2026 *Journal of Social Science Humanities and Literature, Vol. 9, Issue 6, (Jun)*
ISSN 2277-842X
DOI: 10.66069/ojspub.22770607

Smart Education-Oriented Teaching Reform in Computer Science

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Abstract: ***With the rapid development of artificial intelligence technology, computer technology is showing a rapid iterative trend. As a key link in the cultivation of computer professionals, it has been difficult for the traditional computer professional teaching model to meet the needs of society for high-quality talent, and teaching reform is imperative. The application of artificial intelligence technology in professional computer teaching is not only a key measure to respond to the development strategy of smart education in colleges and universities but also the core driving force to promote the digital upgrading of professional computer teaching. This research is based on the connotation and core characteristics of smart education and deeply analyzes the internal adaptability of artificial intelligence technology and professional computer teaching. On this basis, specific reform strategies are proposed from the dimensions of building a smart teaching platform, constructing an "AI + hierarchical teaching" model, innovating a personalized learning support system, and establishing an intelligent teaching evaluation system, aiming to fully explore the teaching potential of artificial intelligence technology and provide a theoretical reference and practical paths for the high-quality development of computer professional teaching.***

Keywords: Smart Education; Artificial Intelligence Technology; Professional Computer Teaching; Teaching Platform.

1. INTRODUCTION

With the rapid progress of information technology, the teaching of computer majors in colleges and universities has undergone a series of profound paradigm changes. From early multimedia-assisted teaching to the widespread application of microlessons, flipped classrooms, and online-offline hybrid teaching models with the help of MOOCs, SPOCs, and various online open education platforms (such as XuetangX and Superstar Learning), the teaching form has been evolving continuously. Entering the era of artificial intelligence, emerging intelligence technologies have injected new vitality and possibilities into the innovative development of major computer teaching, resulting in a deep transformation of teaching models. As early as 2018, the "Artificial Intelligence Innovation Action Plan for Higher Education Institutions" issued by the Ministry of Education noted that intelligent technologies should be used to support the innovation of talent cultivation models, the reform of teaching methods, and the improvement of education governance capabilities, and new teaching models based on artificial intelligence should be explored [1]. The in-depth development of smart education has provided a favorable opportunity and a good environment for the deep integration of artificial intelligence technology and its empowerment of computer major teaching. Therefore, systematically discussing the reform strategies for the empowerment of computer major teaching by artificial intelligence in the context of smart education has important theoretical value and urgent practical significance for promoting the modernization of computer education and cultivating innovative talent.

2. THE CONNOTATIONS AND CHARACTERISTICS OF SMART EDUCATION

The concept of "smart education" was first officially proposed in the "Action Plan for Education Informatization 2.0". The concept of smart education goes beyond the simple addition of traditional "education + informatization". It is a new type of educational form with a new generation of information technology as the core support dedicated to reconstructing the educational ecosystem. Its essence lies in promoting the deep transformation and systematic upgrading of all educational elements to achieve digitalization, networking, and intelligence. Its core characteristics are manifested mainly in the following three dimensions. First, smart education emphasizes the use of advanced technologies such as the Internet of Things and big data to achieve intelligent perception and dynamic decision-making in teaching scenarios. By dynamically capturing and analyzing the behavioral data of teachers and students, digital upgrades and the precise regulation of professional teaching can be achieved. Second, smart education advocates the use of artificial intelligence algorithms to construct refined learner portraits and, on the basis of the knowledge structure, cognitive characteristics, and learning preferences of students, to push personalized learning resources and plan intelligent learning paths. Third, smart education advocates the development of an open, shared, and collaborative educational resource ecosystem, with the goal of overcoming the time and space barriers associated with traditional teaching and strongly promoting in-depth cooperation

between schools and the deep integration of industry, academia, and research [2].

3. THE ROLES AND VALUES OF ARTIFICIAL INTELLIGENCE EMPOWERING THE TEACHING REFORM OF COMPUTER SCIENCE UNDER THE BACKGROUND OF SMART EDUCATION

3.1 Facilitating the Implementation of Precision Teaching in the Computer Science Major

The deep application of artificial intelligence technology in the teaching of computer science majors provides unprecedented possibilities and strong support for the implementation of individualized and targeted precision teaching. First, by relying on artificial intelligence technology, teachers can dynamically and accurately analyze students' mastery of computer science knowledge, thus keenly capturing the difficulties and error-prone points in their learning process and then implementing more personalized and targeted teaching guidance, significantly improving the precision and effectiveness of teaching. Second, with the help of a well-functioning online teaching platform, teachers can carefully design complex classroom teaching content into a number of independent and flexible modular video resources, allowing students to independently select learning content and learning paths according to their own knowledge base, learning rhythm and interest preferences. This not only greatly improves learning efficiency but also further enhances the actual teaching effect. Finally, teachers can use artificial intelligence algorithms to accurately push computer science frontier knowledge, industry trends and high-quality learning resources that highly match students' professional growth needs to students by integrating various professional learning platforms or carefully using selected new media channels (such as professional WeChat official accounts, academic exchange communities, etc.), ensuring the timeliness, frontier nature and practicality of teaching content and better serving the individualized development of students [3].

3.2 Facilitating the Improvement of the Teaching Efficiency of Computer Majors

With the deep empowerment of artificial intelligence, the overall operation efficiency and quality of computer major teaching can be significantly improved in terms of multiple key links, from teaching preparation and classroom interaction to after-class evaluation. First, in the lesson preparation stage, artificial intelligence technology can assist teachers in efficiently collecting, screening, and integrating a vast amount of teaching resources and can intelligently generate a preliminary teaching plan and courseware framework according to preset teaching objectives. This not only greatly reduces the repetitive lesson preparation work of teachers but also enables them to focus more on the in-depth analysis of key teaching points and the careful design of teaching strategies, thus significantly improving the quality and efficiency of lesson preparation. Second, in the practical teaching link, the artificial intelligence assistant can act as an all-weather intelligent tutor, providing students with instant and comprehensive question-answering services, effectively compensating for the deficiencies of traditional classrooms in terms of the frequency of teacher–student interaction and the depth of personalized tutoring. For example, the AI assistant can quickly and accurately answer the basic knowledge questions encountered by students during the learning process, enabling teachers to focus more of their precious classroom time and energy on the in-depth explanation of core concepts, the guidance and discussion of complex problems, and the cultivation of higher-order thinking abilities. Third, in terms of after-class evaluation, on the basis of advanced artificial intelligence algorithms, it is possible to achieve automatic and intelligent preliminary grading and feedback on the homework submitted by students (especially programming assignments). This liberates teachers from cumbersome and repetitive basic grading work, enabling them to invest more energy in providing more targeted and differentiated after-class tutoring and personalized learning support services, truly achieving individualized teaching.

4. RESEARCH ON THE STRATEGIES OF EMPOWERING THE TEACHING REFORM OF COMPUTER MAJOR BY ARTIFICIAL INTELLIGENCE UNDER THE BACKGROUND OF SMART EDUCATION

4.1 Building a Smart Computer Professional Teaching Platform

To comprehensively promote the deep integration and collaborative innovation of artificial intelligence technology and professional computer teaching, universities should strategically plan and focus on building an integrated professional smart computer teaching platform. The platform aims to fully release and maximize the unique teaching value of artificial intelligence technology, thus strongly driving the overall digital transformation

and in-depth teaching innovation of the computer major. First, in the overall architecture design of the smart computer professional teaching platform, the adoption of an advanced "four-layer and three-terminal" hierarchical model (see Table 1 for the specific architecture) is recommended to ensure the modularity, scalability and efficient operation of the platform. Among them, the infrastructure layer provides a solid computing power guarantee for the efficient operation and elastic scaling of various artificial intelligence algorithms by deeply integrating cloud computing and edge computing nodes; the data layer is committed to building a unified and standard data lake to integrate and manage a large amount of information, including teaching behavior data, domain knowledge graphs and other multisource heterogeneous learning data; the service layer adopts a flexible microservice architecture to encapsulate core AI functions such as intelligent recommendation, static and dynamic code analysis, and learning path planning into services that can be independently called and combined; and the top application layer is responsible for developing various business modules for end-users, such as comprehensive teaching management, immersive virtual training, and personalized learning tutoring, and ensuring full compatibility and seamless support for various access methods, such as the Web browser side, mobile intelligent terminals and professional experimental terminals.

Second, at the level of designing the core functional modules of the platform (the logical relationship can be seen in Figure 1), the following mutually coordinated and deeply integrated functional clusters should be constructed: the intelligent lesson preparation module, which uses AI technologies such as knowledge graphs and natural language processing to assist teachers in efficiently collecting, organizing and generating, and optimizing personalized course teaching resources; the virtual training module, which provides highly realistic and interactive virtual experimental scenarios for various practical teaching methods in the computer major based on virtual reality (VR), augmented reality (AR), and simulation technologies and can automatically and instantaneously evaluate and provide feedback on the students' practical operation processes and results in an intelligent manner; the personalized learning module, which dynamically generates and recommends personalized learning plans, learning paths, and adapted resources for each student by continuously analyzing the learner portraits and learning behavior data, effectively guiding them to develop autonomous and efficient learning habits and strategies; and the classroom interaction module, which deeply integrates technologies such as speech recognition, emotion computing, and intelligent Q&As, aiming to break the one-way information transmission mode of the traditional classroom and promote more natural, deeper, and more efficient multidirectional interaction and collaborative exploration between teachers and students and among students; and the teaching decision-making support module.

Table 1: Overall Architecture of the Intelligent Professional Computer Teaching Platform

Level	Function description	Technical implementation and support
Application layer	Build business modules such as teaching management, virtual simulation training, and personalized learning recommendation	Business development frameworks such as Web systems, mobile apps, and virtual simulation platforms
Service layer	Provide core functional services such as code analysis, intelligent recommendation, and learning path planning	Microservice architecture, AI inference engine, container orchestration (such as K8s)
Data layer	Store and manage teaching behavior data, knowledge graphs, and multisource learning data	Data lake, graph database, big data platforms (such as Hadoop, Spark)
Infrastructure layer	Provide underlying computing power and resource scheduling capabilities to ensure the efficient operation of AI algorithms	Cloud computing platform, edge computing nodes, GPU servers

Finally, at the crucial stage of platform deployment and implementation, universities also need to focus on the interfaces between the newly built intelligent teaching platform and various campus information infrastructure, such as the existing academic affairs management system, laboratory resource management platform, and student information system, to data interconnection and seamless connection of business processes; thus, is a new type of teaching support and service system that covers the whole process, integrates, and is intelligent in intelligent preparation before class, intelligent interaction and guidance during class, and precise evaluation and feedback after class.

4.2 Constructing a Professional Teaching Model of "AI + Hierarchical Teaching"

To promote the deep integration of artificial intelligence technology into professional computer teaching, colleges and universities can establish a professional teaching model of "AI + hierarchical teaching" (as shown in Table 2). First, teachers can use AI technologies such as knowledge graph analysis and learning behavior tracking to

comprehensively evaluate and deeply mine the data performance of students in multiple key dimensions, such as programming language foundation, logical thinking ability, and project practice experience. On this basis, by relying on intelligent algorithms such as clustering analysis and machine learning, students are scientifically and dynamically divided into three different levels, namely, the basic level, the advanced level, and the innovative level, providing a solid basic framework and scientific basis for the subsequent implementation of precise and differentiated professional computer teaching. Second, an intelligent hierarchical teaching resource and activity matching engine is constructed and deployed. With respect to students at the basic level, the teaching focus should be on firmly mastering the core grammar of computer programming, understanding and applying basic algorithms, and guiding and heuristic learning through case guidance and simulation interaction; for students at the advanced level, they should focus on guiding them to participate in computer software and hardware practice project training with a certain degree of complexity and comprehensiveness and cultivating their core abilities to analyze problems, design solutions, and practice hands-on, while for students at the innovative level, they should be encouraged to actively carry out interdisciplinary knowledge integration and application exploration and guide them to creatively apply the computer professional knowledge they have learned to solve complex engineering problems and social challenges in the real world to comprehensively improve their professional core literacy of comprehensively applying knowledge for innovative practice.

Table 2: Framework Table of the Professional Teaching Model of "AI + Hierarchical Teaching"

Level	Basis for student division	Teaching focus
Basic level	Weak programming foundation, elementary logical ability, less project experience	Programming grammar training, case simulation interactive learning
Advanced level	Medium programming ability, clear logic, with some project experience	Practice project training, problem-oriented learning
Innovation level	Strong programming and logical ability, rich project experience	Interdisciplinary integration, comprehensive project practice and innovative application

4.3 Innovating the Personalized Learning Support System

To significantly improve the efficiency of students in the process of learning computer professional knowledge and effectively stimulate their internal learning motivation and subjective initiative, colleges and universities should actively rely on the powerful algorithm capabilities and data analysis advantages of artificial intelligence to develop and continuously innovate a highly personalized new learning support and service system. First, advanced algorithms such as machine learning and data mining are used to construct a "holistic" dynamic learning profile and learner portrait system. This system can continuously and nonintrusively collect and deeply analyze multidimensional data from students during the learning process, such as detailed data on programming exercises, the frequency and quality of code submissions, algorithm design and optimization trajectories, online learning behavior patterns, etc. Based on these data, the system can accurately construct a three-dimensional learner portrait covering students' knowledge mastery, logical thinking characteristics, cognitive style preferences, and potential learning difficulties, providing a solid foundation for subsequent personalized interventions. Second, according to the unique computer professional learning needs and personalized learner portraits of each student, develop and deploy an intelligent learning guidance and resource recommendation engine. This engine can automatically generate a dynamic and personalized knowledge graph or learning path plan based on the learner portrait and intelligently match and push high-quality microcourse videos, interactive online exercises, targeted tutoring materials and other accurate learning resources for weak links or potential difficulties in their knowledge structure; at the same time, it can also intelligently recommend relevant open-source project participation opportunities, cutting-edge academic literature, industry technology trends and other in-depth learning content [5] for the advantageous areas they have mastered or the expansion directions in which they are interested.

5. CONCLUSION

With the rapid development and wide integration of artificial intelligence technology, society is accelerating into a comprehensive artificial intelligence era, and intelligent education has become the only way and core strategy for higher education institutions to promote educational modernization and improve the quality of talent cultivation. Deeply integrating artificial intelligence technology and systematically empowering computer professional teaching is not only the inherent logical extension of the concept of intelligent education that takes root in the field of higher education but also the key engine and core driving force for driving the innovative development of computer professional teaching toward intelligence, personalization, precision and omnipresence. The goal of these reforms is to cultivate and transport a large number of compound and high-quality computer professionals

with solid theoretical foundations, excellent practical abilities and continuous innovative spirits who can actively adapt to and lead the development needs of the artificial intelligence era for the country, providing solid talent support and intellectual guarantees for China to gain the initiative in global science and technology competition.

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