

A Study on the Teaching Reform of Hardware-Related Courses under the Drive of the Artificial Intelligence Industry



Chao Shen^{1,*}, Siyu Liu¹ & Yue Fei²

¹*School of Computer Science and Engineering, Xi'an Technological University, China*

²*School of Weapons Science and Technology, Xi'an Technological University, China*

Abstract: The rapid development of the artificial intelligence (AI) industry has led to a surging demand for professionals equipped with AI-related hardware development and debugging skills. However, hardware-oriented courses in universities often suffer from outdated content and insufficient practical alignment, making it difficult to meet industry needs. As a result, promoting curriculum reform has become an urgent requirement to bridge the gap between talent cultivation and industrial demands. Universities are therefore expected to adapt reforms to their specific contexts, clarify the primary directions of curriculum adjustment, and enhance the relevance of teaching by integrating both students' learning needs and industry employment standards. Such efforts are crucial to fostering students' comprehensive development. This paper focuses on the AI industry's demand for hardware-oriented talent and explores pathways for curriculum reform. Strategies are proposed in three key areas: goal reconstruction, content optimization, and methodological innovation, with the aim of improving students' hardware practice capabilities and AI adaptability, thereby providing a reference for the reform of hardware-oriented courses in higher education.

Keywords: artificial intelligence industry, higher education, hardware-oriented courses, teaching reform, talent cultivation

1. Introduction

At present, artificial intelligence (AI) technology has penetrated various fields such as manufacturing and electronic information, which has led to a sharp increase in the demand for professional talents with the ability to develop and debug AI hardware. However, traditional hardware courses in colleges and universities mostly focus on theoretical teaching, have slow content updates, and the practical part is detached from the actual situation of the AI industry. As a result, students find it difficult to quickly adapt to the job requirements upon graduation. Against this background, promoting the teaching reform of hardware courses in colleges and

universities to meet the needs of the AI industry has become the key to solving the mismatch between talent training and industrial demand. This article focuses on this core issue and combs through the reform direction and implementation framework in the hope of providing some thoughts on training hardware talents to meet the development needs of the AI industry.

2. Core Requirements of the AI Industry for Hardware Talents in Colleges and Universities

2.1 Professional ability requirements for AI hardware development

With the rapid progress in the field of artificial intelligence, higher education institutions are now required to equip their hardware professionals with

Corresponding Author: Chao Shen
School of Computer Science and Engineering,
Xi'an Technological University, China

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more comprehensive and advanced skills in AI hardware development. In terms of technology, talents need to have a solid foundation in hardware design and development, and be proficient in the core knowledge of computer organization principles, digital circuit design, and embedded system development. They should also be able to apply this knowledge in the development process of AI hardware products. Not only should they have a thorough understanding of the basic architecture and optimization strategies of general-purpose processors such as CPUs and GPUs, but also an in-depth knowledge of the design principles of AI-specific acceleration chips such as TPUs and NPUs. They should be able to design high-performance, low-power hardware architectures according to the computational requirements of different AI algorithms. In addition, AI hardware development is not just about the design of the hardware itself. It also requires talent to have the ability to develop both hardware and software in an integrated manner. They should understand the operating mechanisms and resource consumption characteristics of AI algorithms, and improve the overall efficiency of AI systems through hardware and software co-optimization. This ensures that the hardware can fully leverage its computational power to meet the real-time and accuracy requirements of AI tasks (Zhang & Huang, 2021).

2.2 Interdisciplinary integration and the comprehensive quality requirements for students

In the context of the deep integration of artificial intelligence technology with various industries, it has become a core requirement for the development of the AI industry that hardware talents in universities also need to have a comprehensive quality in interdisciplinary integration. The development of AI hardware is not limited to a single hardware field. Instead, it requires the integration of professional knowledge from multiple disciplines such as AI algorithms, data science, and computer software. Talents need to understand the basic principles and application scenarios of AI algorithms, such as machine learning and deep learning, and be able to

infer the direction of hardware design based on the needs of the algorithms to achieve a deep match between hardware and algorithms. They also need to have certain software programming and development skills to achieve efficient control and management of AI hardware and software through the writing of drivers and control programs, ensuring a smooth connection between hardware and software systems. In addition, the comprehensive quality of interdisciplinary integration is also reflected in the ability to understand industry application scenarios (Han & Dong, 2021). AI hardware has a wide range of application prospects in many fields such as autonomous driving, medical imaging, and intelligent manufacturing. In different application scenarios, there are different requirements for the functionality, performance, and form of the hardware. Talents need to be able to quickly understand the application needs of specific industries and design AI hardware products in combination with industry knowledge and hardware development technology to meet the real application scenarios of the industry and adapt to the implementation of different aspects of the AI industry.

3. Issues in Traditional Hardware Course Teaching in Universities

There are numerous pressing issues in the traditional teaching of hardware courses in universities that need to be addressed in order to meet the demands of the artificial intelligence (AI) industry. One such issue is that the updating of teaching content trails behind the advancement of industry technology. Traditional course content predominantly consists of classic computer hardware knowledge, such as basic CPU architecture, principles of memory, and digital circuit design. There is limited coverage of AI-specific hardware technologies that are extensively utilized in the AI industry, with a notable absence of introductions to technologies like GPUs and TPUs (Yang, Han, & Jia, 2021). Although systems of new hardware architectures, such as NPUs, have been presented, there has been no in-depth exploration into the

optimization of AI algorithms with hardware. This has led to a deviation between the knowledge that students acquire and the actual requirements of the industry, making it difficult for students to quickly adapt to work environments related to AI hardware development after graduation.

The teaching methods overly emphasize theoretical instruction, while the practical teaching component is inadequate. Traditional hardware courses are typically centered on classroom-based theoretical explanations. Teachers deliver knowledge to students through means such as blackboard writing and PPT presentations, with students being largely passive recipients and lacking active engagement and practical operation. Although practical courses are provided, they mainly focus on basic hardware assembly and fundamental circuit testing, which is significantly different from the actual hardware development environment in the field of artificial intelligence. They fail to effectively train students in aspects such as hardware design, development, and debugging, and do not adequately train students in hardware-software development. As a result, students are left with deficiencies in practical operational skills and the ability to solve real-world problems.

4. Methods for Teaching Reform of Hardware-oriented Courses Driven by the Artificial Intelligence Industry

4.1 Case-based teaching method driven by popular ai applications

Driven by the artificial intelligence (AI) industry, employing a case-based teaching method driven by popular AI applications in the teaching of hardware-oriented courses in universities can significantly enhance teaching effectiveness. AI is widely applied in various fields, such as facial recognition in intelligent security and voice control in smart home systems (Lou et al., 2021). Taking the application of facial recognition in intelligent security as an example, teachers can introduce real-world project cases. In the course introduction, a video demonstrating how facial recognition quickly and accurately identifies passengers' identities in

airports and stations to ensure safe passage is shown, which arouses students' interest in learning. Then, the hardware architecture behind the application is analyzed in detail, mainly including the principles and collaborative working methods of hardware devices such as cameras, image sensors, and processors. The explanation is combined with theoretical knowledge of digital image processing and face-detection algorithms to illustrate hardware-accelerated computing (Chang et al., 2024). Subsequently, students are assigned practical operations to build a simple facial recognition system using development boards and related tools, allowing them to experience firsthand the crucial role that hardware plays in AI applications. Through this case-based teaching method, students can intuitively understand the close connection between hardware and AI applications and how hardware design meets the requirements of AI algorithms. It enhances students' ability to solve real-world problems and their enthusiasm for learning hardware-oriented courses, making teaching more in line with the actual needs of the AI industry.

4.2 Project - driven teaching method based on the boppps model

The project-driven teaching method based on the BOPPPS model provides a scientific and efficient teaching framework for the teaching of hardware-oriented courses in the context of the AI industry. The BOPPPS model consists of six components: Bridge-in, Objective, Pre-assessment, Participatory Learning, Post-assessment, and Summary (Fu & Liu, 2024). Taking the design of an intelligent vehicle based on AI as an example, a video of intelligent vehicles in logistics and warehousing automatically transporting goods is played in the Bridge-in stage to introduce the topic. The teaching objectives are determined, such as enabling students to master the hardware system design and construction of an intelligent vehicle, and understand the principles of sensor data acquisition and processing. The pre-assessment is conducted to understand students' grasp of relevant knowledge and adjust teaching strategies accordingly. In the

Participatory Learning stage, students work in groups to carry out project-based activities, from selecting suitable microcontrollers and sensors to designing circuits and writing programs, with guidance and support from teachers. The post-assessment is conducted by asking students to demonstrate the functions of the intelligent vehicle to check the achievement of teaching objectives. Finally, a summary is made, reviewing the key and difficult knowledge points of the topic and highlighting the significance of hardware design for AI applications. This teaching method allows students to systematically learn hardware knowledge through project practice and develop teamwork and innovation skills, which well meet the needs of the AI industry for hardware talents.

4.3 SPOC-based hybrid teaching approach

The SPOC-based blended teaching method, which combines online and offline learning, meets the innovative requirements of the AI industry for the teaching of hardware-oriented courses in universities. Online, teachers can provide high-quality online teaching resources, such as hardware design, AI algorithms, and other related course videos, through MOOC platforms for students to independently learn basic knowledge, such as the principles of digital and analog circuits (Zhou, Chen, & Xu, 2025). An online communication platform is also established, where students can discuss problems encountered during their learning, and teachers will respond in a timely manner. Offline, teachers provide in-depth explanations and extensions of the key and difficult points learned online and guide students to analyze and discuss AI application cases, such as the hardware design of intelligent medical devices. Laboratory courses are arranged for students to practice operating hardware devices, building and debugging circuits, and applying the theoretical knowledge learned online to practice. For example, after students have learned the principles of AI sensors offline, they connect the sensors to the development board in the laboratory to read and process data. Through this blended teaching approach, students can independently arrange their

learning progress, make full use of the rich online resources, and receive targeted guidance and practical training from teachers, thereby improving learning outcomes and efficiency and cultivating hardware professionals who meet the requirements of the AI industry.

4.4 Industry - University cooperative project - guided approach

The industry-university cooperative project-guided approach is an important means for the AI industry to promote the teaching of hardware-oriented courses in universities. Through in-depth cooperation between universities and enterprises, practice projects are jointly implemented. Enterprises can provide real-world cases of AI hardware projects, such as intelligent robot hardware systems under development (Lan et al., 2021). The university assigns students to participate in project practice, and the enterprise sends experienced engineers to tutor students together with university teachers. The engineers share the latest industry technologies and real project development experiences during the project implementation, enabling students to understand the requirements and challenges faced by AI hardware in practice. University teachers, on the other hand, provide theoretical guidance to help students tackle technical problems in the project. For example, in an intelligent robot hardware project, the enterprise engineers guide students in selecting suitable motor-drive chips and sensors to meet the robot's motion control and environmental perception needs; the university teachers then explain the relevant circuit principles and signal-processing knowledge. Through this industry-university cooperative project-guided approach, students are exposed to cutting-edge industry technologies and the actual project development process, enhancing their practical and innovative abilities as well as their employability. This prepares them for a career in the AI industry, specifically in hardware-related fields.

4.5 Interdisciplinary - integrated hardware comprehensive training method

In the context of the AI industry, the interdisciplinary-integrated hardware comprehensive training method holds significant guiding importance for the teaching of hardware-oriented courses in universities. AI is an interdisciplinary field, and its hardware design requires the integration of knowledge from multiple disciplines such as computer science, electronic engineering, and automation. For example, in the comprehensive training of intelligent transportation system hardware, it involves the hardware design of traffic - flow - detection sensors (electronic engineering knowledge), the processing and analysis of traffic data (computer science knowledge), and the intelligent control of traffic signals (automation knowledge). During the practical training phase, students are divided into different groups to work on projects, with each group comprising students from diverse academic backgrounds. They collaboratively participate in the design, construction, and debugging of the intelligent transportation system hardware. Teachers guide students in applying multidisciplinary knowledge to solve real-world problems, such as how to use electronic engineering techniques to design high-precision vehicle-detection sensors, how to apply computer algorithms to process and analyze collected traffic data in real-time, and how to intelligently control traffic signals based on the analysis results. Through this interdisciplinary, integrated hardware comprehensive training, students can broaden their knowledge base, cultivate the ability to integrate and apply multidisciplinary knowledge to solve complex problems, meet the requirements for compound hardware talents in the AI industry, and lay a solid foundation for future development in the AI field.

4.6 Integrated “teaching - learning - evaluation” continuous improvement

In the era of the booming AI industry, where the demand for hardware talents is becoming increasingly stringent, the continuous improvement of the integrated “teaching - learning - evaluation”

approach offers an innovative path for the teaching of hardware-oriented courses in universities. It can effectively promote the improvement of teaching quality and the cultivation of talents that meet industry needs. The integrated “teaching - learning - evaluation” approach emphasizes the organic combination of teaching and evaluation, forming a dynamic cycle and a continuously improving closed-loop system. The teaching objectives of hardware-oriented courses should be set around the knowledge, skills, and literacy requirements of the AI industry. For example, in the course of embedded system design, the ability to optimize embedded hardware design based on AI algorithms is set as a core teaching objective. In the teaching process, a variety of teaching activities are designed according to the teaching objectives. Using project-based teaching methods, students are involved in projects related to AI hardware, such as the design of intelligent security camera hardware systems. During the project implementation, teachers guide students to apply their hardware knowledge, such as sensor selection, circuit design, and signal processing, and combine AI algorithms to optimize hardware performance. Students gain a deep understanding of the integration of hardware and AI through practical operations, group discussions, and case analyses. The evaluation process is integrated throughout the entire teaching process, employing a diversified evaluation approach. This includes traditional exams to assess students’ grasp of hardware theoretical knowledge, as well as project outcome presentations, group peer evaluations, and teacher comments to assess students’ hardware design abilities, teamwork skills, and problem-solving capabilities during the project practice. For example, after completing the intelligent security camera hardware project, students present their project outcomes, including hardware design drawings and physical demonstrations. Groups then evaluate the strengths and weaknesses of each other’s designs, and teachers provide comprehensive assessments from a professional perspective, offering suggestions for improving hardware performance and cost control. Teachers

reflect on the advantages and disadvantages of the teaching process based on the evaluation results, and adjust teaching strategies and methods in a timely manner to optimize teaching content. Students can also clearly identify their own shortcomings in learning and make targeted improvements. Through the continuous improvement of this integrated “teaching - learning - evaluation” approach, hardware-oriented course teaching can keep pace with the development and changes of the AI industry, and cultivate hardware-oriented professionals with innovative and practical abilities.

5. Conclusion

The rapid development of the AI industry has pointed the way for the teaching reform of hardware-oriented courses in universities and has also brought more demands. Universities need to actively connect with industry needs, break through the constraints of traditional teaching, and promote reform in multiple dimensions, such as content, methods, and assessment, to achieve a deep integration of AI technology and hardware teaching. Only in this way can we cultivate high-quality talents who have a solid hardware foundation and the ability to adapt to AI, achieve the same-frequency resonance between talent training and industrial development, and provide solid talent support for the continuous innovation of the AI industry. Future research can further focus on the specific course reform practices and verify the effectiveness of the strategy implementation through pilot teaching, so as to form a reform plan that can be promoted and used.

Conflict of interest

The authors declare that they have no conflicts of interest in this work.

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References

- Chang, L., Guo, Y. F., Yan, W. G., Wang, B., & Li, J. (2024). Research on the practice of teaching reform of computer hardware courses. *Computer Knowledge and Technology*, 20(20), 123 - 126.
- Fu, Y., & Liu, J. (2024). Exploration of teaching reform of “Computer Maintenance and Repair” course based on hardware - maintenance - engineer position. *Vocational Technology*, 23(8), 90 - 96.
- Han, L. Q., & Dong, X. F. (2021). Exploration of teaching reform of computer hardware courses oriented to application. *Industry and Science Forum*, 20(23), 155 - 156.
- Lan, Y., An, Y. S., Ming, Y., Ma, R. G., & Li, Y. (2021). Teaching reform and practice of computer hardware courses under the background of engineering education certification. *Education and Teaching Forum*, 2021(28), 84 - 87.
- Lou, J. J., Cheng, Q. M., Zhao, Y. X., Zhen, L. L., Luo, J., Huang, Y. F., & Wang, L. (2021). Exploration of teaching reform of the first - class undergraduate course “Computer Hardware Technology” in Shanghai. *China Electric Power Education*, 51, 139 - 142.
- Yang, Q. S., Han, D. Q., & Jia, M. S. (2021). Teaching reform and practice of open - source hardware and programming courses based on open - ended projects. *China Modern Educational Equipment*, 2021(23), 156 - 159.
- Zhang, C., & Huang, J. Y. (2021). Teaching reform and practice of intelligent hardware application courses in industrial design. *Industrial Design*, 2021(8), 40 - 41.
- Zhou, D. F., Chen, Q., & Xu, X. H. (2025). Exploration of teaching - mode reform of computer - hardware - series courses under the background of new engineering for strengthening the military. *Research on Military Higher Education*, 48(2), 51 - 56

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