

The impact of artificial intelligence and virtual technologies on the education of graphic and landscape designers

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Abstract. The digitalisation of design education has intensified the need for a methodological understanding of the application of artificial intelligence, virtual reality, and augmented reality in the training of graphic and landscape designers. The aim of the study was to determine how digital tools transform the educational and project-based preparation of design students. The research methodology was based on a theoretical and analytical review of scientific publications, professional reports, and industry materials using comparative analysis, systematisation, logical-analytical methods, and theoretical generalisation. The study established that artificial intelligence, virtual reality, and augmented reality perform different functions in designers' education and are integrated into educational and professionally oriented projects in different ways. Analysis of the sources demonstrated that the use of digital technologies changes the logic of the creative process: project work becomes more iterative, relying on the generation, testing, refinement, and justification of solutions. It was found that the role of the lecturer may shift from assessing only the final product to supporting the design process, analysing digital stages of work, and evaluating the student's individual contribution. The analysis showed that the training of designers requires the integration of digital tools with fundamental design practices, including hand sketching, conceptual analysis, and contextual validation of solutions. It was substantiated that methodological regulation of the use of artificial intelligence, virtual reality, and augmented reality is necessary to preserve independent design exploration, transparency of authorship, and ethical responsibility in educational projects. The results of the study may be used by lecturers, curriculum developers, and heads of design courses when updating the content of design education, developing learning tasks, and establishing assessment criteria for digital design projects

Keywords: design education; professional competencies; visualisation; project analytics; option generation; educational programmes

INTRODUCTION

The digital transformation of design education is reshaping the tools, structure, and content of project-based training for future professionals. Artificial intelligence (AI), virtual reality (VR), and augmented reality (AR) are increasingly being incorporated into the processes of idea generation, visualisation, modelling, evaluation, and presentation of design solutions, which is particularly significant for graphic and landscape design. In these fields, students are required not only to master compositional, artistic, and spatial principles, but also to work effectively with digital environments, analyse generated alternatives, justify authorship decisions, and consider the conditions of project implementation. Consequently, there is a need to develop a methodological understanding of how these technologies

can be integrated into the educational process without diminishing the role of independent design exploration, hand sketching, critical analysis, and authorial responsibility. Examining the possibilities and limitations of AI, VR, and AR makes it possible to identify directions for updating educational programmes and aligning designer training with the evolving demands of professional practice.

Research has shown that the digital transformation of design education affects not only the tools used but also the sequence of educational and project activities. The design process is increasingly organised as a cycle of generation, selection, evaluation, refinement, and justification of solutions. In the training of graphic and landscape designers, this necessitates combining digital tools with individual

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analysis, manual development, contextual validation, and documentation of the student's independent contribution. In the study by T.J. Reynolds & A. Batley (2024), generative AI was presented as a tool that expands the initial stage of design exploration and accelerates the development of visual hypotheses. Their findings demonstrated that AI contributes not only to the generation of alternatives but also to the refinement of design directions, comparison of solutions, and iterative development of ideas. The authors concluded that the educational value of AI lies not in the act of generation itself but in the student's ability to select, edit, and integrate the generated materials into their own design methodology. This issue is further explored in the work of Y. Yin *et al.* (2025), which identified the limitations of traditional assessment focused solely on the final design product in contexts involving AI use. Lecturers were not always able to confidently distinguish between assignments completed independently by students and those created with the assistance of generative tools. This suggests the need to evaluate not only the visual completeness of a project but also the process through which it is produced, including functional justification, technical feasibility, ethical considerations, and the degree of the student's individual contribution. With regard to immersive technologies, Z. Lin *et al.* (2023) demonstrated that virtual studios can support collaborative design activities within digital environments. Their findings indicated that group discussions, idea exchange, collaborative object creation, and informal communication among participants could be maintained effectively in virtual settings. Thus, VR performs not only a visualisation function but also an organisational one, enabling project activities to be structured within a digital studio environment. A similar conclusion was presented by F. Castronovo *et al.* (2023), who associated VR-based design reviews with increased learner self-efficacy when evaluating project solutions. Spatial models facilitate the perception of scale, proportions, relationships between elements, and potential design flaws. For design education, this indicates that VR can serve as a tool for evaluating design solutions prior to final presentation or professional review.

In the field of illustration, N. Lewis (2025) demonstrated that generative AI does not eliminate the need for professional manual and editorial work. Generated images may be used during the initial stages of exploring form, colour, lighting, and overall visual atmosphere; however, they require subsequent refinement and stylistic control. This finding confirms the importance of preserving fundamental skills in drawing, compositional analysis, and authorial revision within educational programmes. In his study, R. Heaton (2025) associated the use of AI in art education with issues of pedagogical responsibility, authorship, and ethical reflection. AI is regarded not as an autonomous substitute for artistic practice but as part of an educational dialogue concerning technology, influence, limitations, and the responsibilities of the creator. This highlights the need to introduce guidelines for working with AI-generated content, documenting stages of generation, and

discussing the ethical implications of digital tools within designer training. In the work of Y. Hwang & Y. Wu (2025), generative image models were associated with changes in the role of the graphic design student. The student acts not merely as a producer of visual form but also as an organiser of content, context, semantic structure, and visual interpretation. These findings indicate that graphic design education is shifting from the mastery of individual techniques towards the development of the ability to manage digital visual content and justify its communicative function. W. Gao *et al.* (2025) linked the integration of generative AI into product design education with changes in learning tasks and professional competencies. AI is incorporated into idea generation, development of alternatives, prototyping, evaluation of options, and refinement of design outcomes. Consequently, the integration of AI requires reconsideration of assessment criteria, since the significance lies not only in the final product but also in the logic of interaction with generative systems, the quality of selection, and the degree of authorial refinement applied to the material.

Thus, recent studies indicate a broader shift in design education: digital technologies are transforming not only methods of visualisation but also the organisation of the design process itself. Generative AI expands the range of conceptual alternatives while simultaneously requiring transparency of authorship, preservation of manual and analytical skills, and the development of new assessment criteria. Immersive environments enhance spatial evaluation, collaborative design, and educational communication, reinforcing the need for methodological regulation of AI and VR applications in the training of graphic and landscape designers. In the studies reviewed, AI, VR, and AR are most often examined separately, without a comprehensive analysis of their combined functions in the education of graphic and landscape designers. The aim of the study was to identify the impact of modern digital tools on the content, structure and methodology of students' educational and project-based training in the field of design. The research objectives were: to systematise the areas of application of generative and immersive digital tools in the educational and project-based training of graphic and landscape designers; to identify the professional competences developed through the use of digital technologies, as well as the risks associated with their integration and methods of pedagogical regulation.

MATERIALS AND METHODS

For this theoretical-analytical study, the research design incorporated source analysis, systematisation, comparative analysis, logical-analytical methods, and theoretical generalisation of scientific publications, professional reports, and industry materials addressing the application of AI, VR, and AR in design education and project practice. Source analysis was employed to identify and evaluate publications examining the use of digital technologies in the training of graphic and landscape designers. The review primarily included English-language sources published

between 2023 and 2026 and retrieved from the websites of professional organisations, and Google Scholar (n.d.), ScienceDirect (n.d.), MDPI (n.d.), SAGE Journals (n.d.), Frontiers (n.d.), EDUCAUSE Review (n.d.). Searches were conducted using the keywords generative AI in design education, virtual reality in design education, augmented reality in graphic design, AI in landscape architecture, and immersive technologies in higher education. The selection included peer-reviewed articles, conference proceedings, review papers, professional reports, and analytical documents addressing educational, project-related, professional, and ethical aspects of AI, VR, and AR implementation. Promotional materials, duplicate publications, and sources mentioning digital technologies without analysing their functions in education or project practice were excluded.

The systematisation method was used to group sources by technological areas and analytical categories. The materials were categorised as follows: AI, VR and AR functions; educational applications; professionally oriented use; competencies developed; risks of integration; pedagogical regulation. This categorisation made it possible to distinguish materials on generative tools from research devoted to virtual and augmented environments, as well as to compare their educational and project-based functions.

A comparative method was used to contrast AI, VR and AR across several analytical categories: the functions of the technologies, educational applications, professionally oriented use, competencies developed, risks of integration and pedagogical regulation. The functions of digital technologies in design education were examined based on the works of A.M. Al-Ansi *et al.* (2023), O. McGrath *et al.* (2023) and S.Y. Andalib & M. Monsur (2024). Meanwhile, the educational applications of generative and immersive tools were analysed based on publications by N. Hu (2024), J. Ha *et al.* (2024) and S. Habib *et al.* (2024). The professionally oriented use of digital tools in graphic and landscape design was clarified with reference to materials from the Landscape Architecture Foundation (2023), American Society of Landscape Architects (2025) and International Federation of Landscape Architects (2025).

The competencies being developed in designers were summarised on the basis of research by N. Wang *et al.* (2025), S. Zhou *et al.* (2025) and K. Fleischmann (2026). This summary, further informed by the work of S. Alkhateeb *et al.* (2026), includes working with generative systems, formulating queries, the critical selection of digital outputs, design analytics, immersive modelling, authorial control, ethical literacy and interdisciplinary design. The risks associated with the integration of digital tools, including issues of authorship, ethics, legal restrictions, physiological strain and digital inequality, were examined in the works of A. Skulmowski (2023), S. Altaf (2024) and M.G. Wagner (2025). Additionally, these challenges were analysed in light of the research by V. Strunk & J. Willis (2025), which explores issues of learner autonomy and the mindful use of generative tools.

The pedagogical regulation of the use of AI, VR and AR was analysed with reference to the works of L. Eaves & J. Adair (2026) and the Digital Education Council (2026). Materials from the Canadian Society of Landscape Architects (n.d.), the World Economic Forum (2025) and the Organisation for Economic Co-operation and Development (2026) were used to compare professional requirements, the risks of automation and directions for updating educational programmes, as well as to analyse changes in professional competences, requirements for specialist training and the organisational and technological conditions for the implementation of AI in educational and design environments, including the interaction between humans and generative systems during the design process. A logical-analytical method was employed to identify links between digital technologies, design practice, professional requirements and the updating of educational programmes, including an assessment of the transformation of design functions, the risks of standardisation of visual language and changes to the professional role of the designer.

The method of theoretical generalisation was applied to formulate pedagogical conditions for regulating the use of digital tools in design education. Based on a synthesis of the sources, the following conditions were identified: preliminary analysis of the design brief; recording of requests to AI; documentation of the stages of generation and refinement; preservation of manual sketching; development of AI literacy; critical review of digital outputs; and the introduction of rules for the ethical use of digital content. The research methodology ensured a comprehensive examination of the issue through a combination of source analysis, systematisation, the comparative method, the logical-analytical method and theoretical generalisation. A limitation of the study lies in its theoretical-analytical nature, as the research did not involve any pedagogical experiments, student questionnaires, interviews with lecturers or observation of the actual application of AI, VR and AR in the teaching process.

RESULTS AND DISCUSSION

The integration of AI, VR and AR into the educational process has the potential to transform the training of students and young professionals in the fields of graphic and landscape design. These technologies can accelerate the mastery of specific design operations, broaden the scope of creative exploration, and enable a swifter transition from the initial idea to the analysis, comparison and refinement of design solutions (Al-Ansi *et al.*, 2023; Habib *et al.*, 2024). In the traditional teaching model, the stages of idea generation, sketching, stylistic selection, composition development and preliminary visualisation are usually carried out sequentially. Generative AI changes this logic: even at the initial stage, a student can obtain several visual hypotheses, compare them with one another and select a direction for subsequent creative refinement. Thus, the educational value of AI lies not only in accelerating the creation of options, but also in shifting the focus to their critical analysis, the

justification of choices and the assessment of their suitability for the design brief.

In graphic design, AI is used in the development of posters, corporate identity, packaging, advertising layouts, interface solutions and visual concepts for communication campaigns. Tools such as Midjourney, DALL-E, Stable Diffusion and specialised design platforms such as Canva Magic Design, Figma AI and Runway enable the creation of initial images, style references, compositional schemes, colour schemes and variations in the text-to-image ratio. The use of generative AI can accelerate the creative process by 30-50% and enhance the efficiency of design work (Ee & Tasir, 2026). At the same time, AI broadens the range of possibilities in the design exploration process. Students are given the opportunity to work not with a single sketch, but with a series of alternative solutions that differ in composition, style, visual metaphor, colour, scale, rhythm and visual hierarchy. In this context, AI functions as a tool for divergent thinking, as it facilitates the rapid generation of various compositional, stylistic and conceptual options. However, the quality of a creative solution is determined not by the mere use of AI, but by the extent to which the final result corresponds to the design brief, the target audience, the functional purpose and the visual logic of the project.

In landscape design, the use of AI is linked to the development of site layout options, the search for a conceptual vision, the comparison of functional zoning scenarios and the preparation of preliminary visualisations. Its significance is particularly evident in projects where a combination of spatial, environmental and user-related parameters must be taken into account: topography, landscaping, vantage points, climatic conditions, the social function of the space and the nature of users' behaviour. In this context, AI enables the site to be viewed not only as a visual object, but also as a system of natural, social and infrastructural interrelationships. The application of AI in landscape architecture involves processing large datasets, analysing complex ecosystems and developing variant design approaches (Landscape Architecture Foundation, 2023). VR and AR complement the capabilities of AI by enabling a shift from a two-dimensional representation of a project to a three-dimensional and interactive model. In the training of graphic and landscape designers, these technologies develop skills in 3D modelling, spatial analysis, interactive visualisation and the testing of design solutions in digital or mixed environments. In landscape design, VR is used to analyse the

scale of the site, the topography, the balance between open and enclosed areas, the placement of plantings, small architectural features, lighting and materials. A VR model allows the project to be viewed from the user's perspective within the designed environment and enables the design scheme to be compared with anticipated scenarios for the site's use. Working with VR modules can facilitate a quicker understanding of spatial relationships and increase student engagement compared to lectures, 2D drawings and manual modelling (Andalib & Monsur, 2024).

AR can be used to align a digital model with a real or simulated environment. In landscape design, it is used to evaluate the placement of landscape features, the scale of planting schemes, the visual impact of design elements, and the perception of space from different viewpoints. In landscape architecture, AR serves as a tool for analysing spatial relationships between proposed and existing components of the urban environment (Ha *et al.*, 2024). In graphic design, AR is applied to the development of interactive posters, packaging, wayfinding systems, exhibition materials, multimedia objects, and digital visual communications. Within this context, graphic artefacts are considered not merely as static compositions but as elements of user interaction. The integration of AR into graphic design curricula is associated with improved understanding of digital formats, data transformation, cross-platform compatibility, and a shift from two-dimensional to spatial approaches to design (Hu, 2024).

The increasing use of generative and immersive digital technologies in professional practice suggests that they should be regarded as factors contributing to the renewal of educational programmes. According to American Society of Landscape Architects (2025), 55% of practising landscape architects and educators use AI in professional practice, teaching, or research. Consequently, these technologies should be viewed as components of professional training associated with information retrieval, generation of design alternatives, visualisation, presentation of solutions, and communication with clients or project teams. A synthesis of the identified areas demonstrates that AI, VR, and AR perform distinct yet complementary roles in the education of graphic and landscape designers: AI supports the generation and selection of design alternatives, VR provides opportunities for spatial evaluation of solutions, and AR connects digital models with real or simulated environments (Table 1).

Table 1. Areas of application of AI, VR, and AR in the training of graphic and landscape designers

Technology	Application in the educational process	Application in professionally oriented projects	Skills developed
AI	Generation of visual ideas, selection of stylistic approaches, and development of compositional alternatives	Preparation of concepts, visual scenarios, and alternative forms of project presentation	Alternative design development, critical selection, and justification of design decisions
VR	Creation and analysis of 3D models, assessment of scale and spatial relationships	Immersive presentation of landscape objects, parks, and public spaces	Spatial thinking, analysis of user perception, and design validation
AR	Development of interactive posters, packaging, and wayfinding elements	Evaluation of digital objects within real or simulated environments	Interactive visualisation, work within mixed environments, and user interaction

Table 1. Continued

Technology	Application in the educational process	Application in professionally oriented projects	Skills developed
AI+VR/AR	Comparison of design scenarios and their visual evaluation	Preparation of integrated presentations for clients or project teams	Integration of digital tools, interdisciplinary design practice, and professional communication

Source: compiled by the author based on data of A.M. Al-Ansi *et al.* (2023), Landscape Architecture Foundation (2023), O. McGrath *et al.* (2023), S.Y. Andalib & M. Monsur (2024), C. Baker (2024), J. Ha *et al.* (2024), S. Habib *et al.* (2024), N. Hu (2024), American Society of Landscape Architects (2025), S.W. Ee & Z. Tasir (2026)

As shown in Table 1, AI, VR, and AR perform distinct functions within the educational and project-based preparation of designers. AI is primarily associated with the generation, comparison, and preliminary selection of design alternatives, thereby strengthening the analytical stage of idea development. VR provides opportunities for spatial evaluation of solutions, allowing users to assess scale, proportions, pedestrian circulation, and the perception of objects within three-dimensional environments. AR complements this process by aligning digital models with real or simulated surroundings. The combined use of these technologies creates a sequential model of design practice, extending from idea generation and 3D modelling to interactive visualisation, evaluation of solutions, and professional presentation.

The analysis identified AI as a tool for generating visual ideas, selecting stylistic approaches, developing compositional alternatives, and conducting preliminary selection of design solutions. These findings correspond with the results of C.W. Lee (2025), in which the use of generative AI in visual design courses was associated with the development of student creativity through text-based and graphical prompts, as well as through the assessment of flexibility, originality, and the level of detail in design outcomes. Unlike that study, which focused primarily on the influence of AI on students' creative performance, the present research incorporates AI into a broader framework of educational and project-based training, where it functions as a tool for generation, selection, and authorial refinement of solutions. In the present study, AR in graphic design is associated with the development of interactive posters, packaging, wayfinding systems, digital presentations, and visual communication materials. This corresponds with the work of W. Guo *et al.* (2025), in which AR was incorporated into graphic design education through an application model for cultural heritage tourism designed to enhance student engagement and connect visual design with cultural content. In the present study, these findings are generalised more broadly, with AR being considered not only as a means of engaging with cultural heritage but also as a tool for interactive visualisation, user interaction, and evaluation of graphic objects within digital or mixed environments. Furthermore, the present study relates the use of AR in professionally oriented projects to the evaluation of digital objects within real or simulated environments, as well as to the analysis of scale, spatial relationships, and the perception of designed spaces. These findings are consistent with

the conclusions of T.A. Alazzawi & H.A. Alsamer (2024), who associated augmented reality with community participation in design decision-making, support for designers during the selection of solutions, and enhancement of urban environments. In the present study, these conclusions are transferred to the context of graphic and landscape design education, where augmented reality is regarded as a tool for spatial evaluation, comparison of digital models with their surrounding environments, and preparation of projects for professional discussion.

The integration of digital technologies can be regarded as a factor reshaping the structure of the creative process in the education of graphic and landscape designers. The traditional linear sequence of "brief – sketching – refinement – finalisation" is increasingly supplemented by a cyclical model in which the generation of alternatives, their expert evaluation, and subsequent refinement are repeated throughout different stages of the design process. Within a human-AI co-design model, the designer formulates the design intention and prompt, AI generates alternatives, and the human participant subsequently selects, edits, and integrates the results into the project context. This alternation of generation, evaluation, and iteration can enhance the originality of design solutions while maintaining the designer's authorship and control (Wang *et al.*, 2025). As a result, the creative process becomes iterative: rather than progressing directly from a single sketch to a final design, students repeatedly formulate prompts, evaluate generated alternatives, refine them, and develop authorial solutions. In landscape design, this transformation is reflected in the immediate evaluation of design ideas within spatial, environmental, and user-related contexts rather than treating them solely as visual concepts (Andalib & Monsur, 2024).

The implementation of AI, VR, and AR in the studies reviewed is also associated with changes in studio-based learning, where emphasis shifts from assessing only the final product to analysing the design process itself. In this approach, attention is given to problem definition, the logic of digital tool use, the selection of alternatives, and the justification of refinements. In graphic design, AR facilitates the transition from two-dimensional layouts to immersive prototypes, enabling the testing of composition, typography, visual hierarchy, and user interaction across different digital platforms. Such integration is associated with the development of design thinking and problem-solving abilities (Hu, 2024). The role of the lecturer may therefore shift from evaluating outcomes to supporting and monitoring

the design process. Methodological strategies include analysing students' interactions with AI, documenting prompts and iterations, assessing authorial contributions, developing prompt-engineering skills, and incorporating AI literacy modules into educational programmes (Wagner, 2025). In landscape design, AI is employed for site analysis, scenario-based planning, and preliminary visualisation. According to the International Federation of Landscape Architects (2025), 75% of respondents reported increased efficiency in professional tasks through the use of AI, while 71% anticipated significant changes in professional skill requirements within the sector.

The use of AI can also alter the distribution of functions within design activities. Designers retain responsibility for contextual understanding, value-based judgement, ethical evaluation, and the final integration of solutions, whereas AI contributes through the generation of alternatives and the expansion of design possibilities. Human-AI co-design models emphasise that AI may be employed not only for content generation but also for the structuring, comparison, and refinement of design materials. Such integration

supports a more coherent organisation of project outcomes while preserving human control over final decisions (Adobe Research, 2025). In graphic design, this is reflected in the creation of mood boards, the transfer of stylistic characteristics, and the testing of compositional alternatives. In landscape design, AI is used to generate alternative environmental and spatial scenarios that can subsequently be evaluated through VR-based visualisation.

The transformation of educational and project-based activities through digital technologies requires not only proficiency in digital tools but also the development of new professional competencies. As shown in Table 2, these competencies include prompt formulation for AI systems, critical evaluation of generated alternatives, spatial analysis, interactive visualisation, authorship control, and ethical assessment of design decisions. In graphic design, these competencies are reflected in the management of visual alternatives and digital communication formats, whereas in landscape design they are associated with site analysis, scenario-based planning, and the evaluation of solutions within three-dimensional or mixed environments.

Table 2. Emerging professional competencies of graphic and landscape designers under the integration of AI, VR, and AR

Competency group	Content of the competency	Significance for graphic design	Significance for landscape design
Working with AI	Prompt formulation, generation of alternatives, and critical evaluation of outputs	Creation of visual hypotheses, mood boards, and alternative compositions and stylistic solutions	Development of layout, zoning, and spatial organisation scenarios for sites and landscapes
Project analytics	Comparison of alternatives, assessment of suitability to the task, and justification of design choices	Assessment of readability, visual hierarchy, and suitability for the target audience	Evaluation of scale, circulation routes, functional zones, and user scenarios
Immersive modelling	Work within VR and AR environments and interactive validation of solutions	Development of interactive posters, packaging, wayfinding systems, and digital presentations	Spatial validation of landscape features, parks, and public spaces
Authorship control	Documentation of work stages and recording of prompts and subsequent refinements	Justification of individual authorship when using AI	Justification of design decisions with regard to site context
Ethical literacy	Understanding issues of authorship, algorithmic bias, and the standardisation of solutions	Prevention of formulaic visual language	Consideration of the cultural, environmental, and social context of place
Interdisciplinarity	Integration of design, data, technologies, and domain-specific knowledge	Integration of visual communication with digital formats	Integration of design, ecology, data analysis, and spatial modelling

Source: compiled by the author based on data of S.Y. Andalib & M. Monsur (2024), N. Hu (2024), Adobe Research (2025), International Federation of Landscape Architects (2025), M.G. Wagner (2025), N. Wang *et al.* (2025), K. Fleischmann (2026)

As shown in Table 2, the emerging competencies are associated not only with the technical mastery of AI, VR, and AR, but also with changes in the designer's role within the design process. In graphic design, this is reflected in the management of visual alternatives and interactive communication, while in landscape design it is manifested through site analysis, scenario-based planning, and the spatial evaluation of design solutions. The transformation of creative processes may significantly influence designer education: the traditional studio model is increasingly complemented by a flexible project environment in which students engage with AI, VR, and AR as tools for

exploration, evaluation, and refinement of solutions. Changes in pedagogical approaches and the role of the lecturer are therefore regarded as essential conditions for developing the competencies required for professional practice, including critical thinking, the ability to select and justify design alternatives, and ethical responsibility in the use of AI and immersive technologies.

The analysis identified professional competencies in design as a combination of skills related to AI utilisation, project analytics, critical evaluation of digital outputs, authorship control, ethical literacy, and interdisciplinary design practice. These findings correspond with the results of

Y.M. Fang (2025), in which generative AI was incorporated into a multi-level educational strategy encompassing problem definition, feature identification, keyword extraction, generation of alternatives, and subsequent refinement of solutions. The use of AI was also associated with the development of creativity, critical thinking, practical skills, increased student engagement, greater diversity of ideas, and accelerated iterative processes within project-based learning. Unlike that study, which focused primarily on the strategic integration of generative AI into design education, the present research offers a broader interpretation of these competencies. Here, competencies are understood not merely as the ability to use AI tools, but as a comprehensive system encompassing project analytics, selection and refinement of alternatives, ethical oversight, and the integration of digital outputs into educational and project-based activities. In the present study, engagement with AI is not regarded as a substitute for independent creative exploration, but rather as a competency requiring the preservation of student autonomy, an understanding of the logic underlying digital outputs, and the ability to justify individual design decisions. This perspective is consistent with the work of A. Al-sadi & D. Miller (2026), in which human-centred explainable AI was associated with supporting novice designers, enhancing creative self-efficacy, improving idea quality, and preserving user autonomy during interaction with generative systems. The present study extends these conclusions to the broader context of graphic and landscape design education, where authorship control is incorporated into the system of professional competencies alongside critical evaluation, documentation of design stages, ethical assessment, and justification of design decisions. Furthermore, the study links professional competencies to the ability to employ digital technologies for the generation, analysis, visualisation, and evaluation of design solutions while maintaining critical judgement of outcomes. This finding corresponds with the systematic review conducted by W. Rong *et al.* (2025), which associated applications of generative AI in higher art education with expanded learning opportunities, support for creative activity, and changes in the ways students interact with digital artistic tools. Unlike that review, which focused primarily on generative artistic applications in higher education, the present study specifies these implications for the education of graphic and landscape designers through a framework of competencies that includes AI utilisation, project analytics, immersive modelling, authorship control, ethical literacy, and interdisciplinary collaboration.

The use of generative AI in the education of graphic and landscape designers may be associated with the risk of standardising visual language. Since these models are trained on extensive collections of existing images, the outputs they generate may reproduce common compositional structures, stylistic conventions, and visual patterns. Excessive reliance on AI can diminish the role of independent design exploration, resulting in outcomes that exhibit characteristics of standardisation and repetition (Alkhateeb *et al.*, 2026). In graphic design, this risk may be reflected in

similarities of compositional approaches, colour palettes, visual effects, and overall aesthetic qualities. When students begin the design process with automated generation rather than with an analysis of the design brief, target audience, and communication objectives, the development of manual skills, compositional thinking, and conceptual analysis may be weakened. The overuse of AI tools has been identified as a factor that may reduce foundational professional abilities, including manual refinement and in-depth conceptual thinking (Match, 2024). In landscape architecture, the risk may be associated with a weakening of the contextual basis of design decisions. AI can generate visually complete planning solutions; however, such outputs do not always adequately account for topography, soil conditions, climate, vegetation, cultural context, user scenarios, and the social characteristics of a site. Within professional practice, concerns have been expressed regarding the potential reduction of the human dimension in design as AI adoption increases (Canadian Society of Landscape Architects, n.d.).

A long-term limitation of generative systems lies in their dependence on existing datasets and previously established visual models. This may reduce the diversity of unconventional solutions and contribute to increased visual standardisation. Studies examining the use of AI in graphic design have noted that, alongside gains in efficiency, attention must also be paid to the risks of repetition and diminished originality in design outcomes (Zhou *et al.*, 2025). The application of digital technologies is also associated with ethical and legal concerns. One of the principal issues involves the use of copyrighted materials in the training of generative models without the consent of rights holders. In educational settings, this creates risks when AI-generated images are incorporated into portfolios, academic projects, and public presentations, as the provenance of visual materials and the extent of the student's contribution may not be transparent (Altaf, 2024). Ethical challenges include algorithmic bias, questions of authorship, and breaches of academic integrity. Model bias may reproduce cultural, gender-based, or social stereotypes within educational and project materials. Issues of authorship arise when generated outputs are presented as independent work without acknowledging the role of AI in their creation. Consequently, educational programmes require procedures for documenting prompts, stages of generation, selection processes, and subsequent refinements. Questions concerning learner autonomy, informed use of AI, and the right of students to decline the use of such technologies are among the central ethical considerations in digital education (Strunk & Willis, 2025). VR and AR present additional limitations related to physiological and psychological demands. Extended periods of work within immersive environments may lead to cybersickness, disorientation, and visual fatigue. These factors should be considered when determining session duration, assignment structures, and conditions for the use of immersive technologies in educational contexts (Skulmowski, 2023). A further concern is digital inequality. Access to AI tools, VR equipment, AR platforms, and

high-performance hardware varies considerably among educational institutions and individual students. Such disparities may exacerbate differences in educational quality unless the implementation of emerging technologies is accompanied by organisational regulation, equitable access policies, and transparent criteria for assessing individual contributions to project work.

The integration of AI, VR and AR into professional practice in graphic and landscape design can be seen as a basis for refining the content of educational programmes. According to the Future of Jobs Report 2025, some routine tasks in the creative industries may be automated, whilst the importance of creative thinking, AI literacy and the ability to solve complex problems is increasing (World Economic Forum, 2025). In light of this, it is advisable for graphic design courses to include assignments involving the formulation of briefs, the critical selection of generated images, the assessment of visual hierarchy, the adaptation of layouts and the justification of the designer's creative contribution. In the training of landscape designers, these changes can be incorporated through assignments involving site analysis, scenario-based design, spatial verification of solutions in a virtual environment, and the comparison of digital models with the real-world context. AI, VR and AR should therefore be viewed not only as professional visualisation tools, but also as a factor in updating the content of academic disciplines, assessment criteria and forms of project work.

In graphic design, the positions most susceptible to automation are those involving routine layout production, preparation of simple visual materials, adaptation of existing designs, and creation of standardised imagery. For such tasks, AI reduces the need for manual execution of repetitive operations. At the same time, the importance

of competencies related to managing human-AI collaboration, strategic thinking, contextual understanding, and the evaluation of generated outputs continues to grow. For certain professional roles, the risk of displacement has been estimated at up to 41% (Match, 2024). In landscape architecture, the level of automation is comparatively lower because site design requires consideration of topography, ecology, climate, social scenarios, regulatory frameworks, and local context. Nevertheless, the nature of professional tasks is also evolving. AI is increasingly used for site analysis, scenario-based planning, and the preparation of visualisations for clients. According to professional surveys, 71% of practitioners anticipate changes in the skill sets required within the profession, while 75% report that AI is already influencing management processes and decision-making within the sector (Canadian Society of Landscape Architects, n.d.). Consequently, the influence of AI, VR, and AR on the labour market is manifested not through the direct replacement of professions but through the redistribution of professional functions. The proportion of routine technical operations is decreasing, while analytical, strategic, ethical, and interdisciplinary competencies are becoming increasingly significant. For designer education, this implies the need to orient educational programmes towards AI literacy, engagement with immersive environments, critical evaluation of digital outputs, and the preservation of authorship control over design decisions. Alongside the educational and project-related opportunities offered by digital technologies, their integration is accompanied by a range of methodological, ethical, legal, and organisational risks. These factors should be carefully considered when designing educational assignments, developing assessment criteria, and establishing guidelines for the use of digital tools (Table 3).

Table 3. Risks associated with the integration of AI, VR, and AR into the training of graphic and landscape designers

Risk category	Manifestation in graphic design	Manifestation in landscape design	Possible pedagogical regulation
Uniformity of visual language	Repetition of compositions, colour schemes, stylistic approaches, and visual effects	Generation of standardised visual solutions without considering site-specific characteristics	Comparison of AI-generated alternatives with original sketches and mandatory justification of design choices
Reduction of independent design exploration	Commencing work with content generation rather than analysis of the design task and target audience	Replacement of site analysis with the formal generation of layout alternatives	Introduction of a preliminary analysis stage prior to the use of AI
Issues of authorship	Unclear extent of individual authorship in layouts, posters, branding, or packaging designs	Unclear extent of individual authorship in planning scenarios and landscape visualisations	Documentation of prompts, generation stages, selection processes, and subsequent refinements
Algorithmic bias	Reproduction of cultural, gender, or social stereotypes in visual imagery	Insufficient consideration of the local cultural and social context	Critical evaluation of generated outputs and discussion of ethical constraints
Legal risks	Use of images of uncertain origin in portfolios and public projects	Use of visualisations without transparent disclosure of sources and the role of AI	Rules for citation, labelling of AI-generated content, and its use in portfolios
Physiological strain associated with VR and AR use	Visual strain resulting from prolonged interaction with immersive environments	Disorientation or cybersickness caused by prolonged exposure to VR environments	Limitation of VR/AR session duration and alternation between different modes of work
Digital inequality	Unequal access to AI platforms, AR technologies, and high-performance devices	Unequal access to VR equipment and spatial modelling software	Equal access conditions, laboratory-based learning, and institutional support

Source: compiled by the author based on data of Canadian Society of Landscape Architects (n.d.), A. Skulmowski (2023), A.R. Doshi & O.P. Hauser (2024), S. Altaf (2024), R. Match (2024), V. Strunk & J. Willis (2025), S. Zhou *et al.* (2025), World Economic Forum (2025), S. Alkhateeb *et al.* (2026), L. Eaves & J. Adair (2026), Organisation for Economic Co-operation and Development (2026)

As shown in Table 3, the main risks associated with the integration of AI, VR and AR relate to the standardisation of design solutions, a reduction in independent analysis, uncertainty regarding authorship, legal and ethical constraints, and unequal access to digital tools. In graphic design, these risks are more commonly manifested in the repetitiveness of visual language and the use of AI-generated content, whilst in landscape design they manifest as insufficient consideration of the site's specific characteristics and the user context. These risks can be mitigated through preliminary analysis of the task, documenting the stages of working with AI, mandatory justification of solution choices, and transparent rules for the use of digital technologies.

The analysis identified the risks associated with the integration of AI, VR, and AR in terms of authorship issues, reduced originality, algorithmic bias, legal uncertainty, and the unclear provenance of digital content. These findings correspond with the results of K.A. Bartlett & J.D. Camba (2024), who associated the use of generative AI in product design education with ethical and legal concerns, including bias, hidden labour, appropriation of artists' works, lack of originality in generated outputs, and the absence of comprehensive copyright protection for AI-generated images. Unlike their study, which focused primarily on product design and generative imagery, the present research extends these risks to the training of graphic and landscape designers and supplements them with pedagogical mechanisms, including the recording of prompts, documentation of generation stages, selection of alternatives, and justification of authorial refinement. In the present study, issues of authorship and academic integrity are considered among the principal risks associated with the use of AI in educational projects. This position is consistent with the work of M.B. Huh *et al.* (2025), in which architecture and interior architecture students' perceptions of generative tools were linked to ethical responsibility, educational value, career implications, authorship, and the visual representation of design outcomes. The present study broadens these conclusions by considering AI use not only from the perspective of student perceptions but also within the framework of pedagogical regulation, where transparent rules for identifying AI-generated content, documenting the degree of technological involvement, and assessing students' independent contributions are required. Furthermore, the present study associates the risks of VR with the need for methodological limitations on its use, since immersive environments require consideration of session duration, technical accessibility, the quality of learning scenarios, and potential physiological strain. These findings correspond with the bibliometric review conducted by A. Çalışkan & S.G. Kayaakdag (2025), in which virtual learning environments in architecture and design education were described as an emerging field associated with project-based learning, immersive interaction, and the need for more sustainable pedagogical models. The present study further specifies these conclusions through a framework of risks and pedagogical regulation, including limiting the duration of work

in virtual environments, alternating instructional formats, ensuring access to appropriate equipment, and incorporating virtual reality only into tasks where it supports spatial evaluation and professional discussion of design projects.

The balanced integration of AI, VR and AR into the training of graphic and landscape designers requires a combination of digital and fundamental design practices. It is advisable to include modules in educational programmes on formulating prompts for AI, the critical selection of generated options, AI ethics and the assessment of the quality of digital outputs (Wagner, 2025; Digital Education Council, 2026). Preserving traditional design practices also remains an essential requirement for training designers. Assignments utilising AI should be alternated with manual sketching, model-making, conceptual analysis and the independent development of design ideas without automated generation. This helps to maintain a link between digital tools, core professional skills and original design thinking. Transparency in the design process is of particular importance. In academic assignments, it is essential to document the prompts given to the AI, the stages of generation, the selection criteria, the nature of any refinements and the extent of the student's original contribution. Such requirements help to distinguish between the use of digital tools and independent design solutions, whilst also reducing the risks of breaches of academic integrity and copyright. In landscape design, the integration of AI must be accompanied by an analysis of environmental data, the social context, user scenarios and the physical characteristics of the site. Digital modelling should therefore be combined with site surveys, field observations, prototyping and environmental impact assessments. In graphic design, a similar requirement is to evaluate generated solutions in terms of their communicative purpose, visual hierarchy, target audience and conditions of use. The ongoing training of teaching staff is a prerequisite for the implementation of AI, VR and AR. It must include the systematic exploration of the technologies' capabilities, an analysis of their limitations, the development of criteria for evaluating digital projects, and the establishment of guidelines for the use of AI in the educational environment. This approach helps to avoid situations in which technologies are employed merely as technical additions without methodological justification. Thus, the risks associated with automation do not require a rejection of AI, VR and AR, but rather methodological regulation of their use. In the training of designers, it is advisable to regard these technologies as tools for design exploration, visualisation and the testing of solutions, whilst maintaining creative control, ethical responsibility and contextual analysis.

CONCLUSIONS

The theoretical-analytical study demonstrated that AI, VR, and AR are transforming the content of graphic and landscape design education by expanding opportunities for design exploration, enhancing visualisation, and facilitating more interactive forms of design evaluation. Within

the educational process, AI is used for generating visual ideas, selecting stylistic approaches, developing compositional alternatives, and conducting preliminary selection of design solutions. VR is employed for the creation and analysis of 3D models and for assessing scale, proportions, and spatial relationships. AR enables the development of interactive objects and the alignment of digital models with real or simulated environments. It was found that in professionally oriented projects, AI supports the preparation of concepts, visual scenarios, and alternative forms of project presentation. VR is applied to immersive presentations of landscape elements, parks, and public spaces, whereas AR is used to evaluate digital objects within their intended environments. The combined use of AI, VR, and AR creates an integrated model of design practice encompassing idea generation, 3D modelling, interactive visualisation, solution evaluation, and professional presentation.

The analysis indicated that the integration of digital technologies requires the development of new professional competencies. These include proficiency in AI applications, project analytics, immersive modelling, authorship control, ethical literacy, and interdisciplinary collaboration. In graphic design, these competencies are associated with the management of visual alternatives, digital communication formats, and interactive objects. In landscape design, they relate to site analysis, scenario-based planning, spatial evaluation of solutions, and consideration of user context. At the same time, the study identified several risks associated with the integration of generative and immersive

technologies, including the standardisation of visual language, reduced independence in design exploration, ambiguity regarding authorship, algorithmic bias, legal constraints, physiological effects associated with VR and AR, and digital inequality. These risks can be mitigated through methodological regulation, including preliminary analysis of the design task, documentation of AI prompts, recording of generation and refinement stages, preservation of hand sketching practices, and the introduction of ethical guidelines governing the use of digital content. Accordingly, AI, VR, and AR should be regarded not as substitutes for fundamental design training, but as tools for generating, visualising, evaluating, and presenting design solutions while maintaining authorship control, critical analysis, and a context-sensitive approach. Future research should focus on empirically examining the influence of AI, VR, and AR on the quality of design outcomes, the development of professional competencies, the independence of design exploration, and the establishment of assessment criteria for educational projects involving digital technologies.

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