Original Paper

Research on the Reform of Teaching Methods in Higher Education Institutions under the Background of Artificial Intelligence Era - Taking the Design and Construction of Building Steel Structures as an Example

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Abstract

In the rapidly developing era of artificial intelligence, predicting the social environment in the post AI era, the general model of artificial intelligence has become more mature, and relevant professional models have been integrated into the general model or independent. The understanding, development, and use of artificial intelligence have become an indispensable part of social operation. Compliance monitoring of intelligent tools and related usage system requirements are listed and subject to relevant legal constraints. In order to cultivate new talents in the era of artificial intelligence, this article takes the blueprint of higher education in the post artificial intelligence era as an example, taking the course of architectural steel structure design and construction, and combines the blended teaching of Chaoxing AI online and offline classrooms to reflect on the current direction of university teaching reform. It proposes that the current university teaching reform needs to further create a software and hardware ecosystem, further guide and regulate the degree of intervention in AI use, gradually form new talent evaluation indicators, consider the weight of AI use, and lay a solid foundation for the transition of future classrooms.

Keywords

University teaching; artificial intelligence; reform in education; Steel structure design and construction

1. Introduction

With the rapid development of artificial intelligence, its explosive frequency of use, and rapid penetration in various industries, it marks that artificial intelligence is no longer limited to science fiction. Along with this, there is an urgent need to update the training methods that are in line with the characteristics of the times. The concept of what kind of people educators are always rooted in has also undergone subtle changes. It is obvious that the label of lifelong learning still exists, and human innovation is still difficult to replace. In recent years, research on the future classroom has been highly valued by the education sector, government, and enterprises. The reform of existing classrooms will affect the formation and development of future classrooms.

1.1 Research Background

Artificial intelligence is accelerating the reconstruction of social and economic development and governance. Universities shoulder the mission of knowledge inheritance and talent cultivation. As mainstream talent output platforms, their high-quality talent output is beneficial to the progress and development of the entire society. From the emergence of ChatGPT to the widespread use of DeepSeek, it has sparked a wave of enthusiasm in universities. Low cost artificial intelligence software with Deepseek as the mainstream has been promoted in universities. It is important and urgent to have a correct understanding and guide the use of artificial intelligence on the platform of universities. The reform of teaching methods in universities is imperative around the research of artificial intelligence, supporting the impact of artificial intelligence and cultivating talents in the field of artificial intelligence.

1.2 Research Object

Due to their different advantages, major universities have different professional orientations. Basic courses in universities are difficult to update and break through due to the difficulty of theoretical breakthroughs in basic studies, and the knowledge is relatively fixed. Professional courses, on the other hand, expand on basic courses, which is relatively difficult and involves a wide range of knowledge. This article takes the course of architectural steel structure design and construction as an example to explore the changes that artificial intelligence has brought to such a professional course.

1.3 Research Significance

Exploring the impact of artificial intelligence on university professional courses under the current background of artificial intelligence, how to understand, guide, and apply artificial intelligence, and through a new round of teaching method reform, aiming to cultivate intelligent construction composite talents and explore effective ways of reform.

2. Current Situation Analysis

Due to the high difficulty of studying professional courses, some students' basic course learning is not sufficient to fully support in-depth exploration and learning of professional courses. In addition, there are many types of courses offered in universities, and students' time is relatively limited, with high

credit requirements. They will take multiple courses on the same day, making it difficult to ensure that each course successfully completes its scheduled learning objectives. The rapid development of artificial intelligence has intervened in the university education system, bringing more possibilities. Knowledge goals that cannot be completed in class can be supplemented by offline learning. There are currently two recognized perspectives on artificial intelligence: one is to purely instrumentalize artificial intelligence as a commonly used tool; Another perspective is to introduce mature thinking as a part of the teacher's work in the educational process.

2.1 Pain points of Traditional Teaching Mode

The traditional teaching model relies on the rationality of teaching design. China's teaching design started relatively late, and in the early years, it mainly drew on foreign research results. Later, in line with China's national conditions, a series of related teaching design research results were published, with the typical goal of teaching design being to develop reliable and predictable operational programs. Unfortunately, new technologies update and iterate at a fast pace, with different disciplinary backgrounds having different design tendencies and even relative contradictions. This is clearly disadvantageous for subsequent interdisciplinary learners, and even strongly intervenes in the already set teaching design program, causing the teaching process to no longer move forward on the expected track. The rapid development of artificial intelligence has exacerbated the collapse of such programs.

Taking steel structure design and construction teaching as an example, based on the people-oriented design concept, from the perspective of students, teachers need to consider that students have not pre studied knowledge related to steel structure design and construction in advance. They need to consider the three typical problems of three-dimensional space cognition in steel structure design teaching, on-site practical training limitations in construction technology teaching, and the contradiction between standard updates and course content lag. Some three-dimensional spaces can be described through blackboard writing and multimedia display, but the attractiveness is not sufficient. On site technology teaching is also difficult to carry out due to campus site limitations and safety issues of off campus groups, which further restricts the teaching and attractiveness of the course to students. By establishing an online learning platform (such as the Chaoxing Learning App), To some extent, it has solved some of the problems of not understanding, but the lack of supervision makes it difficult to define teaching effectiveness. The update speed of building related regulations is fast, and the textbooks used by students will not be updated in a timely manner due to any changes. The transmission of new things relies more on teachers' lectures in class. Students who want to self-study often give up quickly due to textbook errors and difficulty.

2.2 Current Status of AI Technology Applications

With the development of AI technology, more points of interest have been provided, which is conducive to learners' understanding and learning of this course, such as BIM technology. By learning through relevant BIM software, the popularity of BIM and parametric design tools has increased. Through digital technology, virtual spaces are established to express complex spatial relationships,

accurately modeling reduces drawing problems, improves learners' three-dimensional spatial perception ability, matches corresponding two-dimensional drawings, and solves the problem of difficult viewing. Some AI software can achieve the construction of a virtual simulation experiment teaching platform. Students can display the on-site installation process and precautions by clicking on relevant tool buttons, which is more vivid and safer to operate compared to on-site observation. The relevant intelligent detection technology will also be voice broadcasted throughout the entire construction process, providing prompts. Teachers only need to provide necessary explanations at the beginning of modeling and key node processes, and more importantly, students' operations and Q&A.

3. Reform Path Design

3.1 Construction of Intelligent Teaching Environment

BIM (Building Information Modeling) is a design and construction method based on digital technology, which can provide intuitive display during the design and construction stages, improve the understanding of design structures, and enable participation throughout the entire life cycle. Building a BIM platform requires multiple investments, including software and hardware support. It is necessary for schools to establish a hardware foundation that can run BIM software, purchase or develop relevant software to support related teaching work, or contact relevant software research units to carry out necessary training, collaborate with relevant enterprises for technological innovation, and invite enterprises to give lectures on campus if conditions permit. Secondly, establish an AR/VR immersive construction simulation laboratory to enhance students' interest. Thirdly, make full use of existing artificial intelligence platforms, such as Chaoxing Learning Platform.

3.2 Innovation in Teaching Mode

On the already built platform, using the case library driven machine learning teaching method, teachers can use case library related resources or a set of design materials to let students operate according to machine prompts, thereby learning the entire process of software operation. The full cycle teaching of "design construction operation and maintenance" supported by digital twin technology further deepens students' understanding of steel structure design and construction. Guide students to cleverly utilize artificial intelligence for assisted design during the process, in order to achieve the goal of adaptive learning. I didn't understand in class, but I can continue learning after class.

3.3 Reform of Evaluation System

The evaluation of teaching outcomes no longer relies too much on traditional exams, but more on collecting the entire process of students' class status. Through process evaluation data collection (such as automatic eye tracking/operation log analysis by AI during computer operation), combined with the teacher's evaluation of each student's class status during class, a comprehensive judgment is made. In addition, a knowledge graph based ability assessment model can be built in conjunction with platforms such as Chaoxing. With the assistance of Chaoxing AI assistant, the mastery of each knowledge point can be analyzed, and the learning status of each student can be studied. An intelligent warning system

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for learning intervention mechanism can be established to timely provide the current learning progress and ranking of each student in the class. At the same time, AI can provide targeted suggestions to achieve personalized training for individuals.

4. Practical Cases

4.1 Construction of AI Teaching Platform for Steel Structure in a Certain University

Using the Chaoxing platform, establish a knowledge graph engine that divides knowledge points such as steel structure design principles, node construction, and construction processes into blocks. The blocks are connected by necessary correlation lines to achieve a visual learning path. Students can view the path to determine their current learning progress. Simultaneously activate the AI intelligent agent matrix, integrating AI teaching assistants, AI lesson preparation assistants, etc. AI teaching assistants provide 24-hour Q&A (supporting professional terminology recognition), learning behavior supervision, and weak point analysis. AI lesson preparation generates PPT courseware (including 3D node demonstrations) with one click, intelligently recommends teaching resources, and automatically generates a graded question bank. Practice simulation integration of lightweight 3D models (glTF format), supporting interactive disassembly of steel structure components on mobile devices. AI homework plagiarism detection (including AIGC detection), oral assessment, multi-dimensional writing evaluation report for learning situation management.

4.2 Example of Blended Learning Curriculum Design

(1) Reconstruction of teaching process

Before class: Students self-study basic theories through knowledge graphs, and AI assistants push preview tasks and personalized resources.

In class: Normal teaching of knowledge and interactive communication, interspersed with the use of virtual simulation to display complex node structures, AI generates real-time in class quizzes and analyzes answer data.

After class: AI reviews design assignments and generates improvement suggestions, and students consolidate weak knowledge points through task flow.

(2) Interdisciplinary Integration Practice

Combining BIM technology to carry out virtual construction simulation of steel structures and strengthen engineering practice capabilities.

Embedding intelligent construction industry policies and case libraries (such as super high-rise steel structure projects) to connect with the forefront of the industry.

(3) Comparative analysis of teaching effectiveness

Introducing the Deepseek+Chaoxing platform teaching mode, comparing the learning status of students in two semesters, after using it, students are significantly more engaged in learning and the learning effect has been improved to a certain extent. The disadvantage is that the use of the platform also needs to consider the use of time. Some students still lack interest in class, perform poorly in class, and overly

rely on the platform outside of class, making it difficult to control their engagement in learning outside of class.

5. Challenge and Countermeasures

5.1 Technical Bottleneck

Further through model lightweighting processing, the amount of model data is reduced, the main geometric data is retained, and the attributes are constructed to achieve secondary development and utilization of the model. The mobile end can view the model in real-time, assist in on-site quality work and safety monitoring, improve the transmission of information technology, enhance understanding and decision-making grasp through real-time interactive scenarios, reduce hardware dependence, and promote cross regional collaboration. Convenient for in class presentations and off class student learning.

5.2 Teacher Transformation

Teachers' cognition needs to be reshaped, and they need to keep up with the pace of the times, recognize and utilize AI, and cultivate their basic skills, such as training in the use of AI tools, exercising AI skills, establishing courses for AI practical operation training, strengthening AI utilization, such as advanced ability development and interdisciplinary integration practice. It should also be noted that AI cannot replace complex emotional communication and activities, and cannot achieve creative teaching. Teachers are still the subject that needs to exist throughout the entire teaching process.

5.3 Ethical Risk

It is necessary for teachers to strengthen and impart awareness of data privacy during the teaching process and their own personal growth. Sensitive information should not be casually transmitted to AI software, and necessary technical ethics training should be provided to learn and convey critical use of AI technology.

6. Conclusion and Prospect

6.1 Summary of Research Results

Teachers need to adapt to the changes in teaching methods brought about by the era of artificial intelligence, gradually adapting to and using artificial intelligence software; Develop and disseminate the ability to use artificial intelligence, and disseminate compliant ways of using artificial intelligence; Pay attention to communication and observation in class, and cannot overly rely on artificial intelligence monitoring; The use of artificial intelligence may intensify students' interactive participation in offline classes, and teachers need to observe and prompt them in a timely manner.

6.2 Extended Thinking on Talent Cultivation in Intelligent Construction

The widespread use and increasing intelligence of artificial intelligence have gradually demonstrated its advantages in various industries. In terms of intelligent construction, teachers need to closely monitor the latest knowledge in the field of artificial intelligence construction, update their own learning in a

timely manner, and use artificial intelligence to track the latest status in real time, conveying to students the awareness of how to use artificial intelligence reasonably, the necessity of interpersonal communication, and how to use artificial intelligence to solve problems encountered in life and work, cultivating comprehensive use ability.

References

Feng, X. Y., Xu, X., & Guo, W. L. (2024). How to understand, how to act, how to become? —Reflection on the Professional Development of Teachers in the Era of Artificial Intelligence. *Open Education Research*, *30*(02), 31-41. https://DOI:10.13966/j.cnki.kfjyyj.2024.02.004

Li, X. Y., & Liao, B. Q. (2015). Exploration of Ethical Principles in Teaching Design. *Research on Electronic Education*, *36*(12), 11-16. https://DOI:10.13811/j.cnki.eer.2015.12.002

Miao, F. C. (2024). Autonomous Artificial Intelligence Applications Based on Teacher Rights: An Interpretation of the UNESCO Teacher AI Competency Framework. *Open Education Research*, *30*(05), 4-16. https://DOI:10.13966/j.cnki.kfjyyj.2024.05.00

Miao, F. C. (2024). The Basic Controversy and Countermeasures of Generative Artificial Intelligence and Its Educational Applications. *Open Education Research*, *30*(01), 4-15. https://DOI:10.13966/j.cnki.kfjyyj.2024.01.001

Miao, F. C. (2025). *Reconstruction of Higher Education in the Post Artificial Intelligence Era*. Open Education Research, *31*(02), 4-13. https://DOI:10.13966/j.cnki.kfjyyj.2025.02.001

Mu, S., Chen, X. R., & Hu, X. Y. (2024). Functional Analysis of Intelligent Teaching and Research Platform from the Perspective of Teacher Professional Development. *Modern Distance Education*, (02), 23-32. https://DOI:10.13927/j.cnki.yuan.20240409.001.https://doi:10.16382/j.cnki.1000-5560.2023.07.01

Sun, K. N. (2018). Review and Prospect of Teaching Design Research in China over the Past 40 Years. *Curriculum Textbook Teaching Method*, *38*(11), 39-45. https://DOI:10.19877/j.cnki.kcjcjf.2018.11.006

Wang, J., Liu, Z. W., & Chen, W. D. (2014). Characteristics of Future Classroom Teaching Design: Embodied Cognitive Perspective. *Modern Distance Education Research*, (05), 71-78

Wu, D., Guo, Q., & Zheng, X. D. (2024). How does the advancement of intelligent technology promote student development? *Education Research*, *45*(01), 121-132

Xu, S. N., & Sun, H. (2024). Subversion and Reconstruction: Philosophical Reasoning of Higher Education in the Era of Artificial Intelligence. *Modern University Education*, *40*(05), 34-46+111.