSAMAHY 2016, USKOV et al. 2018). The foundation of landscape architecture lies at the intersection of cognitive processes, recognition of digital technologies, and an evolving educational paradigm (LAWSON 2003). A significant aspect of this foundation is the transition from 2D to 3D thinking, which profoundly impacts landscape architecture education by necessitating the mental visualization of multidimensional spaces (MENSING-DE JONG et al. 2022). While some students may naturally possess 3D thinking abilities, competency in this area can be nurtured through dedicated practice and education (STINTZING et al. 2020). This overlap between cognitive evolution and digital technology underscores the untapped potential within the field. Integral to landscape architecture education is the fusion of cognitive processes with technological integration, serving as the bedrock for innovative approaches

such as Research Through Design (RTD) and Digital Design Studios (DDS) according to PETSCHKE (2019). RTD, recognized as a powerful methodology, engages with multifaceted landscape challenges, fostering collaboration and holistic problem-solving (VAN DEN Brink et al. 2022). Its integration with prevents isolated research by seamlessly incorporating investigations into the design process. Within these, immersive environments provide exposure to advanced tools such as VR, AR, MR, and GIS-based modelling, thereby nurturing critical thinking and problem-solving abilities (HARMSSEN & KOUTAMANIS 2019). The integration of cutting-edge technologies into virtual classrooms remains limited, despite their considerable potential (WALLIS & RAHMANN 2016). This limitation underscores the urgent need for critical educational transformations to fully capitalize on these tools. Emphasizing the necessity for a paradigm shift in education and design methodologies, scholars advocate for innovative approaches aimed at facilitating both 2D and 3D thinking processes (ELSAMAHY 2016, HARMSSEN & KOUTAMANIS 2019). This shift from mere traditional analogue methods to embracing the digital frontier not only transcends geographical boundaries but also fosters collaboration across disciplines (USKOV et al. 2018). Despite the challenges associated with integrating these technologies, their potential to enhance spatial understanding and creativity holds the promise of revolutionizing landscape architecture education. Through this manuscript, which represents the initial phase of a broader, we aim to participate in this significant opportunity to tackle the urgent need for essential educational reforms in landscape architecture.

## 1.2 Aims and Scope of the PhD Investigation and Initial Overview

The central focus of the overarching PhD inquiry is to revolutionize landscape architecture education by integrating traditional methods with digital tools, thereby enhancing students' spatial and design skills. The PhD requires multifaceted foci such as: (i) democratizing planning through virtual worlds, promoting inclusivity; (ii) leveraging digital technologies for research and transdisciplinary education; (iii) aligning with global trends while addressing local needs in the Netherlands; (iv) emphasizing research skills over traditional skill development; and (v) highlighting the importance of research, testing, and design in education. Our vision emphasizes immersive learning experiences and stakeholder involvement, fostering a democratic and progressive approach. This paper outlines our methodology, analysing current trends and gaps in transdisciplinary thinking and technology in landscape architecture education, positioning our research within the landscape of digital innovation.

## 2 Methodology

The reason for choosing a is because we aimed to methodically look at the body of existing literature on landscape architecture education. This is an important step to identify key concepts, types of evidence, and research gaps within this field of discipline. It differs from a systematic review in that it aims to provide an overview of the breadth of literature rather than focusing on answering a specific research question. Scoping reviews often involve summarizing and synthesizing evidence from diverse sources to inform future research directions or policy development.

## 2.1 Procedure and Eligibility Criteria

We used the Scopus database for its extensive coverage of peer-reviewed literature across disciplines. Employing specific eligibility criteria, we selected relevant research studies to compile a comprehensive scope of literature related to landscape architecture education. Our focus was on identifying trends, discrepancies, and gaps, particularly concerning digital design technologies and methodologies. The eligibility criteria log outlines our selection process for scholarly sources included in the review database. The initial pool consisted of 481 entries focusing on landscape architecture education, landscape design and planning education, and urban landscape design, excluding other educational fields. Publications within the range of 2003 to December 2023 were considered, resulting in 441 entries, while those outside this timeframe were excluded. Only English publications were included, leading to 422 entries, with publications in other languages excluded. The review focused on countries offering landscape architecture at higher education or university level, resulting in 179 entries, while those not offering landscape architecture were excluded. Empirical primary research studies and reviews published in peer-reviewed journals were included, resulting in 137 entries, while non-empirical studies and unpublished grey literature were excluded. Disciplinary domains (Architecture, Environmental Science, Urban Planning, Design Studies, Geography & Geospatial Sciences, Arts & Humanities, Art & Design, Engineering, Social Sciences, Higher Education) were considered, yielding 130 entries, with other domains excluded. Primary search terms, along with secondary terminology for expansion, yielded 66 entries. Any concepts outside this scope were excluded. The primary terms are: *'digital design studios'*; *'Research Through Design'*; *'trans-disciplinary thinking'*; *'transparent visual communication'*; *'virtual testing environments'*; *'virtual reality'*; *'augmented reality'*; *'mixed reality'*; *'GIS-based modelling'*. The secondary terms are: *'design education'*; *'urban design'*; *'geo-design'*; *'urban planning'*; *'landscape planning and design'*; *'urban development'*; *'studio pedagogy'*; *'spatial planning'*; *'design studio'*; *'design training'*; *'creativity'*; *'critical thinking'*; *'conventional and digital visualisation'*; *'computer virtual technology'*; *'computer technologies'*, *'architectural education'*. A manual inspection was conducted to scrutinize the generated list against the eligibility criteria, resulting in 55 included articles for further investigation in the process.

## 3 Discussion

### 3.1 Data Extracted from Scoping Review

The 55 articles encompass a diverse array of topics within landscape architecture education. Themes emerge surrounding innovative teaching methodologies, such as the integration of technology, as evidenced by studies on Building Information Modelling (BIM) education, the usage of computer technologies, and the application of virtual reality in landscape design teaching. Pedagogical approaches are explored, including participatory, collaborative, and transdisciplinary design, as well as the utilization of gamification and gaming simulations. The importance of sustainability is highlighted through investigations into embedding sustainability in pedagogy and the examination of biophilic design for restorative learning environments. Additionally, there is a focus on understanding the experiences and motivations of students, including non-traditional students, and the role of design studios in fostering learning and professional development. The intersection of landscape architecture with other dis-

ciplines, such as architecture and urban design, is also evident, along with reflections on the evolving nature and future directions of the field. These themes collectively contribute to a comprehensive exploration of landscape architecture education and its evolving landscape. The generated corpus of knowledge on landscape architecture education unveils a spectrum of diverse trends and discrepancies besides promising gaps for developments. The extracted data aligns with the aim and scope of the overall PhD inquiry, as both touch on the transformative potential of integrating digital technologies into landscape architecture education. The multifaceted foci outlined in the overarching, including democratizing the planning process, exploring virtual testing environments, aligning educational practices with global trends, shifting focus from traditional skill development, and emphasizing RTD, resonate with the diverse themes identified in the extracted articles.

### 3.2 Insights from the Scoping Review

Innovative approaches such as Digital Design Studios, Virtual Testing Environments, and advanced digital tools have transformed landscape architecture education because they “...*facilitates immersive learning experiences*”. These experiences encourage students to explore their “...*creativity*”, “...*spatial visualization skills*”, and “*design decisions*”. These “*iterative learning experiences*” create opportunities for students to enhance “...*their design capabilities*” and their “...*understanding of complex design concepts*” and “...*design decisions*”, which offers a “...*collaborative learning environment, which fosters interdisciplinary interactions*” (DÜZENLI et al. 2023, 802, EREN et al. 2018, 1150). Crossing disciplinary boundaries in higher education is becoming more important, especially because it provides moments to students for “...*trans-disciplinary thinking*,” to “...*integrate multiple forms of knowledge into their design process*,” and to “...*consider different perspectives from diverse disciplines*” -- which are “...*essential in addressing the complex challenges facing landscape architecture*” by better equipping students to develop “...*innovative solutions that balance environmental, social, and economic considerations*.” (JØRGENSEN et al. 2022,168-169, YOUNG & SEGURA-BELL, 2021, 190). While trans-disciplinary thinking encourages collaboration and knowledge integration across different disciplines, Research Through Design is crucial because it “...*emphasizes the integration of research and design processes*” (NIJHUIS & BOBBING 2012, 241). LENZHOLZE et al. (2013, 127) encourages that landscape architecture education should utilise opportunities of RTD “...*in improving interdisciplinary communication with other academic disciplines*”. By including “...*designing in the research process can also help to bridge the ‘utility gap’ between academic knowledge and applicability*”. Transitioning from data generation and analysis to findings, it becomes apparent that the concepts discussed in the extracted data align closely with the objectives and scope of the overall, shedding light on the transformative potential of integrating digital technologies into landscape architecture education.

## 4 Findings

Scholars unanimously acknowledge several prominent **trends** shaping landscape architecture education based on the concepts extracted from the. Firstly, the integration of has been identified as transformative, leveraging digital tools for design and visualization while emphasizing innovative pedagogical strategies (GE et al. 2023). This trend reflects a broader move-

ment towards embracing technology to enhance teaching methodologies within the field. Similarly, RTD emerges as a landscape architecture (PRICE & ARCHER 2023). This approach not only enhances creativity and problem-solving skills but also underscores the evolving nature of research methodologies within the discipline. Additionally, trans-disciplinary thinking stands out as a crucial trend, promoting collaboration and integration across disciplines to address complex environmental and social issues (JØRGENSEN et al. 2022). Scholars recognize the importance of this approach in preparing students to navigate the multifaceted challenges of contemporary landscape architecture practice. Moreover, TVC is highlighted as an essential trend, emphasizing its role in enhancing design concept presentation and collaboration through various techniques and tools (DÜZENLİ et al. 2023). Lastly, the integration of VTE and technologies like VR, AR, MR, and GIS-based Geo-spatial Modelling are acknowledged as trends with immense potential in refining landscape design and facilitating immersive simulations (LI et al. 2018). Collectively, these trends underscore the dynamic landscape of landscape architecture education, reflecting a shift towards embracing technology, interdisciplinary collaboration, and innovative pedagogical approaches to meet the evolving demands of the field. Scholars engage in ongoing **debates** regarding several discrepancies identified within landscape architecture education, as gleaned from the concepts extracted from the. Firstly, concerning, there is a divergence of opinions regarding the negative impact of these tools on creativity and hands-on skills versus their effectiveness in enhancing design education (DÜZENLİ et al. 2023; ÖRNEK & SEÇKİN 2016). This discrepancy underscores the need for further research to reconcile the conflicting perspectives and provide practical guidance for educators. Similarly, debates surrounding RTD centre on the effectiveness and rigor of this research methodology, as well as its applicability within landscape architecture (BEZA et al. 2022). While some scholars advocate for its efficacy in fostering creativity and problem-solving skills, others question its practicality and relevance in addressing complex issues within the discipline. Moreover, discussions on TDT highlight the practicality of breaking down disciplinary boundaries as a means of addressing complex issues, yet there is uncertainty regarding the integration of trans-disciplinary approaches into curricula and their impact on student learning outcomes (KIRKWOOD 2017). Furthermore, debates surrounding TVC revolve around identifying the most effective methods for conveying complex ideas within landscape architecture education and understanding its role therein (PRICE & ARCHER 2023). Lastly, discrepancies related to VTE and digital technologies' focus on the ability of these tools to replicate real-world conditions and their dependability compared to physical environments, as well as the potential benefits and challenges associated with their integration into educational settings (LI et al. 2018). Addressing these discrepancies through further research and discourse is essential for advancing landscape architecture education and informing future pedagogical practices in the field. Scholars underscore various gaps within landscape architecture education, urging action to address these deficiencies and enhance the educational experience. Firstly, concerning, there is a call for providing practical guidance for implementing and assessing transdisciplinary education effectively in landscape architecture, as well as integrating with traditional methods to maximize their educational benefits (ALPAK et al. 2018). Similarly, in RTD, scholars advocate for addressing challenges associated with the integration of, such as resource limitations and inclusivity issues, and for establishing standardized methodologies to ensure consistency and rigor in RTD implementation across educational settings (BEZA et al. 2022). Additionally, in TDT, there is a need to explore the adaptability of virtual testing environments to diverse educational settings and student skill levels, as well as to foster collaboration between disciplines to promote TDT and problem-solving. Moreover, regarding TVC, scholars call for research on the

long-term impacts of visual communication on learning outcomes and the evolving standards and competencies required for educators and students in this context (PRICE & ARCHER 2023). Furthermore, gaps in VTE and digital technologies highlight the necessity of establishing criteria for evaluating RTD outcomes and their contributions to the field, as well as the development of standardized tools and platforms for virtual testing in landscape architecture education (LI et al. 2018). Addressing gaps in RTD implementation in landscape architecture education is crucial for its advancement and relevance. The Phd inquiry aligns with exploring digital innovation's transformative potential, emphasizing the need for standardized evaluation criteria and further research. This convergence supports overarching goals of integrating digital tools, democratizing planning, and aligning with global trends, fostering inclusive design processes.

## 5 Conclusion

In conclusion, this highlights the need for a paradigm shift from two-dimensional to three-dimensional thinking in landscape architecture, emphasizing the importance of cultivating spatial cognition through education and practice. It also underscores the significance of transparent visual communication and the potential of the Research Through Designing (RTD) framework in the transdisciplinary planning and design process. However, it reveals gaps in the current landscape architecture curriculum, particularly in engaging external stakeholders. To address these insights, the advocates for the integration of innovative digital techniques and the establishment of a Digital Design Studio (DDS) within landscape architecture education. This approach bridges the traditional-modern technology gap, enhancing trans-disciplinarity and promoting transparent communication. The identified gaps closely align with the objective of advocating for a transformative shift in design education. The proposed Digital Design Studio () offers a possible solution to these gaps and contributes to the evolution of landscape architecture education in line with current trends and demands. It equips landscape architects to better tackle the evolving design and planning challenges of the world. Moreover, recommendations spanning diverse research domains in landscape architecture education, design studies, and urban planning underscore the importance of transparent communication and RTD. These recommendations are crucial for advancing the landscape architecture field. The envisioned will contribute to the conclusion by emphasizing the importance of transparent visual communication and the potential of the Research Through Designing (RTD) framework in the transdisciplinary planning and design process, aligning with the objective of advocating for a transformative shift in landscape architecture in higher education.

## 6 Recommendations: Bridging Critical Gaps Through Innovative Research

Scholars have identified critical gaps within landscape architecture education, stressing the urgent need for action to enhance the educational experience of university students in landscape architecture. Key concerns include effective transdisciplinary education implementation, integrating digital technologies with traditional methods, and standardizing methodolo-

gies in RTD. Moreover, there is a need to explore virtual testing environments, foster interdisciplinary collaboration, and understand the long-term impacts of visual communication on learning outcomes. Addressing these gaps requires targeted research and initiatives to ensure landscape architecture education's continued relevance and advancement. With the forthcoming PhD inquiry, we are dedicated to serving a pivotal role in this endeavour by help addressing these critical gaps. Embracing a multidisciplinary approach and leveraging methodologies like RTD, the PhD study aims to help revolutionize traditional design studio paradigms. By integrating emerging technologies and fostering transdisciplinary learning environments, we seek to push the boundaries of design pedagogy. Through meticulous exploration, from virtual tech utilization to interdisciplinary facilitation, we aspire with this inquiry to equip future landscape architects with skills to tackle contemporary challenges. The design process in traditional studios often follows a linear path, with inventory and analysis consuming significant time, hindering exhaustive exploration. The RTD process offers flexibility, but constraints of traditional studios limit its full integration. In contrast, a DDS offers a virtual world with immediate access to information, expanding cognitive learning and enabling creative design exploration. The PhD study aims to bridge this gap by advocating for the early integration of research methodologies and exploring the potentials of digital studios, heralding a new era of creativity and proficiency in landscape design education.

## References

- ALPAK E. M., ÖZKAN D. G. & DÜZENLİ T. (2018), Systems Approach in Landscape Design: A studio work. *International Journal of Technology and Design Education*, 28 (2), 593-611. doi: 10.1007/s10798-017-9402-7.
- BEZA B. B., ZEUNERT J., KILBANE S. & PADGETT KJAERGAARD, S. (2022), Examining PhD Modes in the Australian Landscape Architecture Academy. *Landscape Research*, 47 (5), 679-694. doi: 10.1080/01426397.2022.2079614.
- DÜZENLİ, T., YILMAZ, S. & EREN, E. T. (2023), Usage of Computer Technologies in Landscape Architecture Education. In: ÖZYAVUZ, M. (Ed.), *Sustainability, Conservation and Ecology in Spatial Planning and Design. New Approaches, Solutions, Applications*. Peter Lang, Berlin, 801-810.
- ELSAMAHY, E. (2016), Mixed Reality Framework for Architectural Design Education. *Architecture and Planning Journal (APJ)*, 23 (1), Article 10. doi: 10.54729/2789-8547.1079.
- EREN, E. T., DÜZENLİ, T. & YILMAZ, S. (2018), Comparison of the Use of Conventional and Digital Visualization Technologies in Environmental Design Education. *Croatian Journal of Education*, 20 (4), 1149-1171. doi:10.15516/cje.v20i4.2913.
- GE, M., KONG J., YANG, Q., CHEN, M. & WANG, W. (2023), Examine an Intelligence Education Framework of Landscape Architecture (EFLA) Based on Network Model of Technology in Landscape Architecture (NMTLA). *Sustainability*, 15 (4), 11277. doi: 10.3390/su151411277.
- HARMSEN, J. & KOUTAMANIS, A. (2019), New Tools, Old Behaviours: A Research on the Applicability of New Media in the Design Studio.
- JØRGENSEN, K., STILES, R., MERTENS, E. & KARADENİZ, N. (2022), Teaching Landscape Architecture: A Discipline Comes of Age. *Landscape Research*, 47 (2), 167-178. doi: 10.1080/01426397.2020.1849588.

- KIRKWOOD, N. (2017), The Role of Landscape Architecture in Urban Design Education: Design Studios from Korea University and Harvard University. *Proceedings of the Institution of Civil Engineers: Urban Design and Planning*, 170 (3), 133-142. doi: 10.1680/jurdp.16.00043.
- LAWSON, G. (2003), Ecological Landscape Planning: A Gaming Approach in Education. *Landscape Research*, 28 (2), 217-223. doi: 10.1080/0142639032000070210.
- LENZHOLZER, S., DUCHHART, I. & KOH, J. (2013), 'Research through Designing' in Landscape Architecture. *Landscape and Urban Planning*, 113, 120-127. doi: 10.1016/j.landurbplan.2013.02.003.
- LI, Z., CHENG Y. N. & YUAN Y. Y. (2018), Research on the Application of Virtual Reality Technology in Landscape Design Teaching. *Educational Sciences: Theory & Practice*, 18 (5), 1400-1410. doi: 10.12738/estp.2018.5.037.
- NIJHUIS, S. & BOBBINK, I. (2012), Design-Related Research in Landscape Architecture. *Journal of Design Research*, 10 (4), 239-257. doi:10.1504/JDR.2012.051172.
- MENSING-DE JONG, A., RACÓN-LEJA, K. & ZDRAHÁLOVÁ, J. (2022), LAB of Inclusive Urbanism as a Format to Educate Urban Designers. *Research in Urbanism Series*, 6, 151-170. doi:10.7480/rius.6.98.
- ÖRNEK, M. A. & SEÇKİN, Y. Ç. (2016), Development of an Educational Video Game for the Teaching of Landscape Grading Principles. *Journal of Digital Landscape Architecture*, 2016 (1), 308-315. doi: 10.14627/537612035.
- PETSCHKE, P. (2023), BIM Education in Landscape Architecture: The Rapperswil Model. *Journal of Digital Landscape Architecture*, 8, 588-597. doi: 10.14627/537740062.
- PRICE, C. & ARCHER, A. (2023), Resemiotization: Tracing the Movement of Resources in Landscape Architectural Design Trajectories. *Visual Communication*, 22 (1), 152-173. doi: 10.1177/14703572221118583.
- STINTZING, M., PIETSCH, S. & WARDENGA, U. (2020), How to Teach "Landscape" Through Games? In: EDLER, D., JENAL, C. & KÜHNE, O. (Eds), *Modern Approaches to the Visualization of Landscapes*. Springer VS, Wiesbaden, 333-349. doi: 10.1007/978-3-658-30956-519.
- USKOV, V. L., BAKKEN, J. P., HOWLETT, R. J. & JAIN, L. C. (Eds.) (2018), *Smart Universities Concepts, Systems, and Technologies*. Springer, Cham. doi: 10.1007/978-3-319-59454-5.
- VAN DEN BRINK, M., VAN DEN BRINK, A. & BRUNS, D. (2022), Boundary Thinking in Landscape Architecture and Boundary-Spanning Roles of Landscape Architects. *Landscape Research*, 47 (8), 1087-1099. doi:10.1080/01426397.2022.2091121.
- WALLIS, J. & RAHMANN, H. (2016), *Landscape Architecture and Digital Technologies. Reconceptualising Design and Making*. 1st Ed. Routledge, London. doi:10.4324/9781315713526.
- YOUNG, B. & SEGURA-BELL, C. (2021), Shifting Landscapes: Blurring Discipline Boundaries through Community-Engaged, Mixed-Discipline Studios. *International Journal of Design Education*, 15 (2), 157-207. doi: 10.18848/2325-128X/CGP/V15I02/187-207.