The Prospect of Applying Technology in University Education: The Field of Architectural and Urban Design Inclusive Smart City in Vietnam

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Abstract. In an era marked by rapid technological advancement, various new methods have been employed to enhance productivity and efficiency in architectural and urban design. These methods span from surveying existing conditions and collecting data to processing materials, generating design models, and presenting ideas to diverse communities. Technology is harnessed to optimize tasks, affording urban designers and architects more time to develop their professional content under ideal working conditions, thus maximizing their capabilities. Design trends in architecture and urbanism have evolved to necessitate comprehensive and precise input data for informed design decisions. Simultaneously, designs must prioritize human-centered approaches to improve quality of life and ensure sustainability. Consequently, undergraduate students must not only master fundamental skills but also broaden their knowledge of leveraging advanced technology to boost productivity. Nevertheless, excessive reliance on technology in domains demanding creativity and traditional skills like architecture and urban design frequently sparks debate, with such innovative endeavors sometimes viewed as technology misuse. The University, renowned for its innovative scientific research, serves as an ideal conduit for future generations in architecture and urban design to learn how to judiciously harness new technology to optimize their work.

In this article, the research team proposes solutions for integrating various technologies into university curricula and extracurricular activities to expand students' skill sets. Students are not only exposed to these technologies but also taught how to utilize them effectively and discern when to apply them to enhance project productivity. While new problem-solving approaches are introduced, students are reminded of the importance of mastering fundamental skills within the architecture and urban design curriculum. Illustrated practical teaching scenarios featured in this article are part of the undergraduate program provided by the Institute of Smart City and Management, UEH University.

Keywords: Architectural Design, Smart City, Technology Application, University Education, Urban Design.

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1 Introduction

Urbanization represents an inevitable global shift, yielding both positive and negative outcomes. Stemming from this process are emergent urban issues, evolving societal needs, and shifts in social and urban structures. In addressing urban challenges sustainably, smart cities have gained widespread acceptance as a viable strategy. Smart cities have an explosive foundation similar to the 4.0 industrial revolution, which is the remarkable development of Information and communication technology (ICT). The goal of smart urban development strategies is to improve the quality of human life, increase the efficiency of infrastructure and services, and promote sustainable economic development. [1-3]. In the realm of architecture and urban design, professionals must not only adapt design paradigms to align with contemporary trends but also leverage new technologies to tackle existing challenges and enhance project efficiency. Architects and urban designers should constantly search for innovative solutions such as smart urban intervention with the application of advanced technology, software, computing power, and artificial intelligence.

Along with real-world applications in the industry, educational programs for university students in architecture and urbanism must also evolve to align with the global urban development landscape. This ensures that upon graduation, students possess the requisite skills and contemporary design thinking, in addition to fundamental knowledge. To achieve this, the curriculum needs to be updated to incorporate and integrate new solutions into education programs [4, 5]. With the objective of establishing the university as a robust platform for student development, this study has two objectives: (1) To catalogue various applied technologies relevant to architecture and urban design for potential integration into the university program; and (2) To give expertise suggestion based on the strengths, weaknesses, opportunities, and challenges associated with the incorporation of these technologies based on practical experiences. The research was conducted within the Bachelor of Architectural and Urban Design Inclusive Smart City (BAUD) program at the Institute of Smart City and Management (ISCM), UEH University, Vietnam.

2 Literature Review

2.1 The Shift Paradigm in Architectural and Urban Design Workflow

Over time, architectural and urban design have evolved in tandem with societal and urban developments, driven by the objective of addressing human needs. With a focus on enhancing citizens' lives, designs have aimed to resolve contemporary challenges while fostering comfort and convenience. The emergence of smart urban strategies, propelled by the ICT industry's advancements in the 4.0 industrial revolution, has reshaped societal and urban structures significantly [1-3]. Consequently, new needs have arisen, prompting a reevaluation of problem-solving approaches. To enhance quality of life and foster innovation in architecture and urbanism, architects and designers must embrace emerging trends in their field. This necessitates adaptability to

evolving paradigms and a commitment to incorporating design thinking and innovation into their practice [6, 7].

The evolution of applied technologies in architecture and urban development has not only influenced design trends but has also transformed project workflows. Various technologies, including Virtual Reality (VR), Augmented Reality (AR), and hologram, have revolutionized spatial data visualization [8-12]. Additionally, fabrication processes have been revolutionized by technologies such as 3D printing, Computerized Numerical Control (CNC) milling, etc. [13, 14]. Data collection has been enhanced through the use of Light Imaging Detection and Ranging LiDAR, Unmanned Aerial Vehicles (UAVs), sensors, remote sensing, etc. [15-18]. Furthermore, an array of software tools, including Geographic Information Systems (GIS), Building Information Management (BIM), 3-dimensions (3D) modeling, game engines, artificial intelligence (AI), leverage computing power to build, process, analyze, and manage data [19-22]. These advancements have streamlined project workflows, enabling architects and urban planners to leverage cutting-edge technologies for more efficient and innovative design processes. The rapid advancement of communication and media technology has revolutionized the way designers interact with users. By leveraging technology to establish co-creation and co-design platforms in architecture and urban design, projects can better address the needs of communities and enhance people's quality of life [23, 24]. These platforms facilitate collaboration between designers and end-users, allowing for greater input and participation in the design process. As a result, projects are more responsive to the diverse needs and preferences of the communities they serve. By embracing technology-enabled communication channels, designers can foster greater engagement and transparency, ultimately leading to more inclusive and impactful design outcomes [6, 7, 25].

2.2 Traditional Undergraduate Education in The Architectural and Urban Design Field in Vietnam

In 2022, Vietnam boasted a total of 36 educational institutions offering majors in Architecture, Interior Design, and Landscape Architecture. A recent report from Hanoi University of Civil Engineering, one of Vietnam's oldest institutions training architects, reveal that only 45-50% of the graduates in this unit pursue careers in architecture [5]. This discrepancy can be attributed to several factors, with two primary reasons standing out: First, Vietnamese universities lack a coherent architecture training philosophy and strategy aligned with the present urban context. Second, the curriculum and output standards fail to adequately address crucial aspects such as cultural relevance, technological advancements, design thinking methodologies, and practical experience. These deficiencies underscore the need for educational reforms aimed at bridging the gap between academic training and industry demands, thereby better preparing graduates for successful careers in architecture and related fields [5]. The research team believes that to meet the urban context in the 4.0 industrial revolution, undergraduate and graduate programs in architecture and urban design must incorporate elements of smart urban development strategies into their curriculum. Particularly, amidst the surge of ICT technology, architects and urban designers are not solely

focused on shifts in human needs and urban configurations, but also seek avenues to integrate emerging technologies and enhance efficiency in design processes.

2.3 New Pedagogies in The Field of Architectural and Urban Design

The program Architecture and Urban Design Inclusive Smart City program focuses on learning design skills in both architecture and urban design. Students acquire knowledge and skills in architecture, urban design, urban landscape, and technology to set the tone for the rest of the program and prepare the students for the reality of design practice. The research team has identified a wide range of strategies and interventions aimed at enhancing educational performance in this program, such as (1) Using new visualization methods to help students to acquire a better spatial understanding of their work [26]; (2) Using new sustainable performance simulation tool to educating students about innovatively sustainable design [27]; (3) Approaching Design-Based Learning model to enhance students reasoning, self-direction, problem-solving and design thinking for learning [28], with the primary focus of smart education systems in design is on optimizing and creating practical environments that stimulate students' creativity.

In the past few years, the evolving living conditions and rapid technological advancement have significantly influenced how individuals perceive the world around them. These influences have led to noticeable shifts in personality traits, values, expectations, and societal trends [29]. The impact of these changes is not limited to individuals; it extends to the broader society. A noteworthy example is the generation of students who have grown up in the digital revolution era. These individuals are uniquely poised to adapt and excel in an educational environment that leverages smart technology and digital resources. According to Khodeir and Nessim [30], the 21st Century skill framework includes three components: (1) learning and innovation, (2) digital literacy, and (3) life and career skills. In the context of the Architecture and Urban Design Inclusive Smart City program, integrating smart education in design presents a significant opportunity. Equipping students with digital tools and the ability to utilize technology in the design process effectively can greatly enhance their educational experience and professional readiness.

3 Methodology and Data

3.1 The Technology Application in Education in The Field of Architectural and Urban Design

The design of architecture and urban environments has to take into account complex sources of information. This information includes both quantitative and qualitative types of data that require different approaches, sometime with creative methods, to collect an adequate amount of quality data in order to extract meaningful information and knowledge. Recent developments in technology and production has enabled new insights and innovative solution in various activities of architectural and urban design

including data collection, site surveys, data analysis, building virtual environments, data visualization, and supporting design activities.

Use of sensors: A sensor is defined as a machine, module, subsystem, or device that allows users to detect changes and events in the environment. The detected information is shown either on the device itself or will be further sent to various other devices to be displayed, processed, and analyzed. In practice, sensors are used to improve energy efficiency, safety and security, health and comfort, automation and smart building management, and environmental sustainability. There are different ways to categorize sensors based on purposes and types of hardware. In architecture and urban design, the types of sensors commonly used are Temperature sensors, Motion sensors, Light sensors, Humidity sensors, Pressure sensors, Occupancy Sensors, and Acoustic sensors. Incorporating sensors into architectural design enhances the performance and sustainability of buildings by enabling real-time monitoring and control of various environmental factors, contributing to energy efficiency, safety, comfort, and overall management of space and structure. In architecture and urban design education, integrating sensor-related applications in coursework provides students with hands-on, real-time experience and a deeper understanding of the impacts of the design on building, space, and user experience. The subjects that typically incorporate the application of sensory technology include those related to climate factors, human behavior, and activities in spaces, such as architectural physics, acoustics study, fundamental architectural design principles, urban traffic science, etc.

3D reconstruction: 3D reconstruction is the process of generating 3D representations of the 3D appearance of objects from the outputs of data collection equipment [31]. The model of objects of interest will be captured by a system of sensors to collect data which helps to reconstruct the model in the subsequent procedures. Some of the most common methods for 3D reconstruction include Gaussian splatting, (Neural Radiance Fields) NeRF, photogrammetry, and LiDAR scanning. Depending on the different factors of a project, the required sensors for 3D reconstruction also vary; they can be cameras, specialized imaging devices, laser scanners, and so on [32]. However, in some specific processes, combination of different methods and equipment are quite common to achieve the desired results with optimal cost. The product of 3D reconstruction is often a point cloud dataset. This type of data allows for the creation of digital 3D surfaces in other software with low error and colors that closely match reality. In architecture and urban design education, 3D reconstruction is applied to provide students with the most realistic view of design components. It is often used in courses such as heritage conservation, architectural physics, student design projects, etc. Some software used for 3D reconstruction includes WebODM, MeshLab, and Pix4D.

Crowd-sourcing data collection using Global Positioning System (GPS): GPS, which was made public in the early 1990's, is developed to provide information of location and navigation. GPS devices identify its spatial information of position and orientation by analyzing signals from multiple satellites [33]. GPS technology has been integrated into most fields and serves as an important platform for the operation of many human activities today, especially those involving mobile devices. GPS can be used to collect spatial data by analyzing the spatial and temporal data stored in

GPS devices. This application of GPS technology has made it possible to study human behavior through travel routes and travel times [34]. Due to the specific nature of the technology and its scale of application, GPS technology is primarily used in certain subjects such as urban design, urban infrastructure management, sociology, urban surveying, etc. GPS data in the teaching process is often processed using popular GIS software such as ArcGIS and QGIS.

GIS: refers to powerful computer based "toolboxes" that create, manages, analyze, and display geographic data in support of integrated decision making [35]. GIS application allows architects and planners to perform spatial analysis using different techniques [36, 37]. According to the Royal Town Planning Institute, some of the benefits of using GIS include: (1) improved mapping accessibility and cost efficiency; (2) improved information extraction; (3) improved data management and analysis; (4) the ability to explore more evidence-based prediction; (5) improved communication between experts and stakeholders; and (6) improved quality of services. GIS is commonly taught in urban design and planning courses such as urban mapping, geomatics for urbanism, spatial planning, etc. [38]. Popular GIS software used in the teaching of Architecture and Urban Design includes ArcGIS and QGIS.

Parametric design, conventional design: 2D/3D modeling encompasses various groups of tools for managing information, setting up, and showcasing designs in the form of drawings, models, and different analyses. These tools range from 2D/3D tools to presentation systems, integrated information management systems, or comprehensive integrated platforms. Depending on the specifics of each task, architects and urban designers often choose different processes and tools. Some popular tools include Autodesk AutoCAD, Adobe Photoshop, Autodesk 3D Studio Max, Blender, Unity, Unreal Engine, etc. Due to the diversity of these software applications, most courses in architecture and urban design programs integrate some of these applications.

Extended Reality: Extended Reality is an umbrella term encompassing immersive technologies that blur the line between the real and virtual worlds. Extended Reality typically employs visual effects, sound, and interactions to seamlessly integrate users into pre-designed environments or experiences, including three major technology groups: VR, AR and Mixed Reality (MR) [39]. In the fields of architecture and urban design, applications of Extended Reality are becoming increasingly popular, especially in areas such as visualization, design management, and the metaverse. However, in the realm of architectural and urban design education, Extended Reality has not been widely adopted yet, primarily serving as a supplementary role in some courses or seminars related to technological aspects. Depending on the specifics and complexity of projects using extended reality technology, curricula often consider combining software such as Blender, Autodesk 3D Studio Max, Unity, Unreal Engine, Enscape, and others.

Physical representation: Physical representation or physical model-making is one of the most fundamental techniques used in training across all design disciplines to visualize design solutions. It is an important tool in decision-making as it allows experimentation and changes before the designs are actualized [14]. This technique often involves additive and subtractive manufacturing, which utilizes different tech-

nologies such as CNC milling, laser cutting and engraving, and 3D printing. In architectural and urban design education, additive and subtractive manufacturing play the role of supportive tools that are often taught in workshops or seminars. Software commonly used for creating physical models include Corel Draw, Adobe Illustrator, Blender, Autodesk 3D Studio Max, SketchUp, Orca Slicer, Ultimaker Cura, Fusion 360, SolidWorks, and others.

Hybrid: In addition to the technologies mentioned above, there are emerging technologies that integrate different disciplines to create new applications in the architecture and urban design process. These technologies often involve exploring various ways to enhance the presentation of design solutions for different stakeholders, such as projection mapping and holography.

3.2 The Integration of New Technology into The University Program

At ISCM, a practical teaching method is used, and new technology is directly incorporated into most levels of teaching. This is achieved through a combination of dedicated study activities, including formal and informal courses. The prevalence of technology in architecture education has notably increased in recent years. In the program Architectural and Urban Design inclusive Smart City undergraduate program, the institute offers a 250-credit, 7-semester program in which many courses introduce technology application from year one.

Table 1. The integration of new technology into different university education activities (P means the provision of technology application).

Application	Studio	Study project	Seminar	Internship	Workshop	Training course	Real project
Sensor		P			P		P
3D Reconstruction	P	P			P	P	P
GPS	P			P		P	P
GIS	P	P		P	P	P	P
2D/3D modeling	P	P			P	P	P
VR/AR/MR	P	P					P
3D Printing	P	P	P		P	P	P
CNC milling + laser cutting	P	P			P	P	P
Project mapping					P	P	
Hologram					P	P	

The studio plays a crucial role as the cornerstone of the bachelor program structure, providing a dynamic and creative working environment for students. It serves as a platform for honing problem-solving skills and nurturing design thinking across various studios, including architecture, landscape design, architectural and urban design, and urban design. Through engaging with real-world topics and hands-on activities, students have the opportunity to develop practical skills and gain valuable insights

into the complexities of these fields. Besides the studios, study projects in theories courses and seminars also contribute to providing practical experiences from learning by doing methods and advanced knowledge from experts invited from many different fields such as the public sector, academics, or the private sector. Additionally, internships require students to work in a professional environment outside of school for at least 80 hours in 2 months to help students gain more practical experience.

In order to focus on developing students' skills in all three components, many workshops, training courses, and real projects were conducted at the Institute of Smart City and Management in the past three years. The program is organized in a compressed format from two weeks to one month so that students can focus on researching a problem from reality to creating a concept design or producing a prototype. Most of the smart education methods in the bachelor program utilize technology from the initial stages of topic research to the visualization of the final product. This is clearly shown in Table 1, about the matrix between applying technologies in the program Architectural and Urban Design inclusive Smart City courses.

4 Result and Discussion

4.1 Applying Technology in The Program: Architectural and Urban Design Inclusive Smart City

Through conducting experiments in applying various technologies in architecture and urban design, the research team has optimized the most updated technologies by arranging them with different methods (Figure 1). In the following diagram, each subject, based on its purpose and content within one or more stages of the design process, will select specific groups of technologies and tools relevant to those technology groups. The first column represents the groups of subjects and activities in the Architecture and Urban Design program, including formal activities like studios and study projects, as well as informal activities like seminars, workshops, and collaborative projects. From here, depending on the detailed content of each specific subject, they will be connected to a specific group of products in the design process, including input data, process, design (process), building output, and presenting the design results (outcome). Subsequently, one or more technologies and tools will be suggested for selection. The chosen tools are relatively familiar in the actual design process within the field of architecture and urban design and are familiar to students of architectural and urban design majors.

After a period of implementing different applications during the education and training process at the University environment, the research team came up with a list of software applications that can be used for different purposes for the project. architecture and urban design students. The technologies and their supplementary software and tools shown in Figure 1 are listed below:

- Sensors: R studio, Python, Arduino, ArcGIS, QGIS.

- 3D reconstruction: Meshlab, WebODM, Pic4D, Sketchup, Blender, 3d Studio Max, Autodesk Revit, Autodesk AutoCAD, Adobe Photoshop, Adobe Illustrator, Rhino 7.
- GPS: ArcGIS, QGIS, Unity, Unreal Engine.
- GIS: ArcGIS, QGIS.
- 2D/3D modeling: Autodesk AutoCAD, Adobe Photoshop, Adobe Illustrator, Meshlab, Sketchup, 3D Studio Max, Blender, Autodesk Revit, Rhino 7, Solidworks.
- Extended reality: Unity, Unreal Engine.
- Additive and Subtractive manufacturing: Adobe Illustrator, Corel, Meshlab, Sketchup, 3D Studio Max, Blender, Autodesk Revit, Rhino 7, Solidworks.
- Hybrid: Madmapper, Lightact, 3D Studio Max, Blender, Unity, Unreal Engine.

Based on this optimization model, instructors can easily create workflows from input to final product, using appropriate technologies in suitable educational activities. Students can also use the recommended software list to develop study plans aligned with their goals.

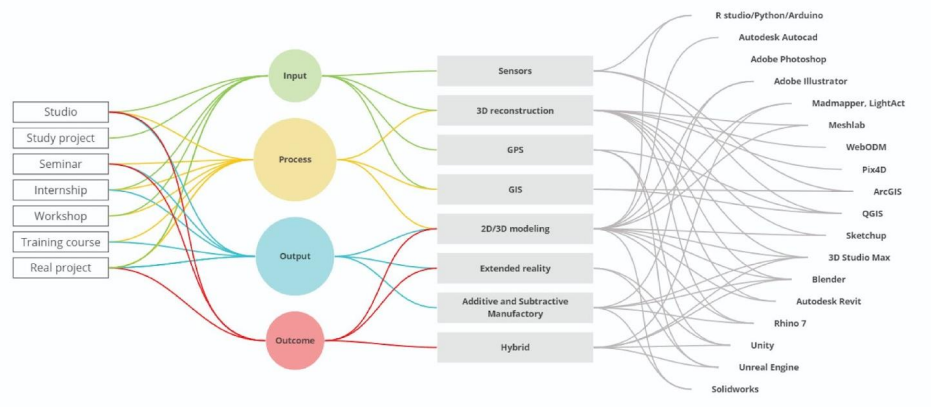

Fig. 1. Diagram showing the distribution of selected technology in the workflow of architectural and urban design projects.

4.2 Strengths, Weaknesses, Opportunities, Threats (SWOT) Analysis of The Application

After the experimental process of integrating technology applications in architecture and urban design into education, training, and research for students, the research team can draw some discussions (Table 2). The application of technology in teaching activities for students is mainly affected by two groups of factors (1) Technology and (2) Student activities. From the characteristics of technology, as well as the absorbing

ability of students, university lecturers need to make adjustments to suit the program and social context.

Technology

. The strengths that technology brings to learners in the fields of architecture and urbanism lie in its ability to facilitate the practice of new skills in real-world contexts, offering students hands-on experience. Building upon fundamental knowledge, students can learn how to optimize workflows in projects with technological support. For instance, when a design requires precise data, such as environmental conditions or community opinions, technology enhances decision-making effectiveness. These experiences are valuable for students as they prepare for professional careers after graduation. The weakness of technology when applied in education and training at the university level is primarily the cost of investment. Although many supporting software tools in architecture and urbanism, such as Revit, SketchUp, CAD, Unreal Engine, and QGIS, are affordable or even free, some technologies require significant financial investment for necessary equipment. High-cost technologies include VR, AR, holograms, 3D printing, LiDAR, and projection systems. Additionally, to use these technologies effectively for studying and working, students must possess basic knowledge about the technologies and a sound understanding of their applications. The opportunity for technology in education, particularly in architecture and urbanism, is immense, as we are living in an era of rapid technological advancement. New technologies are continually being upgraded and becoming more accessible to users. In the context of smart urban development and digital transformation strategies, technology plays a crucial role in addressing urban challenges. On the other hand, the rapid development of technology presents significant challenges for its application in education. As technology evolves quickly, older technologies become obsolete, necessitating that learners continuously update their skills and knowledge to stay current. This constant need for updating can be demanding for both students and instructors, who must frequently revise and adapt textbooks and teaching materials to incorporate the latest advancements. Additionally, integrating various technologies into subjects with diverse requirements can lead to a lack of cohesiveness among courses and programs, complicating the curriculum and potentially creating gaps in the learning experience.

Table 2. The SWOT ideas are drawn from application experience.

Factors	Strengths	Weaknesses	Opportunities	Threats
Technology	S1: Improve the hands-on experience of studying S2: Optimize the workflow for	W1: Some technologies require a high investment W2: Require learners to have a	O1: The rapid advancement of technology O2: Smart city and digital transformation strategy	T1: Technology trends quickly change T2: Lack of cohesiveness among courses and programs

Factors	Strengths	Weaknesses	Opportunities	Threats
	projects S3: Improve the effectiveness of decision-making in some context	good sense of using technology		
Students' activities	S4: Leverage students' innovative ideas in solving problems S5: Adapt to the change in architectural and urban design	W3: Consume more time for learning to utilize devices W4: Can reduce the students' independence	O3: The high demand in technology skills in the industry for practical projects O4: Young people can access new technology easily nowadays	T3: Reduce the originality of students' products T4: Students' awareness of technology importance is low

Students' activities

. Once students have mastered the fundamental knowledge, supporting technologies become powerful tools for realizing their innovative ideas. These technologies enable the creation of innovative designs and the optimization of workflows in architectural and urban projects, which are essential for smart urban interventions. Another significant strength is the adaptability that these technologies offer, allowing students to keep pace with evolving trends in urban architectural design, particularly in the context of smart cities, contributing to lifelong learning. However, the technologies employed in architecture and urbanism demand that students invest time in mastering their operation. Over-reliance on technology in design can sometimes undermine students' independence. While modern 3D modeling software is highly advanced and enables designers to create virtually any product, using these tools too early in the learning process can diminish students' spatial thinking abilities and limit their creativity. The opportunity for students to practice applied technology in architecture and urban design lies in their ability to meet the demands of the job market, as companies increasingly seek to optimize project workflows. Today's young people benefit from easy access to technology from an early age and can even self-study using open online resources. However, the use of technologies in the architectural and urban design industry also presents several challenges. Firstly, the originality of design products may diminish because students can easily rely on supporting technology tools and reference information. Conversely, some students may avoid practicing or updating their skills with new technologies, believing them to be unnecessary in the field of architecture and urban design.

Through observations from the experimental application of technology in education and training of architecture and urban design in the university environment, the research team can provide some expertise suggestions (Table 3). The research team

believed that integrating the latest technologies in architecture and urban design into academic programs to enhance student experience demands significant effort from lecturers. They must constantly update their knowledge of the latest industry applications and create various out-of-class activities such as workshops, short training courses, real projects, internships, and online materials to enhance students' capabilities. In the new era of smart city development, students are encouraged to develop innovative, comprehensive, and human-centric design ideas to create smart urban interventions and solve urban problems. Since technologies are diverse and can be applied across many subjects or different stages of a project, instructors need to create optimized technology application workflows for courses. This can also be achieved by closely linking learning content and practice between different subjects or even different fields.

Some technologies require high investment costs and considerable time for students to practice. Therefore, instructors need to plan for expanding the application of a method or technology across multiple subjects to maximize its utility and effectiveness. Changing the habits of a generation of students is not easy, so consensus and unity among all lecturers participating in the program are essential. The application of technology in architecture and urban design must be consistently and repeatedly emphasized across different subjects. Finally, to maintain the quality and originality of students' design products, instructors need to balance training in fundamental skills with skills in using new technology.

Table 3. The suggestion for application based on SWOT analysis[1]

Strengths and Opportunities	**Strengths and Threats**
S25-O123 Update the new technology application in the industry constantly **S45-O134** Provide various extra activities besides classes to enhance students' capability **S345-O2** Encourage comprehensive and human-centric design	**S123-T12** Create optimized workflows for every project with technology application **S124-T24** Integrate different courses and different programs in terms of practice and topic **S45-T34** Encourage the innovation in students' design
Weaknesses and Opportunities	**Weaknesses and Threats**
W13-O1234 Expand the applicability of technology in many projects and subjects **W23-O34** Provide online materials to support students in studying technology by themselves	**W3-T124** Constantly introduce and guide for technology application in various courses **W4-T34** Balance the application of tech-

[1] Notes: n in SnOn is the number of the opinion order in Table 1. S25-O123 means the suggestion based on Strengths 2,5 and Opportunities 1,2, and 3

	nology and develop design thinking
	W4-T3 Ensure the fundamental knowledge and skills of students

5 Conclusion

This study explores the application of emerging technologies from architecture and urban design to education and training within universities. Technologies such as sensors, GIS management software, 2D and 3D design software, and visualization tools like extended reality, holograms, and projections are highly promising for smart city development. These technologies support physical representation and data visualization. Training students can be achieved through design studios, theoretical study projects, internships, workshops, training courses, and practical projects. Instructors have various options to integrate these technologies into the curriculum effectively.

ISCM has incorporated these technologies into the curriculum, allowing students to gain practical experience. Through this process, valuable insights have been gathered regarding the strengths, weaknesses, opportunities, and challenges of applying these technologies. Several recommendations emerge for both students and instructors. Instructors must continuously update technology applications and develop optimal workflows for each activity while integrating these activities across various subjects and programs. Technologies should be used across multiple projects to maximize their benefits. Utilizing online resources can help shorten learning times. Instructors should also encourage innovation in design initiatives for smart cities, emphasizing comprehensive, human-centric design supported by technology. Despite technological advancements, fundamental skills must be maintained. Balancing traditional methods with modern technology is crucial to ensure students' creativity and originality. This research contributes to university training programs in architecture and urban design, aiming to update and integrate the latest technology trends in design, regarding the context of a smart city.

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