

Exploring the combination of Chinese architectural design education and artificial intelligence (AI)

Yuanfeng Yang*

Faculty of Creative Industries , City University Malaysia, Petaling Jaya 46100, Malaysia

*Corresponding author's email: 0459yyf@163.com

Abstract: This article aims to explore in depth the integration path, impact, and future development trends of Chinese architectural design education and artificial intelligence (AI). With the rapid development of technology, AI technology is gradually penetrating into various industries, and the field of architectural design is no exception. As an important base for cultivating future architects, China's architectural design education is facing unprecedented changes in its educational model, content, and methods. This article will start from the current situation of architectural design education in China, analyze in detail the opportunities and challenges brought by AI technology to this field, and explore in depth the strategies and practical cases of combining the two. Finally, it looks forward to the future development trend, in order to provide reference for the reform and development of architectural design education.

Keywords: architectural design education, AI technology, educational model transformation

1 Introduction

Architectural design is a combination of art and science, which not only requires designers to possess innovative thinking and artistic aesthetics, but also to master solid professional knowledge and skills. In recent years, with the rapid advancement of technology, especially the rapid development of artificial intelligence technology, the field of architectural design is undergoing profound changes (Hu Wei.,2023) . AI technology, with its powerful data processing, learning optimization, and automation design capabilities, has brought unprecedented possibilities to architectural design. China's architectural design education, as an important cradle for cultivating future architects, how to adapt to this change and integrate AI technology into the education system has become an urgent problem to be solved (Cai Weijie.,2023) .

2 The Current Status of Architectural Design Education in China

2.1 Education System and Curriculum Design

The Chinese architectural design education system is mainly based on undergraduate education, supplemented by graduate education, forming a multi-level and wide-ranging talent cultivation system

(Baldwin.,2021) . In terms of curriculum design, emphasis is placed on the combination of theory and practice, covering multiple aspects such as architectural design principles, architectural history, architectural technology, and architectural environment. However, with the popularization of AI technology, the existing curriculum system has shortcomings in cultivating students' innovative thinking, interdisciplinary abilities, and digital skills.

2.1.1 Undergraduate Education

During the undergraduate education stage, the architectural design major usually includes courses such as preliminary architectural design, architectural design principles, architectural construction, building materials, architectural physics, and computer-aided architectural design (Walter Kehl.,2020) . These courses focus on cultivating students' basic knowledge and professional skills, but lack specialized courses for AI technology.

2.1.2 Graduate Education

In the graduate education stage, the architectural design major usually includes courses such as architectural design methodology, architectural design and theory, architectural and urban design, and architectural history and theory (Montjoyi.,2023) . These courses place greater emphasis on the integration of theory and practice, as well as interdisciplinary research. However, there is still a lack of in-depth research and practice in the application of AI technology.

2.2 Teaching Methods and Means

Traditional architectural design education often adopts teaching methods such as lecture style and discussion style, supplemented by teaching methods such as model making and field investigation (Ouxing.,2023) . These methods have played an important role in cultivating students' basic knowledge and professional skills, but there are limitations in stimulating students' innovative thinking and cultivating their ability to solve practical problems. With the development of AI technology, new teaching methods such as virtual reality (VR) and augmented reality (AR) are gradually being applied in teaching, bringing new opportunities for architectural design education.

2.2.1 Lecture based and Discussion based Teaching

Lecture based and discussion based teaching methods are commonly used in architectural design education. Through teachers' explanations and students' discussions, students can master the basic principles and methods of architectural design (Reza Hafezii.,2020) . However, this teaching method lacks interactivity and interest, making it difficult to stimulate students' learning interest and innovation ability.

2.2.2 Model making and on-site investigation

Model making and field investigation are important teaching methods in architectural design education. By creating models, students can intuitively understand the spatial layout and structural details of architectural design (Lu Hanyue.,2023). Through on-site inspections, students can gain a deeper understanding of the actual situation of architectural design and urban planning. However, these teaching methods are limited in time and space, making it difficult to meet the diverse needs of students.

2.2.3 Virtual Reality and Augmented Reality Teaching

Virtual reality and augmented reality technology provide new teaching methods for architectural design education. Through virtual reality technology, students can enter a virtual architectural environment to simulate and practice architectural design (Anne Boysen.,2020). Through augmented reality technology, students can combine architectural design schemes with actual environments for real-time adjustment and optimization. These technologies can greatly enhance students' practical and innovative abilities.

2.3 Faculty and Teaching Resources

China's architectural design education has a highly qualified and specialized teaching staff, who have accumulated rich experience in teaching, research, and practice. However, with the rapid development of AI technology, some teachers need to improve their mastery and application ability of new technologies (Lars Egevad.,2020). Meanwhile, in terms of teaching resources, although digital teaching resources are becoming increasingly abundant, professional teaching resources for AI technology are still relatively scarce.

2.3.1 Teaching staff

The teaching staff of Chinese architectural design education is mainly composed of teachers with rich teaching experience and professional knowledge. They usually hold a doctoral degree or senior professional title, possess solid professional knowledge, and have a high level of teaching proficiency. However, with the rapid development of AI technology, some teachers have deficiencies in mastering and applying new technologies, and need to strengthen training and learning (Russell Belk.,2020).

2.3.2 Teaching Resources

With the development of digital technology, teaching resources for architectural design education are becoming increasingly abundant. However, professional teaching resources for AI technology are still relatively scarce. This includes relevant textbooks, courseware, case libraries, etc (Pedersen.,2020). To make up for this deficiency, schools need to strengthen cooperation with enterprises, research institutions, etc., and jointly develop professional teaching resources for AI technology.

3 The opportunities and challenges brought by AI technology to China's architectural design education

3.1 Opportunities

3.1.1 Improving Teaching Efficiency and Quality

AI technology can provide accurate teaching resource recommendations and personalized learning path planning for architectural design education through intelligent analysis, data mining, and other means, thereby improving teaching efficiency and quality (Marco Bevolo.,2020) . For example, AI technology can recommend suitable learning resources and courses for students based on their learning progress and interest preferences; At the same time, AI technology can also intelligently correct and provide feedback on students' homework and works, helping them to discover and correct errors in a timely manner.

3.1.2 Cultivate innovative thinking and interdisciplinary abilities

AI technology can break through traditional disciplinary boundaries, promote the cross integration of multiple disciplines such as architecture, computer science, and information technology, and provide strong support for cultivating students' innovative thinking and interdisciplinary abilities. Through AI technology, students can be exposed to knowledge and technology from various fields, thereby broadening their horizons and enhancing their innovation awareness (Lan Xu.,2020) .At the same time, AI technology can also provide new design methods and tools for architectural design, such as machine learning based parametric design, deep learning based image recognition, etc. These new technologies and methods can stimulate students' innovative thinking and practical abilities.

3.1.3 Enhance practical application ability

AI technology can simulate real building environments, provide students with virtual practice platforms, help them master architectural design skills in practice, and improve their ability to solve practical problems. For example, through virtual reality technology, students can enter a virtual architectural environment to simulate and practice architectural design. Through augmented reality technology, students can combine architectural design schemes with actual environments for real-time adjustment and optimization (Russell T.,2020) . These technologies can greatly enhance students' practical and innovative abilities.

3.2 Challenge

3.2.1 Rapid technological updates require teachers to continuously learn

The rapid development of AI technology requires teachers to constantly learn new technologies and methods in order to keep up with the pace of the times and provide high-quality teaching services for students. However, due to the involvement of multiple disciplinary fields and the fast pace of updates in AI technology, some teachers face difficulties in learning and mastering new technologies (Li Jingl.,2023) .

Therefore, schools need to strengthen their training and support for teachers, helping them improve their ability to apply AI technology and teaching level.

3.2.2 Difficulty in integrating teaching resources

AI technology involves multiple disciplinary fields and updates rapidly, making it difficult to integrate teaching resources. In order to provide comprehensive and systematic AI technology teaching resources, schools need to strengthen cooperation and communication with enterprises, research institutions, etc., and jointly develop professional teaching resources for AI technology (Rudy van Belkom.,2020) . However, in practical operation, it is difficult to coordinate the cooperation mode and benefit distribution among different institutions, making it challenging to integrate teaching resources.

3.2.3 Data Security and Privacy Protection

The application of AI technology involves the use and processing of a large amount of data, making data security and privacy protection important challenges facing architectural design education. In architectural design education, students usually need to submit personal works and design proposals, which contain their personal information and creative achievements (Walsh.,2020) . If these data are leaked or abused, it will cause damage to students' privacy and intellectual property rights. Therefore, in the application process of AI technology, it is necessary to strengthen the security management and privacy protection of data.

4 Strategies and practical cases of combining Chinese architectural design education with AI technology

4.1 Strategy

4.1.1 Update educational concepts and focus on interdisciplinary integration

In order to adapt to the development trend of AI technology, architectural design education needs to update its educational philosophy and focus on interdisciplinary integration. This includes strengthening the cross integration of architectural design with fields such as computer science, information technology, and environmental science; Encourage students to take interdisciplinary elective courses, participate in scientific research projects, and engage in practical activities; Establish interdisciplinary teaching and research teams, etc (Zhou Ziqian.,2022) . Through these measures, students' comprehensive qualities and innovative abilities can be cultivated, laying a foundation for them to better apply AI technology in the future field of architectural design.

4.1.2 Strengthen the construction of the teaching staff and enhance the AI literacy of teachers

Teachers are an important force in architectural design education, and their AI literacy and technical application ability directly affect the quality and effectiveness of teaching. Therefore, schools need to

strengthen the construction of their teaching staff and enhance their AI literacy and technological application capabilities. This includes organizing teachers to participate in relevant training and seminars; Invite experts and scholars to give lectures and exchange ideas at the school; Encourage teachers to participate in research projects and practical activities related to AI technology (Li Jing.,2020) . Through these measures, teachers can be helped to understand the latest developments and application trends of AI technology, and improve their technical application ability and teaching level.

4.1.3 Integrate teaching resources and build an intelligent teaching platform

In order to provide comprehensive and systematic AI technology teaching resources, schools need to integrate online and offline teaching resources and build an intelligent teaching platform. This includes establishing a professional course library, case library, and laboratory for AI technology; Develop intelligent teaching management systems and learning support systems; Utilizing technologies such as cloud computing and big data to achieve the sharing and optimization of teaching resources. Through these measures, students can be provided with a more convenient and efficient learning experience, promoting their comprehensive development.

4.1.4 Strengthen practical teaching and cultivate practical abilities

Practical teaching is one of the important aspects of architectural design education. In order to cultivate students' practical abilities, schools need to strengthen the design and implementation of practical teaching activities. This includes establishing cooperative relationships with enterprises, research institutions, etc., to provide students with more practical opportunities (Rudy van Belkom.,2020) .Develop practical teaching projects and cases based on AI technology; Encourage students to participate in architectural design competitions and practical activities. Through these measures, students can be helped to apply their learned knowledge to practice, improving their practical and innovative abilities.

4.2 Practical Cases

4.2.1 School of Architecture, Tsinghua University

The School of Architecture at Tsinghua University is one of the leading architectural design education institutions in China. In recent years, the college has actively explored the application of AI technology in architectural design education and achieved significant results. For example, the college offers a course on "Artificial Intelligence and Architectural Design", inviting industry experts and business representatives to explain the application cases and development trends of AI technology in architectural design to students; At the same time, the college has also collaborated with relevant enterprises to jointly develop AI based architectural design software and tools, providing students with more convenient and efficient design methods. In addition, the college encourages students to participate in architectural design competitions and practical activities, apply their learned knowledge to practice, and improve their practical and innovative

abilities (Ju Song.,2018) .

4.2.2 School of Architecture and Urban Planning, Tongji University

The School of Architecture and Urban Planning at Tongji University is also one of the well-known architectural design education institutions in China. The college focuses on cultivating students' innovative thinking and practical abilities, actively exploring the application of AI technology in architectural design education. For example, the college offers a course on "Intelligent Building and Environmental Design", which helps students understand the application scenarios and advantages of AI technology in building and environmental design through case analysis, group discussions, and other methods; At the same time, the college has also established a virtual laboratory based on AI technology, providing students with a more intuitive and vivid practical platform. Through these measures, the college has successfully cultivated students' innovative thinking and practical abilities, laying a solid foundation for them to better apply AI technology in the future field of architectural design (Li Jing.,2023) .

4.2.3 School of Architecture, Southeast University

The School of Architecture at Southeast University is one of the earliest colleges in China to apply AI technology in architectural design education. The college focuses on cultivating students' interdisciplinary and practical abilities, actively exploring the integration path of AI technology and architectural design. For example, the college offers a course on "Parametric Design and Algorithmic Art", which helps students master the specific application of AI technology in architectural design by explaining the basic principles and methods of parametric design, as well as application cases of algorithmic art; At the same time, the college has also collaborated with enterprises to jointly develop AI based architectural design software and platforms, providing students with more convenient and efficient design methods (Lan Xu.,2020) .

5 Future Development Trends of Combining Chinese Architectural Design Education with AI Technology

5.1 Deep integration of AI technology to promote educational model transformation

With the continuous development of AI technology, in the future, Chinese architectural design education will pay more attention to the deep integration of AI technology and promote the transformation of education models. AI technology will not only be applied as an auxiliary tool in teaching, but also become a core element in teaching design, implementation, and evaluation. Through AI technology, more personalized and intelligent teaching services can be achieved to meet the diverse needs of students. For example, using AI technology to intelligently analyze students' learning behavior and outcomes, providing teachers with accurate teaching feedback and suggestions, thereby optimizing teaching design; Building a virtual practice platform through AI technology to provide students with more realistic and vivid practical experiences. Utilizing AI technology for intelligent evaluation to achieve objective and fair assessment of

students' learning outcomes (Alejandro.,2020) .

5.2 Strengthen interdisciplinary education and cultivate versatile talents

In the future, the field of architectural design will pay more attention to interdisciplinary integration and cross innovation. Therefore, Chinese architectural design education will strengthen interdisciplinary education and cultivate versatile talents. Interdisciplinary education will cover multiple fields such as architecture, computer science, information technology, and environment. Through curriculum integration and project collaboration, it will achieve organic connection and deep integration between different disciplines (Ju Song.,2018) . At the same time, students will be encouraged to take interdisciplinary elective courses, participate in scientific research projects and practical activities, and cultivate their comprehensive qualities and innovative abilities. Through interdisciplinary education, it is possible to cultivate composite talents with multidisciplinary knowledge and skills, who can tackle complex problems and provide strong support for innovative development in the field of architectural design (Pedersen.,2021) .

5.3 Promote the deep integration of industry, academia, research and application, and promote technological innovation and achievement transformation

In the future, China's architectural design education will actively promote the deep integration of industry, academia, research, and application, and promote technological innovation and achievement transformation. By establishing close cooperative relationships with research institutions, enterprises, and industry associations, we jointly carry out scientific research projects and technology development, and promote the innovative application of AI technology in the field of architectural design. At the same time, we will strengthen the collaborative innovation between industry, academia, research and application, and promote the transformation and application of technological achievements. For example, we can collaborate with enterprises to develop AI based architectural design software and tools, providing the industry with more efficient and convenient design methods; We can collaborate with research institutions to conduct cutting-edge technology research and promote technological progress and innovative development in the field of architectural design.

5.4 Strengthen international exchanges and cooperation to enhance international competitiveness

With the continuous deepening of globalization, international exchange and cooperation play an increasingly important role in architectural design education. In the future, China's architectural design education will strengthen exchanges and cooperation with internationally renowned educational institutions, research institutions, and enterprises to jointly promote the application and development of AI technology in the field of architectural design. Through international exchanges and cooperation, advanced educational concepts and technological means from abroad can be introduced to enhance the quality and level of

domestic architectural design education; At the same time, domestic research results and innovative applications can also be promoted to the international market, enhancing the international competitiveness and influence of Chinese architectural design education.

6 Conclusion and Prospect

In summary, the combination of Chinese architectural design education and AI technology is an inevitable trend for future development. By deeply integrating AI technology, strengthening interdisciplinary education, promoting the deep integration of industry, academia, research and application, and enhancing international exchanges and cooperation, measures can be taken to promote the innovative development of Chinese architectural design education, cultivate compound talents with multidisciplinary knowledge and skills, and be able to cope with complex problems. In the future, with the continuous development of AI technology and the expansion of application fields, Chinese architectural design education will usher in broader development prospects and opportunities. However, we should also recognize that in the process of promoting the integration of Chinese architectural design education and AI technology, there are still many challenges and problems to be faced. For example, how to balance the relationship between traditional architectural design education and AI technology education? How to ensure the safety and reliability of AI technology? How to establish an effective evaluation system to assess the effectiveness of AI technology in architectural design education? These issues require us to think deeply and explore. Therefore, in the future, we need to further strengthen research and practice, constantly explore new paths and models for the combination of Chinese architectural design education and AI technology. At the same time, it is also necessary to strengthen policy support and guidance to provide a better environment and conditions for the integration of architectural design education and AI technology. Only in this way can we cultivate more architectural design talents with innovative thinking and practical abilities, and make greater contributions to China's construction industry and urban development.

References

- Alejandro DÍ az-Domí nguez. How Futures Studies and Foresight Could Address Ethical Dilemmas of Machine Learning and Artificial Intelligence[J]. *World Futures Review*,2020,12(2).
- Anne Boysen. Mine the Gap: Augmenting Foresight Methodologies with Data Analytics[J]. *World Futures Review*,2020,12(2).
- Baldwin, Eric. When Machines Design: Artificial Intelligence and the Future of Aesthetics] 16 February 2021. ArchDaily. (Trans. Milly Mo) . <<https://www.archdaily.cn/cn/938299/zai-ren-gong-zhi-neng-shi-dai-ji-qi-she-ji-dui-wei-lai-mei-xue-de-ying-xiang>>
- Cai Weijie Research on the Impact and Application of Artificial Intelligence on Architectural Design [J] *Jiangxi Building Materials*, 2023291 (04): 142-143+146
- Hu Wei, Sun Chengyu, Zhang Dongdong Architectural Design Framework with the Participation of Artificial Intelligence [J]. *New Building*. 2023, (3). DOI: 10.12069/j.na.202303050

- Ju Song, Yang Xiaodong Research and Application Status of Artificial Intelligence Technology in the Construction Industry at Home and Abroad [J]. Value Engineering, 2018, (4).
- Lu Hanyue, look around Analysis of Artificial Intelligence Content Generation Technology in Architecture [J]. Era Architecture. 2023, (1).
- Li Jing The Application of Artificial Intelligence Technology in Intelligent Buildings [J]. Urban Building Space. 2023, (S01).282-283.
- Lars Egevad, Peter Strøm, Kimmo Kartasalo, Henrik Olsson, Hemamali Samaratunga, Brett Delahunt, Martin Eklund. The utility of artificial intelligence in the assessment of prostate pathology[J]. Histopathology, 2020, 76(6).
- Lan Xu, Paul Tu, Qian Tang, Dan Seligman. Contract Design for Cloud Logistics (CL) Based on Blockchain Technology (BT)[J]. Complexity, 2020, 2020.
- Montjoy, Valeria. What is the Future Role of Architects in the Age of AI and Data? 03 December 2023. ArchDaily. (Trans. July Shao) . <<https://www.archdaily.cn/cn/1004834/zai-ren-gong-zhi-neng-he-shu-ju-shi-dai-jian-zhu-shi-de-wei-lai-jiao-se-shi-shi-yao>>
- Marco Bevolo, Filiberto Amati. The Potential Role of AI in Anticipating Futures from a Design Process Perspective: From the Reflexive Description of " Design" to a Discussion of Influences by the Inclusion of AI in the Futures Research Process[J]. World Futures Review, 2020, 12(2).
- Ouxing Analysis of Architectural Design Paradigms under the Background of Digital Technology [J] Low Carbon World, 2023, 13 (03): 100-102
- Pedersen, Martin . An Optimist's Take on AI and the Future of Architecture] 29 May 2021. ArchDaily. (Trans. Milly Mo) . <<https://www.archdaily.cn/cn/962344/wei-le-guan-zhu-yi-zhe-dui-ren-gong-zhi-neng-yu-wei-lai-jian-zhu-de-kan-fa>>
- Rudy van Belkom. The Impact of Artificial Intelligence on the Activities of a Futurist[J]. World Futures Review, 2020, 12(2).
- Reza Hafezi. How Artificial Intelligence Can Improve Understanding in Challenging Chaotic Environments[J]. World Futures Review, 2020, 12(2).
- Russell T. Warne, Jared Z. Burton. Beliefs About Human Intelligence in a Sample of Teachers and Nonteachers[J]. Journal for the Education of the Gifted, 2020, 43(2).
- Russell Belk, Mariam Humayun, Ahir Gopaldas. Artificial Life[J]. Journal of Macromarketing, 2020, 40(2).
- Walsh, Niall. 6 ideas about how artificial intelligence can change architectural design 07 April 2020. ArchDaily. (Trans.) . <<https://www.archdaily.cn/cn/936661/6ge-you-guan-ren-gong-zhi-neng-gai-bian-jian-zhu-she-ji-de-chang-xiang>>
- Walter Kehl, Mike Jackson, Alessandro Fergnani. Natural Language Processing and Futures Studies[J]. World Futures Review, 2020, 12(2).
- Zhou Ziqian, Gao Wen, He Qiushi, etc Exploration of Artificial Intelligence in the Field of Architectural Design: From Generative Design to Intelligent Decision Making [J]. Industrial Architecture. 2022, 52 (7). DOI: 10.13204/j. gyjzG21090801.