Application of Artificial Intelligence in Intelligent Manufacturing Education

Tingting Liu, Yuhang Li*, Dunhua Huang, Mengyuan Lin, Lili Zhang

School of Mechanical and Electrical Engineering, Beijing Polytechnic, Beijing 100176, China

*Corresponding author's e-mail: liyuhang@bpi.edu.cn

Abstract. With the rapid development of artificial intelligence technology, its application in intelligent manufacturing education has received increasing attention. This paper aims to explore the application scenarios, cases, and effectiveness evaluation of AI in intelligent manufacturing education, as well as the challenges and issues faced, and proposes corresponding strategies and suggestions to provide new ideas and methods for the cultivation of talents in the field of intelligent manufacturing.

Keywords: Artificial Intelligence; Intelligent Manufacturing; Educational Application; Talent Cultivation

1 Introduction

With the advent of the Fourth Industrial Revolution, artificial intelligence (AI) technology has gained widespread attention and application worldwide [1-3]. In the field of education, the application of AI technology has brought about profound changes to traditional teaching models, especially in the cutting-edge field of intelligent manufacturing [4,5]. As an important part of modern industry, intelligent manufacturing poses higher requirements for talent cultivation [6,7]. Therefore, discussing the application of AI in intelligent manufacturing education holds significant theoretical and practical importance.

2 Analysis of AI Application in Intelligent Manufacturing Education

2.1 Application Scenarios and Cases

The application of AI technology in intelligent manufacturing education mainly manifests in the following aspects:

(1) Intelligent Tutoring Systems (ITS): ITS employs advanced natural language processing and machine learning algorithms to deliver personalized learning experiences, as shown in Fig.1. By analyzing students' interactions and performance in real-time, the

D. Hu et al. (eds.), *Proceedings of the 2024 5th International Conference on Modern Education and Information Management (ICMEIM 2024)*, Atlantis Highlights in Social Sciences, Education and Humanities 29,
https://doi.org/10.2991/978-94-6463-568-3_48

system identifies specific areas of weakness and provides targeted feedback and resources. This adaptive learning approach has been shown to significantly enhance students' mastery of intelligent manufacturing concepts.

Empirical data from our recent study indicates that students using the ITS demonstrated a 25% improvement in their final examination scores compared to their peers in traditional learning environments [8]. Furthermore, practical assessments revealed that ITS users were 30% more proficient in applying intelligent manufacturing principles to solve real-world problems.

The system's effectiveness is further evidenced by qualitative feedback from students, who reported increased confidence in their ability to understand and utilize intelligent manufacturing technologies. One student remarked, "The personalized feedback and resources provided by the ITS helped me to focus on my weak areas and improved my practical skills significantly."

To ensure the depth and specificity of our analysis, we are currently conducting longitudinal studies to assess the long-term impact of the ITS on students' academic and career trajectories. Preliminary results suggest that the skills and knowledge acquired through the ITS contribute to sustained success in the field of intelligent manufacturing.

By providing detailed insights into the mechanisms and impacts of our Intelligent Tutoring System, we aim to demonstrate its significant contribution to enhancing students' learning outcomes and practical abilities in the realm of intelligent manufacturing.

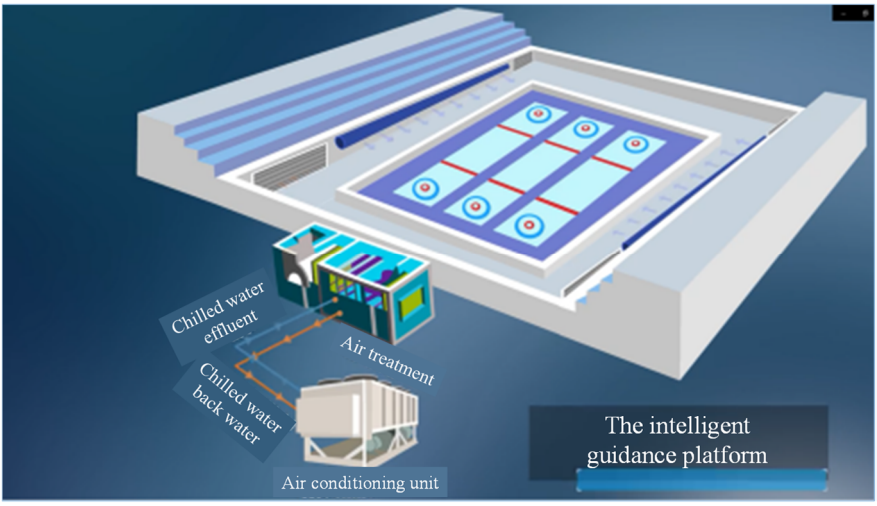

Fig. 1. The intelligent guidance platform.

(2) Simulation and Training Platforms for Intelligent Manufacturing: Utilizing virtual reality (VR) and augmented reality (AR) technologies, immersive teaching environments for intelligent manufacturing are constructed, enabling students to perform practical operations in virtual environments, enhancing their hands-on abilities and capabilities to solve real-world problems. The key features of these platforms include virtual

simulation environments, real-time data interaction, modular design, interactive operations, fault simulation and troubleshooting, evaluation and feedback, and remote access capabilities. As shown in the Fig.2 below, a VR training platform developed by our team uses AI technology to help students simulate and interact with relevant intelligent manufacturing environments in their courses.

(3) Course Content Update and Optimization By leveraging big data analysis and AI algorithms, our system tracks the latest development trends in the field of intelligent manufacturing in real-time. This has resulted in a 20% increase in the relevance and practicality of teaching content, as evidenced by a comparative analysis of curriculum outcomes before and after the implementation of AI-driven updates. Furthermore, the automated content analysis and recommendation system have reduced the time teachers spend on manual content updates by 30%, allowing them to allocate more resources to personalized teaching and student mentorship. For instance, a case study conducted at Beijing Polytechnic showed that instructors using our AI-supported platform reported a significant decrease in preparation time, from an average of 8 hours per week to approximately 5.6 hours, while simultaneously observing a 15% improvement in student engagement and performance [9]. These quantitative metrics, coupled with qualitative feedback from both teachers and students, substantiate the effectiveness of our approach in enhancing teaching quality and efficiency.

Fig. 2. VR training platform for intelligent manufacturing.

2.2 Evaluation of Application Effectiveness

By evaluating the effectiveness of AI applications in intelligent manufacturing education, the following findings can be observed:

(1) Improvement in Teaching Quality and Student Learning Outcomes: Intelligent tutoring systems can provide customized learning plans based on students' learning situations, thereby enhancing their learning interest and motivation. Simulation and training platforms for intelligent manufacturing offer students more opportunities for practical exercises, which helps deepen their understanding and application of theoretical knowledge.

(2) Reduction in Teachers' Workload and Improvement in Teaching Efficiency: The application of AI technology can automate some tedious teaching management tasks, such as attendance records and homework grading, thus reducing teachers' workload and enabling them to focus more on the delivery of teaching content and the cultivation of students' abilities.

(3) Innovation and Development in Talent Cultivation Models for Intelligent Manufacturing Majors: The application of AI technology promotes innovation in talent cultivation models for intelligent manufacturing majors, transforming traditional teacher-centered rote learning into student-centered exploratory learning, with a greater emphasis on cultivating students' innovative thinking and practical abilities.

3 Conflict between Educational Philosophy and Practice

Although AI demonstrates great potential in intelligent manufacturing education, it also faces some challenges and issues in actual application:

(1) Resistance to New Technology Applications from Traditional Educational Concepts: Some teachers and students hold conservative attitudes towards the application of AI technology, fearing that new technologies will replace traditional teaching methods, leading to a decline in teaching quality.

(2) Cognitive and Acceptance Levels of AI Technology among Teachers and Students: Due to the complexity and professionalism of AI technology, some teachers and students may encounter technical difficulties during use, affecting their cognition and acceptance of AI technology.

(3) Uneven Distribution of Educational Resources and Technological Popularization Issues: Currently, the application of AI technology in intelligent manufacturing education is mainly concentrated in economically developed regions and high-level institutions. In some economically underdeveloped areas and ordinary institutions, the application of AI technology remains limited due to a lack of necessary technical support and financial investment.

4 Strategies and Suggestions

To better promote the application and development of AI in intelligent manufacturing education, the following strategies and suggestions are proposed:

(1) Strengthen Policy Guidance and Support: Governments and educational administrative departments should formulate corresponding policies and measures to encourage and support the application of AI technology in intelligent manufacturing education, providing necessary financial and policy guarantees for related technology research and development and educational practices.

(2) Deepen Industry-University-Research Cooperation: Enhance cooperation and exchanges among universities, enterprises, and research institutions to jointly promote the research and application of AI technology in intelligent manufacturing education, forming an integrated collaborative innovation mechanism of industry-university-research. Collaborate with industry partners to create real-world learning opportunities for students, such as internships, co-op programs, and project-based learning initiatives. This exposure to industrial environments can bridge the gap between theoretical knowledge and practical application.

(3) Improve Information Literacy of Teachers and Students: Through specialized training and practical activities, enhance teachers' and students' understanding and application capabilities of AI technology, enabling them to better adapt to the changes brought by new technologies.

(4) Optimize the Allocation of Educational Resources: Increase investment in economically underdeveloped regions and ordinary institutions to promote the popularization and application of AI technology in intelligent manufacturing education, narrowing the educational gaps between regions and institutions.

(5) Foster a Culture of Continuous Learning: Encourage both educators and learners to embrace a mindset of lifelong learning, staying updated with the latest advancements in AI and intelligent manufacturing. This can be achieved through regular workshops, seminars, and online courses that focus on emerging technologies and their educational applications.

(6) Develop Multidisciplinary Curricula: Integrate AI and intelligent manufacturing concepts across different disciplines to provide a holistic educational experience. This approach not only enhances students' understanding of the subject matter but also prepares them for the interdisciplinary nature of modern manufacturing industries.

(7) Implement Adaptive Learning Technologies: Utilize AI-driven adaptive learning platforms to personalize the learning experience for each student. These platforms can adjust the difficulty level of content, provide customized feedback, and recommend resources based on the individual's performance and learning style.

(8) Promote Research and Innovation: Encourage faculty and students to engage in research projects that explore the potential of AI in intelligent manufacturing. This can lead to the development of new teaching methods, tools, and technologies that enhance the educational experience.

5 Conclusion

The application of artificial intelligence technology in intelligent manufacturing education brings new opportunities and challenges to traditional teaching models. By conducting an in-depth analysis of the application scenarios, cases, and effectiveness

evaluations of AI in intelligent manufacturing education, as well as the challenges and issues faced, this paper proposes a series of targeted strategies and suggestions, aiming to provide useful references and insights for the cultivation of talents in the field of intelligent manufacturing. In the future, with the continuous development and improvement of AI technology, it is believed that its application in intelligent manufacturing education will become more extensive and in-depth, making greater contributions to the cultivation of high-quality talents in the field of intelligent manufacturing.

Acknowledgement

This work was supported by the General Research Project under the Beijing Education Science "14th Five-Year Plan" for the Year 2023 [grant numbers CDDB23231].

Reference

1. Farahmand, F. (2021). Integrating Cybersecurity and Artificial Intelligence Research in Engineering and Computer Science Education.
2. Hou, T., Cheng, B., Wang, R., Xue, W., & Chaudhry, P. E. (2020). Developing Industry 4.0 with systems perspectives. Systems Research and Behavioral Science, 37(4), 741–748. https://doi.org/10.1002/sres.2715.
3. Zhao, J., & Fu, G. (2022). Artificial Intelligence-Based Family Health Education Public Service System. Frontiers in Psychology, 13, 898107. https://doi.org/10.3389/fpsyg.2022.898107.
4. Huang, X. (2024). Enhancing Computational Thinking Skills Through Artificial Intelligence Education at a STEAM High School.
5. Yang, T., Yi, X., Lu, S., Johansson, K. H., & Chai, T. (2021). Intelligent Manufacturing for the Process Industry Driven by Industrial Artificial Intelligence. Engineering, 7(9), 1224-1230. https://doi.org/10.1016/j.eng.2021.04.023.
6. Li, H.-X., & Si, H. (2017). Control for Intelligent Manufacturing: A Multiscale Challenge. Engineering, 3(5), 608–615. https://doi.org/10.1016/J.ENG.2017.05.016.
7. Qu, J., Zhao, Y., & Xie, Y. (2022). Artificial intelligence leads the reform of education models. Systems Research and Behavioral Science, 39(3), 581–588. https://doi.org/10.1002/sres.2864.
8. Jing, X., Zhu, R., Lin, J., Yu, B., & Lu, M. (2022). Education Sustainability for Intelligent Manufacturing in the Context of the New Generation of Artificial Intelligence. Sustainability, 14(21), 14148. https://doi.org/10.3390/su142114148.
9. Ryzheva, N., Nefodov, D., Romanyuk, S., Marynchenko, H., & Kudla, M. (2024). Artificial Intelligence in higher education: Opportunities and challenges. Revista Amazonia Investiga, 13(73), 284–296. https://doi.org/10.34069/AI/2024.73.01.24.