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Exploration of Teaching Mode for Computer Organization and Architecture Course Empowered by DeepSeek

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ABSTRACT

With the rapid development of artificial intelligence (AI) technology, DeepSeek emerged in response to the times and has demonstrated great potential in the field of education. In view of the problems existing in the Computer organization and architecture course, such as abstract concepts that are difficult to understand, complex correlations of knowledge points, untimely teaching feedback, and difficulty in ensuring personalized learning, an innovative teaching model of the Computer organization and architecture course driven by AI like DeepSeek is proposed. By integrating resources such as DeepSeek AI large models, Chaoxing Learning Pass, Huawei Cloud, and MOOC, the deep integration of online learning and training tasks is achieved. From dimensions such as teaching content reconstruction, intelligent auxiliary teaching, immersive practical teaching, personalized learning support, and a multi-dimensional assessment and feedback system, the problems of traditional teaching models are systematically solved. Students can carry out intelligent optimization project practices and dynamic diagnosis and assessment under the guidance of the system. This model has effectively enhanced students' learning interest and innovative practical ability, providing a practical reference for the intelligent reform of similar courses.

KEYWORDS

DeepSeek enabling teaching; Computer organization and architecture; Teaching model; Intelligent assisted teaching

1 Introduction

With the rapid development of artificial intelligence (AI) technology, the application of related technologies in various industries is becoming increasingly widespread. As proposed in the *Government Work Report* issued by the government in 2025, efforts should be made to “promote the integrated development of technological innovation and industrial innovation”[1]. In 2024, the Ministry of Education made a number of specific action plans for empowering education with AI. These plans are closely related to “AI + Empowering teaching”, aiming to promote the deep integration of AI and education and teaching, and provide strong support for cultivating innovative talents that meet the needs of the new era [2-3]. Among the mainstream generative ais abroad, ChatGPT stands out with its powerful natural language understanding and generation capabilities, while Claude excels in long text processing and logical coherence. The applications of both in global education, research, business and other fields have formed mature paradigms [4]. In China, platforms represented by products such as DeepSeek, Doubao, and iFlytek Spark not only possess basic capabilities like text creation, multilingual processing, and professional knowledge response, but also have achieved breakthroughs in high-level interaction scenarios such as logical reasoning, complex mathematical derivation, and support for multiple programming languages (such as Python and C++ code generation and debugging) It can meet the diverse needs of different users [5-6]. The GLM4 large model independently developed by Tsinghua University has developed an intelligent teaching assistant, achieving functions such as automatic question generation and Q&A. Many domestic universities have also carried out local deployment of the Deepseek series of large models, bringing new opportunities for the high-quality development of the education industry [6-8].

2 Current Situation Analysis

Computer Organization and Architecture, as a core fundamental course for computer-related majors, mainly introduces storage systems, instruction systems, CPU, buses and input-output systems, etc. The course “Computer Organization and Architecture” contains a large amount of circuit combinational logic, and knowledge needs to be consolidated through practice. In the traditional offline teaching mode, teachers rely on courseware explanations, blackboard writing deductions, and after-class Q&A, lacking hierarchical guidance and personalized feedback. It is difficult to take into account students' differentiated understanding needs for knowledge points such as “CPU working principle” and “memory hierarchical structure”. At present, the hardware experiment content of “Computer Organization and Architecture” in most universities still mainly consists of traditional verification experiments, such as “Verification of arithmetic and Logical Operations of Arithmetic Units”, “dual-port memory Experiment”, “Simulation of CPU Instruction Execution Process”, etc. The experimental steps are highly standardized. Students only need to connect the circuits, input fixed parameters and observe the expected results according to the experimental manual. There is a lack of independent design and exploration space. Course teachers have relatively weak awareness of the application of intelligent technology and have not fully recognized the importance of integrating AI technology with teaching. Students' learning mainly relies on textbooks and PPT and experiment reports provided by teachers. The resources are limited and it is difficult to meet the personalized learning needs. Finally, the teaching model still remains in the traditional dual structure of "teachers teach and students learn", which is difficult to meet the current personalized and participatory learning demands. The advent of the AI era, especially the popularization of AI tools like DeepSeek, has provided a new opportunity for the reconstruction of teaching models [6,9]. Based on the above considerations, this paper explores the teaching mode of the Computer Organization Principles course enabled by DeepSeek. It deeply integrates domestic DeepSeek AI large models, Huawei Cloud and other tools, and systematically solves the problems of the traditional teaching mode from the dimensions of teaching content reconstruction, immersive practical teaching, personalized learning support and the construction of multiple evaluation mechanisms. Provide practical references and theoretical support for the intelligent upgrade and teaching quality of hardware-related courses in colleges and universities.

3 DeepSeek Empowers the Teaching Exploration of Computer Organization and Architecture Course

DeepSeek's intelligent algorithm conducts in-depth mining and reorganization of course content, builds a knowledge graph system, and forms a course system that is more in line with professional directions and vocational ability goals. In addition, students can leverage DeepSeek's personalized recommendation feature to tailor a learning path for each student, meeting their individualized and effective learning needs.

3.1 Design of the Knowledge System Architecture for Course

3.1.1 Build a Knowledge Graph System

Knowledge graph technology has powerful semantic association and cognitive modeling capabilities, providing new ideas for the structured reorganization of knowledge. This paper utilizes the knowledge extraction and integration capabilities of DeepSeek to construct a knowledge graph for each knowledge point of computer organization principles, presenting the interrelationships among the knowledge points. Extract knowledge points, concepts, relationships and other information from data sources such as classic textbooks, past exam papers, case analyses, and open-source knowledge bases to build a clear content framework. DeepSeek can generate knowledge graphs that contain core knowledge, important concepts, and confusing points. The graph contains modules such as data representation and operation, storage system, instruction system, central processing unit, bus system, input/output system, etc. The knowledge points of each module are closely related through lines, forming a complete knowledge network, which visually demonstrates the interdependence and interaction among them. Students can clearly understand the entire knowledge system architecture of computer organization principles by reviewing the knowledge graph, better understand the position of each knowledge point in the architecture, and thus study more systematically. Knowledge graphs can also help students identify loopholes in the learning process; clarify the position and role of each knowledge point in the architecture. For instance, when they have a vague understanding of the correlation between Cache replacement strategies and main memory address mapping, they can promptly fill in the gaps and make the knowledge system more complete.

Knowledge graphs not only present the hierarchical structure among knowledge points but also reflect the connections among different knowledge points. For instance, the "storage system" of Computer Organization and Architecture Course (a multi-level storage architecture of registers, cache, main memory, and external memory) serves as the hardware foundation for the "virtual memory management" of the Operating System Course. The "interrupt mechanism" of the Operating System Course relies on the hardware design of the interrupt controller in the Computer Organization and Architecture Course.

3.1.2 Personalized Learning Path Design

Personalized learning can accurately analyze students' knowledge strengths, weak points and learning outcomes in the Computer Organization and Architecture course. For students with weak foundations, it plans a step-by-step path, focusing on core knowledge points such as instruction systems, storage systems and CPU, to gradually consolidate the foundation. Develop improvement plans for students who have spare capacity for study, thereby systematically addressing the problems they encounter in course learning. Meanwhile, this model accurately predicts students' abilities, pushes targeted teaching content, helps students build the core concept system of the course in a short time, and corrects and prevents cognitive biases in real time. In addition, customized teaching materials and practical projects can be recommended based on students' development needs to broaden their understanding of the Computer Organization and Architecture in high-performance computing, embedded systems and other fields, thereby enhancing their comprehensive qualities. This course of study is highly logical and coherent. Students may experience fluctuations in their progress due to factors such as changes in learning pace and differences in knowledge absorption. As learning progresses, DeepSeek will collect students' learning data in real time, such as the accuracy rate of exercises and the types of mistakes, and dynamically adjust the learning path. If students perform poorly in practical tasks such as CPU design and memory hierarchy optimization, relevant case explanations and virtual simulation operation tasks will be automatically added.

3.1.3 Immersive Practical Teaching and Project-Driven Learning

The deep integration of immersive practical teaching and project-driven learning provides an effective solution for the course of Computer Organization and Architecture course. Relying on the Huawei Cloud virtual simulation platform and AI tools like DeepSeek, with the progressive project of “from components to systems, from simulation to verification” as the core, students can immerse themselves in building knowledge and honing their abilities in highly realistic hardware development scenarios. In immersive practical scenarios, with the help of Huawei Cloud's hardware simulation environment, students can visualize the timing logic of instruction execution in real time, dynamically debug components such as registers and ALU, and intuitively experience “how code instructions are transformed into hardware actions”. During the process of completing the project, students can not only master the core knowledge of the course but also cultivate the ability to solve practical problems.

3.2 Design of Teaching Mode for Course

3.2.1 Reconstruction of the Teaching System for the Course

Based on DeepSeek's semantic analysis and association mining capabilities, systematically sort out the internal logical context of the core knowledge points of the course, precisely divide and clarify the core knowledge domains such as instruction systems, cpus, storage systems, and bus transmission. Finally, a five-level progressive teaching path of "preparatory knowledge, core principles of computer organization, hardware module design, intelligent optimization project practice, and comprehensive course practice" is constructed to form a well-structured and gradient progressive teaching content system.

In terms of resource construction, we integrate mainstream online tools such as Chaoxing Learning Pass, Virtual Simulation Experiment Platform, Huawei Cloud Hardware Development Community and DeepSeek large model to build an integrated teaching resource library. This resource library provides comprehensive teaching support for teachers, covering core functions such as courseware integration, micro-video production, textbook synchronization, teaching content customization, personalized exercise generation, typical case design, and real-time problem-solving, to facilitate the efficient implementation of teaching processes. For the student end, the system focuses on personalized learning needs and provides diversified services such as online video self-study, level-based hierarchical testing, real-time intelligent Q&A, generation of personal knowledge graphs, guidance on virtual experiment steps, hardware simulation debugging guidance and error correction, significantly stimulating students' enthusiasm for learning.

In terms of teaching organization, a blended teaching model is adopted to construct a teaching framework that combines theoretical learning with practical operation. Personalized preview materials are automatically pushed before class. Students can complete the preview and consolidation of basic knowledge through the Chaoxing AI Experimental Workbench. With the real-time assistance of the platform, they can carry out practical tasks such as virtual hardware construction and time series simulation verification, improving their active learning ability and practical operation ability.

3.2.2 Teaching Process Design

This study divides the teaching process into three stages: before class, during class, and after class. Relying on the AI platform, it is deeply embedded in each link to achieve the organic integration of precise matching of teaching content, dynamic optimization of teaching methods, and real-time response of learning support.

Pre-class stage: Relying on the AI teaching assistants of Chaoxing Learning Pass, combined with course materials, online resources (MOOC National Excellent Courses), micro-videos and other resources, a knowledge base is built. By using AI teaching assistants to provide guidance for students, some personalized guidance can be achieved, and they can also serve as learning assistants for students. Subsequently, students' interest in learning was aroused through perception-related cases, and they conducted self-study through online platforms, initially establishing the course framework and knowledge system. Relying on DeepSeek's semantic analysis capabilities, we push hierarchical preview resources that are suitable for students' basic needs, including micro-videos of core knowledge points, basic exercises, and tasks such as completing pre-class quizzes. By collecting preview data through an AI platform, analyzing students' blind spots in mastering knowledge points, types of mistakes they are prone to, and other learning characteristics, class learning situation reports and individual learning profiles are generated.

During the in-class stage: Teachers, through online platforms and feedback on the learning process, combine knowledge graphs and AI teaching assistants to keep track of students' learning progress on basic conceptual knowledge in real time. Based on the feedback results, they promptly adjust classroom teaching strategies and plans, and strengthen the presentation and explanation of corresponding knowledge points in classroom teaching. In the classroom, organize on-site interactive discussions, group collaborations, project designs and other activities, provide immediate and accurate Q&A services, and clearly indicate the source of the Q&A. In the classroom, students not only complete the study of basic theories but also focus on project practice and social practice applications.

After-school stage: Students can check their knowledge mastery through personal knowledge graphs, clearly identify weak links in knowledge points, and conduct targeted review and consolidation based on the recommended learning paths, combined with virtual simulation cases, principle breakdown lecture notes and other resources. Meanwhile, students can also customize personalized exercises based on their individual learning needs in combination with AI teaching assistants. AI teaching assistants guide students to complete online tasks on the Chaoxing Learning Pass platform. Teachers and students promptly answer questions through online communication, thus completing the presentation and evaluation of achievements. Teachers can comprehensively grasp students' learning situations through knowledge graphs, clearly identify the differences among students, and deeply analyze students' mastery of each knowledge point. In addition, students can make use of resources such as the DeepSeek auxiliary platform, Huawei Cloud virtual simulation experiment platform, and hardware development case library to carry out comprehensive practical training. By combining virtual debugging tools, they can deepen their understanding of the working mechanism of hardware and enhance their system design thinking and problem-solving abilities.

3.2.3 The Integration of Positions, Courses, Competitions and Certificates

In the teaching module and practical tasks of the Computer Organization and Architecture course course, emphasis is placed on the integration of four dimensions: “position (such as hardware development and system architecture design, etc.), course (core knowledge system of the course), competition (such as electronic design and other subject competitions), and certificate (industry technical certification)”. Relying on the full-chain empowerment of DeepSeek technology for teaching implementation and ability cultivation, it guides students to deeply integrate core knowledge such as instruction systems, CPU, storage systems, and temporal logic in computer organization principles with fields like high-performance computing, embedded system development, and interdisciplinary engineering practice, broadening their technical horizons. Comprehensively enhance the capabilities of hardware logic analysis, virtual simulation development and engineering application solutions. Finally, DeepSeek is utilized to conduct multi-dimensional assessment and analysis of the learning outcomes of the modules (including the precision of knowledge point mastery, proficiency in hardware design practice, and efficiency in solving system problems), continuously optimizing the teaching content and practical tasks, enhancing the adaptability of teaching implementation to job technical requirements, competition preparation, and certificate assessment, and helping students solidify their foundation in the underlying principles of computer hardware. Lay a solid foundation for further education and career development.

3.3 Student Situation Monitoring and Evaluation Feedback System

The traditional evaluation system for computer organization courses often takes examination scores as the dominant measurement indicator, and this model has obvious limitations. First of all, examination scores usually only reflect students' memory and understanding of specific knowledge points, and cannot comprehensively measure how students apply knowledge in actual scenarios. Secondly, traditional evaluation relies on static and uniform testing forms, which cannot adapt to the learning pace, style and personalized needs of different students. For students with weak foundations and slow learning progress, traditional evaluations are difficult to provide timely and targeted feedback and support. Based on this, the course urgently needs to innovate the assessment and feedback model and introduce more comprehensive and personalized methods to meet the learning and development needs of students.

When building a course evaluation feedback system, fully leveraging DeepSeek's powerful data analysis capabilities, through dynamic analysis of students' basic knowledge, cognitive abilities, learning attitudes, and phased learning outcomes, it can help teachers accurately identify teaching difficulties and key points, and achieve multi-dimensional evaluation. The DeepSeek intelligent teaching platform collects learning data from various types of students and builds a rich pool of raw data, laying the foundation for multi-intelligence assessment. Behavioral data: study duration, number of repeated studies, error rate in answering questions and types of mistakes, etc. Interactive data: Collect interactions between teachers and students as well as among students themselves, such as questions in discussion forums and private messages, etc. Outcome data: assignments, experiment reports, online simulation experiment practice results and examination scores, etc. Through in-depth mining and analysis of these data, detailed and accurate learning reports are generated. Based on the report, teachers can clearly understand students' learning progress, weak links in knowledge acquisition, and the effectiveness of learning methods, thereby providing guidance that suits students' actual situations.

4 Conclusion

This paper conducts an in-depth discussion on the teaching mode of DeepSeek in the course of Computer Organization and Architecture. With the support of intelligent algorithms, the framework of the course knowledge system, teaching mode and assessment feedback system have been significantly optimized. By integrating DeepSeek's intelligent algorithms, a diversified teaching module is designed. Through the dynamic reconstruction of classroom teaching and the precise adaptation of personalized learning, the teaching efficiency and learning quality are significantly improved, and the correlation between the core knowledge points of the course, programming thinking and practical application is strengthened. Meanwhile, the Chaoxing AI Workbench provides precise diagnosis and personalized content push based on multi-dimensional learning situation data, enhancing students' interest in learning and accurately grasping the deficiencies in the learning process. By making reasonable use of DeepSeek, learners can enhance their engineering knowledge and the ability to design and develop solutions. Meanwhile, by deeply integrating virtual reality (VR) and augmented reality (AR) technologies, an immersive and interactive practical teaching environment is created, significantly enhancing the efficiency of programming skills transfer. It can be foreseen that DeepSeek will play an increasingly important role in education and teaching. It not only provides new approaches and methods for “AI + education” in the field of programming teaching, but also offers references and inspirations for the exploration of teaching reforms in similar courses.

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