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ADAPTING ARCHITECTURAL DESIGN EDUCATION FOR THE AI ERA: PRELIMINARY FINDINGS AND FUTURE DIRECTIONS

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Abstract

Architectural design courses are an essential part of many universities' curricula, offering students the opportunity to learn about building construction, building physics, mechanics, environmental ecology, and architectural aesthetics. Traditional architectural training typically starts with architectural graphics and model making by hand, which helps students understand the relationship between human scale and space scale and develops their aesthetic taste and innovative thinking. However, the rise of advanced technologies and AI products in recent years has led to a decline in students' interest in practical training. Some students prefer to use online searches to understand room size rather than taking measurements, and they would rather learn how to use 3D printers than how to make models with utility knives. This trend has prompted questions about the relevance of traditional architectural training methods to the new generation of students. Should educators abandon traditional training and adopt new technologies?
This research examines traditional architectural training methods through personal teaching experience in universities, using first-stage AI skills to compare traditional methods and adjusted methods. The study seeks to determine the adaptability of traditional training methods to face AI trends while maintaining the relevance of human scale and space scale, aesthetic taste, and innovative thinking. The findings of this research offer insights into how educators can adjust their teaching methods to provide students with the necessary skills to succeed in the current and future technological environment. The study also offers discussions and possible solutions to address the challenges faced by architectural educators for future generations.

Keywords: *Architectural design, AI trend, architectural training, innovation.*

1. Introduction and objectives

The industrial revolution of the early 20th century had significant impacts on traditional hand-made crafts industries. Some individuals emphasized the value of hand-made crafts, while others embraced the new industrial technology to develop the industrial design style that emerged after the revolution. In the 21st century, digital technologies have developed rapidly, and once again, traditional practices and new technology are being impacted. Unlike the disputes of the early 20th century, individuals in contemporary society, equipped with smartphones, are not fighting against the digital technology revolution. Instead, they are seeking to optimize productivity and innovation, including architects and architectural educators (Lee & Wang, 2017). This group reflects the core of architects and architectural educators who discuss the future of construction industries and education. The central question is whether the current core of architectural education should be eliminated. Moreover, will hand drawing and architectural model-making be displaced by digital media, and can students learn architecture without physically attending universities through online learning? This research aims to investigate the impact of digital technologies on architectural education. Specifically, it will explore the implications of digital technologies, including artificial intelligence, on the traditional practices of architectural education and the future of architectural design education.

This research seeks to investigate the impact of digital technologies, specifically artificial intelligence (AI), on architectural education. To achieve this, the study will commence with an analysis of architectural education under the influence of digital technology. Preliminary findings will introduce the unique character of architectural education and its differences from other professional fields to identify the core of architectural design education. Additionally, the study will reflect on the impact of AI on the field of architectural education and explore the efforts of architects in this regard. The study will also take into account the expectations of Taiwanese stakeholders regarding AI and its impact on architectural education. By examining these factors, the research aims to identify possible ways forward and future trends for architectural education in the digital age.

2. Methods

The preliminary research has compiled bibliographic data, which has been analyzed to provide a comprehensive overview of architectural education in recent times. In light of the emergence of AI, the research aims to examine the perspectives and concerns of architectural educators. This investigation will provide a platform for discussing the current state of traditional architectural training and identifying future trends in the field. Ultimately, this research seeks to offer valuable insights and recommendations for architectural educators and practitioners.

3. Perspectives and interpretations of Artificial Intelligence

As defined by the Oxford Language, AI refers to "the theory and development of computer systems capable of performing tasks that typically require human intelligence, including visual perception, speech recognition, decision-making, and language translation."

The European Parliament (2021) provides a definition of AI as the demonstration of human cognitions, such as reasoning, learning, planning, and creative thinking, through machines. AI systems are particularly useful in quickly solving problems and achieving goals, provided that they have access to a significant amount of data to recognize and respond to various situations.

Accordingly, AI involves the simulation of human cognitive processes, such as recognition, reaction, and learning, through computer and machine-based systems, with a focus on minimizing errors. The development of AI is aimed at solving problems and enhancing learning effectiveness. In the context of architectural education, the primary goal of AI is to assist students in learning architecture design effectively. However, in practice, teachers express concerns about being replaced by AI systems and have limited time to provide guidance to their students. Students, on the other hand, tend to rely on AI to solve their design problems and perceive traditional teaching methods, such as hand drawing and model-making, as outdated. As such, exploring the impact of AI on architectural education and finding ways to effectively integrate AI technology into the curriculum while retaining traditional teaching methods is essential.

4. Recent architectural education in Taiwanese universities

The organization of architectural education in Taiwanese universities is divided into engineering and design colleges. Consequently, some architectural faculty is situated in engineering colleges, while others are located in art or design colleges. Despite this structural division, architectural design courses carry the highest credit points, highlighting their significance in the curriculum.

According to Chen and Hung’s (2013) analysis of architectural curricula in Taiwanese universities, there are five distinct categories: history and human behavior (humanities), technology (construction and architectural physics), practice (architectural laws and budget controls), and design. Architectural design is an obligatory course and typically requires 6 to 8 hours of class time per week. Based on the group character, it is evident that architectural design is an interdisciplinary field that integrates humanities, technology, and practice. To be a successful architect, one must possess both artistic vision and the skills to bring that vision to life through practice.

The duration of the university year in Taiwan is generally four years, although some universities require five years depending on the students' future path. Students who select architectural design must complete a five-year program, while those who select planning or construction can finish in four years.

The introductory architectural design course for freshmen is called Basic Design, which is influenced by the Bauhaus tradition (Shiu, 2014). This course is not meant to teach students how to design a building, but rather to develop their sense of form, material usage, and aesthetics. Teachers use various forms of art, including movies, music, and art objects, to inspire students' creativity and innovation. During this stage, students may choose to sign out or change their majors if they feel that they lack the necessary creativity or if the course does not meet their original expectations.

The second year of architectural education in Taiwanese universities requires students to produce designs ranging from small to larger scales, starting from designing their own homes to more complex spaces such as multi-functional community centers. Typically, they must complete two to three designs per semester, with each design taking one to one and a half months to complete. During this time, students commonly inquire about using CAD or related softwares or express difficulty in generating design ideas.

The second-year students are required to study architectural laws to gain knowledge about the fundamental dimensions of architectural elements. For instance, the balcony railing should not be lower than 90-120 cm, which is a standard measurement used to verify the reasonable basic requirements of architectural design.

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5. Design expression and possible Al design in the future

In the context of architectural education, freshmen students are required to take an obligatory course known as graphic science. The purpose of this course is to teach students the architectural languages used to communicate with other architects and builders. Students are taught to understand the various architectural signs, such as the positioning and dimensions of doors and windows. It is crucial for students to learn these signs as they are essential in creating designs that are both functional and aesthetically pleasing to the human scale. Furthermore, it is crucial that drawings are clear and easily communicable with builders, as any misunderstandings could lead to inaccuracies in the final building design.

Typical architectural drawings encompass plan, elevation, section, and perspective, which are essential for expressing the relation between space and function. Beforehand, architects would draw every floor plan to depict the building's internal spaces. The elevation and perspective drawings provide an outlook of the building, while the section drawings exhibit the room's internal dimensions. Modern drawing software like Archicad or Revit can create a 3D digital model, rendering plan, elevation, and section drawings redundant. Recently developed AI programs like MidJourney can simulate real spaces, further reducing the need for perspective drawings. Consequently, with technological advancements, students may struggle to see the relevance of the graphic science course.

Figure 1. The generated image for the kindergarten design idea, effect is fancy but hard and expensive to build under the recent construction technology (MidJourney).

According to Wang (1970), design is a process of transforming abstract concepts into tangible forms, making the transition from abstract to concrete an essential component of design. Architectural design differs from graphic design in that it deals with real space and human dimensions, with the latter being subject to psychological, social, and cultural differences. For instance, the inclination of roofs in Norway and Thailand reflects differences in construction methods, functions, and aesthetic preferences. As AI technology advances, should it be used to imitate these styles or create a new "AI style"?

In addition to visual aesthetics, the functionality of architectural spaces is of utmost importance. Alexander, Ishikawa, Silverstein, Jacobson, Fiksdahl-King, and Angel (1977) analyzed spatial patterns to identify the possible elements that make up good space design. These researchers use numerical patterns to suggest possible ways of organizing space to achieve specific purposes. For example, if the aim is to design a space for reading, they provide the relevant numerical patterns to guide the creation of a good reading environment. Ojala (2008) also believes that pattern language can facilitate architectural design. It is possible that AI-based architectural design could incorporate pattern language, although the limits of this approach require further examination.

Jeng (2023) argued that the current era is characterized by integration, especially with the advent of AI technology. Architects are no longer limited to creating architectural designs, but they must also consider ecological and landscape design, as well as future construction trends. Jeng proposed that the future of AI design should incorporate AI construction methods to enable a fully integrated design process, covering architectural plans, schemes, building physics, and AI or BIM (Building Information Modeling) construction.

The emergence of various design tools poses a challenge to architectural educators: should the core of architectural education be replaced by AI?

6. Discussion

Given the unique characteristics of architectural education and the potential impact of AI, the following questions and discussions arise:

6.1. Hand or computer drawing?

The discussion of whether to use handmade drawing or computer drawing in architectural education is an ongoing debate among educators. The decision made by teachers should not solely depend on the students' computer skills, but also on the core principles of architectural design and the digital ability gap that exists among students from different social backgrounds. Recent research has shown that hand drawing remains an essential skill in the creative process (Żychowska, 2019). Therefore, educators may continue to emphasize the importance of hand drawing for freshman students, while providing them with opportunities to develop their digital skills in later stages of their education. This approach can help reduce the gap in digital abilities among students.

6.2. The object size? The spatial sense?

The prevalence of social media platforms has provided students with diverse visual experiences. However, relying solely on images collected from the internet may lead to difficulties in accurately gauging the size of objects. If students are asked to generate a spatial image, they may struggle to create a concrete model. Typically, students will resort to creating a cubic form of space due to the difficulty of constructing an uncertain form. Ultimately, this may hinder their ability to fully realize their creative vision.

6.3. The gap of architectural thinking and its adjustment

With the advent of new technologies and the younger generation, architectural faculties are now mostly employing new teachers between the ages of 40-50 who did not rely on computers in their studies. However, teachers must now learn new technologies in order to effectively teach their students. During this transition period, there is no integrated answer among teachers on how to approach computer training. Some believe that creation is important, and that accurate graphic drawing is an irritant. Others feel that hand drawing is basic for creation, but this method may lead to loss of patience among students. Additionally, architectural teachers must consider what students need to learn for their future careers in order to adjust the curriculum accordingly.

6.4. The challenge from plan to elevation drawing

The process of traditional architectural drawing usually begins from the first-floor plan and continues to higher floor plans. However, if designers want to create unique spaces, such as a lobby that spans two or three floors, they must adjust the proportion of height and width. This adjustment requires creating an actual model to simulate the future space, and the plan and model must be adjusted simultaneously. Nowadays, students prefer to create architectural models in the final week of their training. However, with computer design, it is difficult to adjust the space through a computer screen, and the transition from 2D to 3D training is challenging to implement.

6.5. The drawing between architects and builders

The traditional approach in architecture involved architects creating the construction drawing, with contractors checking its feasibility and controlling the budget. In the era of AI, however, there is a need to integrate design drawing, shop drawing, and construction drawing to enable architects and builders to work together on a unified platform to facilitate construction.

6.6. Copyright

The generation of AI images requires a large amount of data, which raises questions about ownership of the generated image and associated information. The article by Architizer Editors (n.d.) emphasizes the importance of hand drawing not only in stimulating creative design and communication but also in protecting the designer's rights. As students learn about AI, they should also be educated on copyright laws to respect the original creations of others.

7. Conclusions

In order for AI to learn and correct errors, it requires access to data. When dealing with challenges related to human needs, climate change, and sustainability, architects must make design decisions with consideration for their surrounding environment. AI can serve as an aid, providing architects with accurate information to inform their design choices.

Although AI can engage students and stimulate their curiosity through interaction, it should also be taken into consideration that the stability and concentration of students may be affected.

The primary objective of architectural design is to create comfortable, healthy, safe and sustainable environments for people. AI can aid in verifying compliance with architectural laws and

regulations, as well as facilitating the design of unique forms. However, the use of AI in architecture is currently limited to 2D image analysis for the general public. The introduction of new construction methods will fundamentally transform architectural education.

While students may believe that AI can solve their problems, it is essential for them to learn how to identify problems and devise solutions independently. Rather than seeking direct answers from AI, students should present the problem, describe it, and request potential solutions. This should be the focal point of architectural education. Human needs and the environment are constantly changing, and as educators in this field, it is our responsibility to train students to develop sustainable and socially responsible solutions that prioritize human and environmental well-being.

In the core of human-centered architectural design thinking, the preliminary findings suggest that AI should be considered as a tool to facilitate interactive and engaging architectural education, rather than a replacement for the role of educators. To effectively prepare future architects with the necessary skills, educators must maintain flexibility in adapting to changing human and environmental issues, as well as advancements in technology and the architectural industry. This includes providing students with up-to-date information and guidance on the appropriate use of AI, while promoting human-centered thinking with a focus on sustainability and social responsibility. Ultimately, a balanced approach that integrates AI and human expertise will enhance the quality of architectural education and prepare students for successful careers in the field.

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