

Exploring Pathways for Educational Reform in Environmental Design Disciplines in the Context of Digital Transformation

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Abstract: In the context of digital transformation, the traditional educational model of environmental design disciplines is increasingly inadequate to meet the demands of modern green and sustainable development. The rapid advancement of digital technologies and the growing emphasis on sustainability have reshaped the way environmental design is practiced, requiring an urgent shift in educational approaches. This paper addresses this challenge by analyzing the talent cultivation needs of the digital age, focusing on the skills and knowledge required to meet the evolving demands of the industry. It explores specific pathways for the transformation of environmental design education, proposing a more forward-thinking and adaptable approach. The paper examines this transformation from three key aspects: disciplinary positioning, ensuring the field remains relevant to technological and environmental changes; curriculum design, integrating digital tools and sustainability principles into academic programs; and industry-academia integration, emphasizing collaboration between educational institutions and the design industry to enhance practical learning. Ultimately, the aim is to achieve diverse reforms in disciplinary education, increasing its competitiveness and relevance in a rapidly changing global landscape.

1. Introduction

The digital transformation of education has driven disruptive changes across the entire education process and all sectors, providing strong momentum for the development of new productive forces[1]. With the trend toward digital transformation, production models and structures have undergone profound changes, indicating that the digital age is increasingly becoming the mainstream trend in social development. Technological innovations, particularly in the fields of artificial intelligence (AI), big data, cloud computing, and the internet of things (IoT), are reshaping how industries and sectors operate. This transformation is not only affecting the way we live and work but is also reconfiguring the ways in which education systems function globally. In particular, digital technologies are revolutionizing the educational landscape, providing new avenues for both teaching and learning. These technologies have become catalysts for innovation, pushing the

boundaries of traditional education frameworks. The digital transformation of education is driving institutions to rethink how knowledge is delivered, how curricula are structured, and how students are engaged with content. The move toward digital education models reflects the broader societal shift towards integrating technology into every aspect of daily life. With breakthroughs in new technologies, all industries will inevitably achieve innovation and development that align with the digital age. The demand for skilled professionals who can navigate this digital landscape has never been greater, and educational institutions must adapt to these needs to prepare the next generation of leaders and innovators. Among these sectors, it is essential to focus on the current concept of sustainable development, which has become a critical concern across all industries and educational fields. Sustainability, which encompasses the principles of environmental stewardship, social equity, and economic viability, is now at the forefront of global discourse. In the context of environmental design education, this requires cultivating a new generation of interdisciplinary talents equipped with green development concepts and cross-disciplinary knowledge. As environmental issues become more urgent, particularly in light of climate change and resource depletion, it is crucial that the next generation of environmental designers not only understand the technical aspects of their field but also grasp the broader implications of sustainability in the built environment.

Since the beginning of the 21st century, an increasing number of universities worldwide have established environmental design disciplines, reflecting society's growing recognition of the need for environmental awareness and innovative design solutions. The environmental design field spans a wide range of disciplines, including architecture, landscape architecture, urban planning, and interior design, all of which intersect at the crossroads of technology, design, and environmental science. This expansion of academic programs highlights society's demand for skilled environmental design talent. However, much of the environmental design education that has been established so far relies heavily on traditional Western teaching models. These models often emphasize conventional design principles, theoretical knowledge, and technical skills but fall short of incorporating cutting-edge digital tools or the principles of sustainable development into their curricula. The traditional teaching methods that have been dominant in the field of environmental design often reflect outdated practices that are ill-suited for the challenges of the 21st century. While these traditional methods have provided valuable foundational knowledge, they do not sufficiently prepare students for the rapidly changing landscape of environmental design that is increasingly influenced by digital technologies. As such, there is a pressing need for educational reform to bring environmental design education into alignment with the digital age. In response to these challenges, educational institutions must rethink their approach to teaching and learning in the environmental design field. The release of the "Outline of the National Education Development Plan (2024–2035)," which emphasizes education digitization as a key breakthrough for high-quality educational development, has set new requirements for the development of environmental design disciplines. This government policy underscores the importance of digital transformation in education, aiming to foster a more dynamic and responsive educational system that can meet the needs of an increasingly digital society. The policy calls for a shift away from traditional, static teaching models towards more dynamic, flexible, and technologically integrated systems. The new guidelines highlight the importance of using digital technologies to enhance teaching methods, facilitate interdisciplinary collaboration, and improve the overall quality of education. This transition represents a significant opportunity for environmental design programs to adopt innovative teaching methods and technologies that better reflect the needs of today's learners and industries.

In the context of the digital economy, the demand for talent in the field of environmental design has undergone fundamental changes. The digital revolution has transformed how design work is conceptualized, developed, and executed, with new technologies playing an increasingly central

role in the design process. As industries continue to integrate digital tools into their practices, the skills and knowledge required of environmental design professionals have evolved as well. The demand for talent in the field is no longer limited to traditional roles such as architects and designers. The digital age has given rise to new professions and job categories that require specialized expertise in digital technologies, sustainable practices, and interdisciplinary collaboration. This demand can be categorized into three main types: intelligent environmental designers, intelligent environmental design engineers, and intelligent environmental design operations specialists. The role of the intelligent environmental designer involves integrating digital technologies such as building information modeling (BIM), virtual reality (VR), and augmented reality (AR) into the design process. These tools allow for more efficient, accurate, and sustainable design practices. Intelligent environmental design engineers are responsible for implementing these digital technologies in practical applications, ensuring that designs meet technical, environmental, and regulatory standards. Meanwhile, intelligent environmental design operations specialists focus on managing and optimizing the performance of designed environments, including energy efficiency, resource use, and sustainability outcomes. As the digital economy continues to penetrate various industries, the demand for professionals who can navigate this evolving landscape has grown. Educational institutions must recognize these shifts and update their curricula accordingly to produce graduates who are not only knowledgeable about environmental design principles but also skilled in the use of the latest digital technologies. By focusing on the development of interdisciplinary skills that combine design, engineering, and technology, educational programs can better equip students to meet the demands of a rapidly changing job market. Exploring pathways for educational reform in environmental design offers significant opportunities to bridge the gap between individual student development and societal needs. At the micro level, it is essential to ensure that students receive a well-rounded education that prepares them to thrive in a competitive and increasingly digital workforce. At the macro level, it is important to address the broader societal challenges that come with digital transformation, including the need for sustainable development and the integration of digital technologies into the design process. By updating educational practices, universities can contribute to the development of a workforce that is not only highly skilled but also prepared to tackle the global challenges of the digital age. The demand for skilled professionals in environmental design, which aligns with the digital age, is expected to continue growing. Educational reforms in this field will ensure that future professionals are equipped with both the interdisciplinary knowledge and the practical skills required to thrive in this new environment. By integrating digital tools into environmental design curricula, institutions can promote a shift toward more innovative and sustainable design practices. These reforms will not only enhance the efficiency of practical course delivery but also align educational practices with the contemporary demand for interdisciplinary talents capable of addressing the complex challenges of the digital age[2][3].

2. Challenges Facing Environmental Design Education

2.1 Education Models Out of Sync with Modern Needs

In the context of digital transformation, environmental design education is facing both unprecedented opportunities and challenges, the most prominent of which is the disconnect between current educational models and the needs of modern society. As we move further into the 21st century, it becomes increasingly clear that the traditional educational paradigms cannot adequately address the rapidly evolving demands of today's interconnected, digital, and environmentally conscious world. Environmental design, as a multi-faceted and interdisciplinary field, must embrace new methodologies, frameworks, and technologies to stay relevant and effective.

Although environmental design curricula have become more comprehensive than in the past, most programs still focus primarily on theory, technical skills, and design practice. Traditional approaches often place significant emphasis on artistic creativity and architectural design principles, which are essential components of the profession. However, to meet the demands of the digital era, the discipline must also address emerging issues such as smart city development, sustainable design practices, and the integration of digital tools like Building Information Modeling (BIM), Virtual Reality (VR), and Augmented Reality (AR). These tools are not just enhancing design processes but are also revolutionizing how designs are implemented and experienced in the real world. At the heart of this challenge is the failure to integrate modern technological advancements into environmental design education. Many universities still emphasize traditional design concepts and neglect the incorporation of cutting-edge digital technologies into their curricula. For example, although digital tools like BIM are widely used in professional practice to optimize the use of materials and energy in construction, they are often underrepresented in educational settings. This gap between what is taught in classrooms and what is required in professional environments results in a lack of practical, real-world preparation for students. As a result, environmental design graduates are entering the workforce with a limited understanding of the digital tools and interdisciplinary collaboration that are now indispensable in the field.

This lack of cross-disciplinary integration results in a narrow and homogeneous learning experience, limiting students' ability to engage with the complexities of the modern design landscape. Students are often not exposed to the full spectrum of skills they need, such as digital tools, interdisciplinary collaboration, and sustainability principles, which would enable them to be more innovative and adaptable in their future careers. The absence of these essential elements in the curriculum also creates a disconnect between the theoretical foundations of the discipline and the practical applications demanded by the industry. At the same time, new demands for green building and intelligent design have emerged with the rise of the digital economy. Sustainable development is no longer just an abstract concept or a peripheral concern—it has become a central principle that guides the development of cities, infrastructures, and built environments. For instance, students could greatly benefit from learning BIM technologies, which help optimize the use of energy and materials in real-life construction projects, producing works that are both aesthetically pleasing and functional. BIM's ability to create accurate, data-driven models of buildings and infrastructures enables architects and designers to consider the full lifecycle of their designs, including energy consumption, resource usage, and environmental impact. Integrating such tools into environmental design education would not only provide students with a deeper understanding of sustainable design practices but also equip them with the skills needed to implement these practices in their work.

In the same vein, curricula must be designed to align with the real-world needs of the environmental design industry. Educational programs should be more closely linked with industry standards, trends, and technological innovations. This alignment can be achieved through the incorporation of practical projects, industry partnerships, and the inclusion of emerging technologies that are shaping the future of environmental design. One such approach is to enrich teaching methods by introducing Virtual Reality (VR) and Augmented Reality (AR) technologies into the curriculum. These technologies provide immersive learning environments that enhance students' spatial imagination, boost their creativity, and allow them to visualize their designs in three dimensions before they are physically constructed. For example, Beijing University of Civil Engineering and Architecture organized a "Roman Forum Restoration" project, combining virtual tools and intelligent design practices. In this project, students used VR and BIM to create a virtual restoration of the ancient Roman Forum. The project allowed students to engage with historical data and design techniques while also integrating modern tools such as VR to simulate the reconstructed forum. By using these digital tools, students were able to explore the possibilities of digitally

recreating ancient sites while developing critical skills that are applicable to contemporary environmental design challenges. This project is an excellent example of how the integration of digital technologies can enhance the educational experience of students and provide them with valuable, real-world skills. The use of VR and AR technologies in education can also enhance collaboration between disciplines, encouraging students to work together on projects that combine knowledge from architecture, engineering, urban planning, and environmental science. This cross-disciplinary approach is essential for addressing the complex, interconnected problems of modern environmental design. For example, the design of a sustainable city cannot be achieved by a single discipline alone; it requires a collaborative effort between architects, engineers, urban planners, and environmental scientists. By incorporating these technologies into the curriculum, educational institutions can foster an environment that encourages interdisciplinary cooperation, which is vital for preparing students to work in today's integrated and technology-driven design industries.

In today's market, environmental design professionals are required not only to master theoretical knowledge but also to develop cross-disciplinary skills and innovative thinking. With the increasing complexity of modern design challenges, environmental design professionals must be able to draw on knowledge from multiple fields, including architecture, technology, sustainability, and urban planning. This ability to integrate knowledge from diverse fields will be critical for addressing the complex problems posed by climate change, resource depletion, and urbanization. Therefore, environmental design education must evolve to incorporate interdisciplinary approaches that foster innovation and adaptability among students. Addressing the disconnect between traditional teaching methods and the modern needs of the industry is therefore essential for driving the digital transformation of environmental design education. The integration of digital tools, sustainable practices, and interdisciplinary collaboration into the curriculum will ensure that future environmental designers are equipped with the skills and knowledge necessary to thrive in the digital age. Furthermore, these changes will ensure that environmental design education remains relevant to the needs of the industry and society, preparing graduates to tackle the complex challenges of the future. The transition to digital education models, supported by technologies such as BIM, VR, and AR, will also open up new opportunities for teaching and learning. Digital tools can provide students with more flexible, personalized learning experiences, enabling them to engage with the material in more dynamic and interactive ways. By incorporating these technologies into environmental design education, institutions can create more engaging, collaborative, and hands-on learning environments that prepare students for the digital challenges of the modern design world.

In conclusion, the digital transformation of environmental design education presents both significant challenges and exciting opportunities. The traditional educational models, while foundational, are no longer sufficient to meet the demands of the digital age. To remain relevant, environmental design programs must integrate digital tools, sustainability principles, and interdisciplinary collaboration into their curricula. By doing so, educational institutions can equip future environmental design professionals with the knowledge, skills, and innovative thinking required to address the complex challenges of the digital economy. As digital technologies continue to evolve, it is crucial that educational institutions remain agile and responsive, ensuring that their curricula align with the ever-changing needs of the industry and society. This transformation will not only enhance the quality of education but also contribute to the development of a sustainable and innovative future for the built environment[4].

2.2 Challenges of Digital Transformation

The core content of environmental design education still revolves largely around traditional

foundation courses, such as design skills or hand-drawing. These fundamental subjects have historically been essential to the development of a designer's eye and skills, laying the groundwork for creativity and technical precision. However, as the world rapidly transitions into the digital era, environmental design education is facing profound challenges in adapting its teaching methods and content to align with the demands of modern industries and the digital economy. In many institutions, digital initiatives remain largely aspirational, and there is often a significant gap between the current curriculum and the skills required by today's job market. This paper explores the multifaceted challenges that environmental design education faces in the context of digital transformation and offers solutions to help bridge this gap.

(1) The Disconnect Between Traditional Education and Modern Needs

While traditional courses focusing on design skills and hand-drawing are foundational, they do not adequately prepare students for the dynamic and increasingly technological design industry. The global push towards digitalization, along with the rise of technologies like Artificial Intelligence (AI), Building Information Modeling (BIM), Virtual Reality (VR), and Augmented Reality (AR), has significantly reshaped how design is practiced. Yet, the traditional educational models in many environmental design programs have failed to fully embrace these advancements. Students who graduate with limited exposure to these tools may find themselves unprepared for the real-world challenges they face in the workforce. As a result, there is an increasing need for a curriculum overhaul that reflects the demands of the digital age, incorporating digital tools, innovative methodologies, and interdisciplinary learning to meet the current needs of the environmental design industry. This mismatch between the traditional teaching model and the rapidly evolving industry is one of the primary obstacles faced by environmental design education. While many educational institutions around the world are beginning to integrate digital technologies into their programs, there is a distinct lag in how quickly these changes are being implemented. The digital age requires not only a shift in how design is taught but also a rethinking of the underlying principles of design education. This involves a fundamental change in the way knowledge is shared, how students engage with the material, and how they apply their learning in real-world scenarios.

(2) The Barriers to Digital Transformation in Environmental Design Education

Despite the growing recognition of the importance of digital tools in environmental design education, the transition to fully digital curricula has not been seamless. Digital transformation in education, particularly in the field of environmental design, faces several key obstacles, which can be broadly categorized into three main areas: insufficient funding, lack of systematic guidance, and the misalignment between teachers' expertise and course content. Each of these barriers presents its own unique challenges that hinder the effective integration of digital technologies into environmental design programs.

1) Insufficient Funding: A Major Barrier to Digital Integration

The first and perhaps most significant challenge to the digital transformation of environmental design education is insufficient funding. While some of the more prestigious institutions have the resources to adopt cutting-edge digital software and equipment, many local universities and smaller institutions struggle to secure the financial resources needed to keep pace with technological advancements. Digital tools and technologies such as BIM, VR, AR, and AI are not only expensive to implement but also require regular updates, maintenance, and upgrades to stay current. This poses a significant challenge for institutions that are operating on limited budgets, as they must prioritize the allocation of resources across multiple areas, including faculty salaries, student support services, and infrastructure development. To accelerate the adoption of digital technologies in environmental design education, it is essential for universities and colleges to secure greater investments from relevant authorities, including government bodies, private sector partners, and philanthropic organizations. One potential solution is for governments to provide more targeted

funding for educational institutions to help bridge the technological gap. In countries where higher education funding is heavily dependent on government grants or private donations, it may be difficult for institutions to independently secure the necessary resources for digital transformation. However, when educational programs are able to access the appropriate funding, they can invest in essential technologies such as BIM software, VR equipment, and the development of online learning platforms. These investments would not only improve the quality of education but also increase the overall relevance of the programs offered by these institutions, ensuring that students are learning the skills that will be in demand in the future workforce. Moreover, university partnerships with industry leaders can help address this funding gap. Private companies and tech firms are often at the forefront of technological advancements, and collaborations between educational institutions and industry can provide mutual benefits. These partnerships can offer access to the latest software, hardware, and training, ensuring that students are exposed to the most up-to-date tools available in the design industry. Industry partnerships can also provide internship and job placement opportunities, allowing students to gain hands-on experience with digital tools before entering the workforce.

2) Lack of Systematic Guidance: The Need for Practical and Comprehensive Digital Education

The second major barrier to digital transformation in environmental design education is the lack of systematic guidance. While digital technologies are often discussed in broad terms, many institutions still lack a structured, comprehensive approach to integrating these tools into their curricula. As a result, the implementation of digital technologies often remains superficial, with digital education confined to basic awareness campaigns or isolated projects that do not offer in-depth training in their practical application. In some cases, digital technologies are introduced through optional courses, rather than being embedded into the core curriculum. This piecemeal approach to digital education limits the effectiveness of digital tools in enhancing students' learning experiences. For example, VR and AR technologies, while useful for visualizing designs and spatial relationships, are often not integrated into the daily learning process in a meaningful way. Instead, students may only experience these technologies in one-off projects or as supplementary activities. As a result, they fail to fully grasp how these tools can be applied across various stages of the design process, from conceptualization and drafting to project execution and analysis. To address this gap, universities must adopt a more systematic approach to integrating digital technologies into their programs. This can be done by ensuring that digital tools are embedded throughout the curriculum, rather than being relegated to optional courses or isolated workshops. For instance, the use of BIM can be introduced in the early stages of the program and continue throughout, with increasing complexity and application as students progress through their studies. By integrating digital tools into every aspect of the environmental design education process, students will gain a deeper understanding of how these tools can be leveraged to solve complex design problems and create more sustainable, efficient, and innovative designs. Moreover, universities should partner with industry professionals and experts to provide students with real-world guidance and mentorship. This would not only help students develop practical skills but also ensure that the education they receive is aligned with the latest industry trends and standards. Workshops, internships, and collaborative projects with industry can provide students with the opportunity to apply their learning in real-world contexts, helping them build the confidence and competence needed to succeed in the workforce.

3) Misalignment between Teachers' Expertise and Digital Tools: Training for Faculty Development

Finally, the third barrier to the digital transformation of environmental design education is the misalignment between teachers' professional backgrounds and the latest digital design tools. Many faculty members who have been teaching for years may lack the training and expertise needed to

effectively teach students how to use modern digital tools such as BIM, VR, and AI. As a result, there is a growing gap between the capabilities of students and the ability of instructors to provide the necessary guidance and training in these areas. To overcome this barrier, it is essential to invest in faculty development. Faculty members must be given the opportunity to gain proficiency in the digital tools and technologies that are transforming the field of environmental design. This can be done through targeted professional development programs that focus on training faculty in the use of modern design tools. These programs should be designed to accommodate the diverse needs of instructors, from those who are new to digital tools to those who are already experienced but need to expand their knowledge. Furthermore, universities should provide faculty with the resources and support they need to integrate digital tools into their teaching effectively. This could include providing access to the necessary software, hardware, and training materials, as well as creating a collaborative environment where faculty can share best practices and learn from each other. Faculty members should be encouraged to participate in professional networks, workshops, and conferences related to digital design tools to stay up to date with the latest developments in the field. By investing in faculty development, universities can ensure that instructors are equipped with the knowledge and skills to teach students how to use the latest digital tools effectively. This, in turn, will help students develop the competencies they need to succeed in the increasingly digital design industry.

(3) Conclusion: A Path Forward for Digital Transformation in Environmental Design Education

The digital transformation of environmental design education presents both significant challenges and exciting opportunities. By addressing the barriers of insufficient funding, lack of systematic guidance, and misalignment between faculty expertise and course content, educational institutions can create a more effective and relevant curriculum for the digital age. These changes will not only improve the quality of education but also ensure that students are equipped with the skills needed to succeed in the rapidly evolving digital economy. By integrating digital tools into the core curriculum, fostering collaboration with industry, and investing in faculty development, environmental design programs can ensure that their graduates are well-prepared for the challenges and opportunities of the future.

2.3 Insufficient Integration of the Green Development Concept

Under the digital transformation agenda, the insufficient integration of green development principles is another pressing challenge for environmental design education. As the world grapples with the effects of climate change, resource depletion, and environmental degradation, sustainable design practices have become more urgent than ever. However, despite the growing recognition of the importance of sustainability, many environmental design education programs still fall short in integrating contemporary sustainability principles into their curricula. While concepts such as green building and ecological design have been incorporated into some programs, most teaching frameworks remain deeply rooted in traditional models that do not effectively address the complexities of modern sustainability. In general, current environmental design curricula place a heavy emphasis on technical and artistic skills, which are undeniably essential for the discipline. The development of design expertise in architectural form, spatial aesthetics, and functionality is at the core of many programs. However, the growing global emphasis on sustainability and environmental responsibility demands that environmental design education evolve to encompass a broader, more holistic understanding of design. Current courses often lack comprehensive theoretical guidance on sustainable development, leaving students ill-prepared to address the urgent need for eco-conscious, resource-efficient design solutions.

Students in traditional environmental design programs are often taught to focus on aesthetic and

functional layouts that prioritize form and style over environmental impact. While this artistic focus is valuable, it fails to equip students with the necessary knowledge of how their designs will impact the environment. For example, students may be well-versed in creating visually appealing spaces and structures but may receive limited exposure to critical topics such as eco-friendly building materials, energy-saving technologies, and strategies for reducing carbon footprints. This leaves them underprepared for the real-world challenges they will face when designing buildings and cities that meet modern standards of sustainability. As a result, there is a significant gap between the education provided and the demands of society, which increasingly values environmental stewardship and sustainable practices in design.

The lack of sufficient green development principles in environmental design education has serious consequences. It perpetuates the status quo, where environmental design professionals may continue to practice design in ways that prioritize aesthetic value and functionality without considering the full environmental cost of their projects. In this context, sustainability is often treated as an afterthought rather than an integral part of the design process. This gap in education can also contribute to a lack of innovation in the design industry, as students are not taught to think creatively about how to incorporate sustainability into their work. The real-world implications of this gap are profound. Today's society demands designers who are not only technically proficient but also environmentally responsible. The need for energy-efficient buildings, resource-saving technologies, and eco-friendly construction practices has never been more urgent. Yet, without an educational foundation that emphasizes sustainable development, future designers may struggle to meet the growing demand for sustainable solutions in the built environment. Furthermore, as public awareness of environmental issues grows, consumers and businesses alike are placing greater pressure on the design industry to embrace green principles in their work. Environmental design professionals who are not equipped to address these concerns will find themselves at a competitive disadvantage, particularly as more companies and governments adopt policies that prioritize sustainability.

1) Shifting the Focus of Environmental Design Education

As public awareness of environmental issues continues to rise, the focus of environmental design education must shift from purely aesthetic considerations to resource efficiency and sustainability. Educators must recognize that the future of design lies in the integration of ecological stewardship, energy efficiency, and resource conservation into every phase of the design process. This shift will require a rethinking of what it means to educate environmental designers and a reevaluation of how sustainability can be woven into curricula. One of the first steps in this transformation is the incorporation of sustainability principles into the foundational courses of environmental design programs. Rather than relegating green building concepts to specialized or elective courses, sustainability should be embedded throughout the curriculum, starting from the very first year of study. This would allow students to see sustainability not as a separate discipline or an add-on to design but as a fundamental aspect of the design process. In this way, students will understand that sustainable design is not merely a trend or a regulatory requirement but an integral part of their role as designers in the modern world. Educators can begin to integrate green design principles by introducing courses that focus on topics such as energy efficiency, air quality, and resource recycling. These courses can provide students with the knowledge and tools they need to design buildings and spaces that minimize their environmental impact. In particular, students should be introduced to the concepts of energy-efficient architecture, passive design strategies, and the use of renewable energy sources in the built environment. These principles are becoming standard in many parts of the world, and students who are not equipped with this knowledge will be at a disadvantage when entering the workforce. Beyond these technical skills, students should also be taught how to think critically about the environmental impact of their designs. For instance, they should be

encouraged to consider the life cycle of materials and the energy consumption of buildings throughout their lifespan. This shift in focus will encourage students to think more holistically about design, understanding that the materials and techniques they choose can have long-lasting effects on both the environment and the people who use the spaces they create. Moreover, incorporating sustainable design principles into environmental design education can lead to the development of more innovative, cutting-edge solutions to environmental challenges. By pushing students to think beyond traditional design constraints, educators can foster a new generation of designers who are capable of addressing the complex challenges of the digital age. These solutions may include not only energy-efficient buildings but also the integration of smart technologies into urban planning, the use of sustainable materials in construction, and the development of circular economy models that minimize waste and maximize resource reuse.

2) The Role of Digital Tools in Green Design Education

The integration of digital tools into environmental design education can play a key role in facilitating the adoption of green development principles. Digital technologies such as BIM, VR, and AR provide students with powerful tools for creating sustainable designs that optimize resource use and minimize waste. For example, BIM allows students to model buildings with precise data on energy consumption, material use, and environmental impact, enabling them to make informed decisions about how to reduce the carbon footprint of their designs. By incorporating digital tools like these into the curriculum, universities can enhance students' ability to design buildings that are not only aesthetically pleasing but also environmentally responsible. BIM software, for example, can be used to simulate energy usage in a building over time, helping students understand how their design choices impact energy efficiency and resource consumption. Similarly, VR and AR technologies can allow students to visualize how a building will perform in real-world conditions, helping them identify potential design flaws that could lead to inefficiencies or negative environmental impacts. Incorporating these technologies into environmental design education not only enhances students' technical skills but also fosters a deeper understanding of the role that digital tools can play in promoting sustainability. By integrating digital design tools with green building principles, students will be better equipped to create innovative solutions that address the challenges of the digital era.

3) Modernizing Environmental Design Education: A Comprehensive Approach

To address the current shortcomings in environmental design education, institutions must adopt a modernized approach that combines intelligent building concepts with resource recycling and cutting-edge digital technologies. This approach involves revisiting traditional educational frameworks and infusing them with the latest technological advancements and sustainability principles. It is essential for universities to embrace green design principles and implement innovative teaching methods that challenge students to think creatively and critically about their work. One key aspect of this modernized approach is the active involvement of industry professionals in the educational process. Industry partnerships can help ensure that the education students receive is aligned with the latest trends and technologies in the environmental design field. These partnerships can take many forms, from guest lectures and workshops to collaborative projects and internships. By working closely with industry leaders, students will gain a better understanding of how sustainability is implemented in real-world design projects and how they can apply their knowledge in professional settings. In addition, universities should focus on fostering interdisciplinary collaboration between environmental design students and those studying related fields such as urban planning, engineering, and environmental science. The complexity of modern design challenges requires input from a variety of disciplines, and students who are trained to collaborate across fields will be better equipped to address the complex issues of the digital age. This collaborative approach will help students understand the interconnectedness of design,

sustainability, and technology and prepare them for the multi-disciplinary nature of the workforce they will enter.

3. Pathways for Reform under Digital Transformation

3.1 Optimizing Educational Models: Addressing the Gap with Modern Needs

Environmental design is an interdisciplinary field that integrates art, architecture, environment, and technology. The introduction of cross-disciplinary teaching models allows students to examine environmental art design from a broader academic perspective, breaking away from the confines of single-discipline thinking. This integration enables the convergence of art and science as well as humanities and technology, providing richer and more diverse perspectives for environmental art design [5]. Currently, most environmental design programs continue to follow traditional design concepts without sufficiently considering the realities of digital transformation. To optimize educational models, it is necessary to redefine the nature and direction of environmental design as a discipline and leverage its interdisciplinary advantages. Design practice should not only focus on aesthetics but also integrate environmental and ecological considerations to achieve sustainable design solutions.

As emerging fields such as smart cities and green buildings gain greater attention, the development of environmental design must shift toward the rational use of resources and adopt comprehensive training approaches. For example, advanced technologies such as intelligent architecture and Building Information Modeling (BIM) can be incorporated into teaching methods to align environmental design education with digital transformation and cultivate innovative design talents who meet the educational ideals of the new era. At the same time, environmental design education should be closely connected to real-world social demands. By strengthening the integration of industry and education, curricula can include more practice-oriented content that allows students to engage fully in authentic design processes—from concept sketches to implementation plans. This experiential learning not only improves students' understanding of the design process but also enhances their ability to solve complex problems.

Additionally, collaboration between universities and industry partners can promote project-based teaching. Enterprises can introduce cutting-edge design tools and provide students with real-world contexts to apply their knowledge, improving their competitiveness and practical skills. Such partnerships will lay a solid foundation for students' future career development.

3.2 Coping with Digital Transformation: Overcoming Challenges in the Current Educational System

With increasing attention to social and environmental issues, environmental design has shifted toward resource efficiency and the adoption of emerging intelligent design tools. However, the discipline continues to face structural challenges in building a robust educational framework. First, relevant authorities should increase funding for environmental design programs to support their digital transformation. Insufficient funding is a major obstacle for many universities, particularly local institutions, which lack the resources to attract highly skilled professionals. In addition to government funding, universities can strengthen cooperation with enterprises to drive industrial development and introduce advanced digital equipment. This would improve design efficiency and enhance students' practical skills, achieving the dual goals of fostering innovation and improving digital literacy.

Digital educational resources also help promote educational equity by protecting every learner's right to education. They can provide strong support for rural revitalization and the broader

construction of a “Digital China” [6]. Through school-enterprise partnerships, universities and design or construction companies can build closer connections, enabling students to learn through application, stay updated on industry trends, and develop the ability to address complex problems in practice. Second, universities should provide regular training for teachers to improve the quality of instruction in the context of digital transformation. Such training should ensure that faculty are proficient in the latest digital design tools and technologies. Importantly, teacher development should not be limited to digital tools but also include emerging fields such as green design. Faculty who complete training or industry placements can translate their experiences into teaching content, moving beyond aesthetic or spatial design to incorporate sustainability concepts. This will help students develop environmental awareness and improve the efficiency and effectiveness of classroom instruction.

Finally, environmental design programs should establish standardized, systematic digital teaching platforms to facilitate resource sharing and promote educational fairness. In the past, the quality of environmental design education depended heavily on campus facilities and faculty expertise. However, digital teaching platforms can provide students with diversified learning channels, enabling them to access cutting-edge course materials and detailed instructional videos at any time and from any location. Such platforms empower students to take ownership of their learning while fostering collaboration among students from different institutions. In addition, comprehensive evaluation mechanisms should be established for environmental design programs under digital transformation. Assessment should move beyond final exam scores to include peer feedback and evaluations from potential employers, allowing a clearer understanding of students’ theoretical knowledge and practical competencies. Teachers can analyze students’ mastery of environmental design from multiple dimensions—such as aesthetics, functionality, and sustainability—and adjust teaching strategies accordingly. Through continuous evaluation, universities can conduct macro-level assessments of environmental design programs and drive the discipline’s development.

3.3 Integrating the Green Development Concept: Advancing Sustainable Educational Reform

Technological change drives social progress, and education is always rooted in specific social contexts, influenced and shaped by social structures and technological developments. The concept of green development, which integrates ecological protection with socio-economic development, emphasizes rational attention to natural ecosystems, efficient resource utilization, and sustainable growth. This concept also provides valuable theoretical guidance for education and has enormous potential when applied to environmental design education. Green development seeks a balance between economic growth and environmental protection, pursuing a “win-win” outcome across economic, social, and ecological dimensions. In environmental design, educators must consider the relationship between design practice and the larger social-ecological system, avoiding excessive resource consumption in pursuit of aesthetics. This calls for an educational approach that emphasizes sustainable development.

To drive the reform of environmental design education, it is essential to cultivate students’ sense of social responsibility and environmental awareness in addition to teaching design theory and technical skills. Only by understanding the significance of sustainability can students fully embrace environmental stewardship and innovation in their designs. The Ministry of Education has issued the Opinions on Strengthening the Talent Training System for Carbon Peaking and Carbon Neutrality in Higher Education, which highlights the importance of integrating green and low-carbon concepts into textbooks, classrooms, and students’ mindsets. This policy aims to nurture high-quality talent with strong awareness of green and low-carbon development. Environmental

design education must shift its focus from traditional aesthetics and functionality to ecological protection and resource efficiency under a green, low-carbon mindset. The discipline is also moving from single-disciplinary training toward interdisciplinary development, enhancing students' ability to solve complex problems. For instance, Beijing University of Civil Engineering and Architecture has integrated green building design courses into its environmental design curriculum. These courses emphasize energy conservation, low-carbon design, and resource recycling, helping students understand and apply green design concepts. Similarly, Southern University of Science and Technology has incorporated green development concepts into its environmental design curriculum, launching courses such as "Green Building and Sustainable Urban Planning" to deepen students' understanding of urban development and sustainability.

In summary, integrating the green development concept into environmental design education under digital transformation aligns with curriculum objectives and cultivates design professionals capable of meeting the needs of the new era. This approach also represents a necessary step toward advancing sustainable educational reform in the discipline.

4. Conclusion

The transformation brought about by digital technologies has disrupted traditional educational models and placed new demands on the practical pathways of environmental design education. As educational concepts continue to evolve, gaps remain between conventional teaching methods and the requirements of modern society. This reflects the pressing challenges that the discipline of environmental design must address in the digital era. At the same time, integrating the concept of green development into curricula has become an essential issue for educators. Therefore, environmental design education must strengthen its connections with related disciplines and overcome the challenges posed by digital education. Actively incorporating green development principles into teaching not only helps solve practical problems in the reform of environmental design education but also promotes interdisciplinary development in the future. By responding to the call of the times, environmental design education can cultivate a new generation of professionals with cross-disciplinary thinking, innovation capabilities, and a strong awareness of sustainability, meeting the demands of the digital age and contributing to the advancement of the discipline.

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