

Research on the Application and Development of Micro-Courses for Computer Majors Under the Background of New-Quality Productivity

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Abstract: New-quality productivity is featured by digitization, intelligence and green-orientation. New technologies such as artificial intelligence, large-scale models and digital twins have spawned a large number of new-type computer-related posts, forcing the digital transformation of computer-major courses in colleges and universities. As lightweight and iterable digital teaching resources, micro-courses are of great value in addressing pain points in traditional computer teaching, including insufficient guidance in large-class teaching, lagging textbook updates, and difficulties in practical-training review. They also adapt to the hierarchical talent-cultivation demands for foundation-level improvement and innovation in new-quality industries and support the integrated talent cultivation of posts, courses, competitions and certificates. This paper constructs a six-step standardized micro-course development procedure: “demand investigation — top-level planning — hierarchical content development — digital-intelligent technology empowerment — school-enterprise joint review — dynamic iterative updating”. It disassembles micro-skill units relying on knowledge graphs, develops micro-course resources covering traditional skills and cutting-edge new-quality technologies in accordance with the basic layer, improvement layer and innovation layer. It realizes in-depth digital-intelligent empowerment with AIGC-assisted production, digital-twin virtual practical training and intelligent learning platforms. Supporting mechanisms of school-enterprise dual-subject review and quarterly iteration guarantee resource quality and industrial adaptability.

Keywords: New-quality productivity; Computer major; Micro-courses; Digital teaching

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1. Introduction

Dominated by scientific and technological innovation, new-quality productivity takes digitization, intelligence and green-orientation as its core features. Digital technologies including artificial intelligence, cloud computing, big data, Internet of Things and large-model development have become core driving forces for industrial upgrading. New business forms such as the digital economy, intelligent manufacturing and smart

services keep expanding, giving rise to numerous new-type computer-technology posts, such as large-model tuning engineers, intelligent-system operation and maintenance specialists, digital-twin developers and AIGC application developers. The rapid iteration of industrial posts compels colleges and vocational colleges to accelerate the digital transformation of computer-major curricula. The traditional 45-minute standardized classroom, static paper textbooks and unified practical-training modes can hardly match the fragmented, real-time and scenario-based skill-learning demands of posts.

2. Application-and-development value of micro-courses for computer majors under the background of new-quality productivity

2.1. Address core pain points of traditional computer teaching

Computer courses feature both abstract theories and high-intensity practical operations. Traditional teaching has multiple drawbacks. First of all, teachers in large-class lectures cannot take care of students with varied foundations, and one-on-one guidance for code debugging and hardware-fault troubleshooting is insufficient. Secondly, textbooks are updated every 2-3 years, lagging behind the development of new-quality technologies such as large-model and intelligent Internet-of-Things technologies. Thirdly, practical-training class hours are limited, and students have no playback-and-review channels after making operational mistakes in class. Fourthly, there is a lack of systematic teaching resources for extended content on competitions and vocational certificates. Micro-courses targetedly solve the above-mentioned problems. Students can replay practical-operation steps repeatedly to make up for weak skill points independently, and micro-courses on cutting-edge technologies supplement classroom-teaching contents in real time ^[1-3].

2.2. Adapt to hierarchical talent-cultivation demands of new-quality industries

Posts in new-quality digital industries show obvious hierarchical differentiation, and skill requirements for junior operation-and-maintenance personnel, intermediate developers and senior algorithm engineers vary greatly. Micro-courses can be designed into three categories of resources at the basic layer, improvement layer and innovation layer. The basic layer covers general skills such as Python fundamentals and database operations. The improvement layer focuses on core post-related skills including Web development and Internet-of-Things deployment. The innovation layer centers on cutting-edge new-quality technologies such as large-model fine-tuning and digital-twin-system development. Students can independently select learning paths according to their own career planning to realize precise hierarchical and classified talent cultivation.

2.3. Support the implementation of integrated teaching of posts, courses, competitions and certificates

Talent cultivation oriented toward new-quality productivity emphasizes the interconnection of post competencies, course contents, skill competitions and vocational certificates. Micro-courses can develop supporting resources centering on computer-skill competition questions, examination points for vocational certificates such as software engineers and AI trainers, and real-world enterprise post tasks. They embed practical-operation procedures of competitions, assessment standards of certificates and post-work workflows into micro-course videos and supporting tasks, and get through the complete educational chain of “classroom learning — practical-training practice — competition improvement — employment with certificates” ^[4-5].

3. Existing problems in the development and application of micro-courses for computer majors

3.1. Lack of top-level design for resource development and severe fragmentation

In most colleges and universities, micro-courses are produced dispersedly by individual teachers without unified planning based on computer-major knowledge graphs and industrial post-competency graphs. There is a lack of logical connection among micro-courses; they are merely slices of single knowledge points without linking to comprehensive-project micro-courses. When students watch scattered videos separately, they can hardly construct a complete technical system, resulting in a learning discontinuity of “mastering independent code syntax yet incapable of developing complete projects”, which fails to meet new-quality industries’ requirements for comprehensive-project-development capabilities. Meanwhile, there are no unified development standards. Video picture quality, supporting materials and task-design quality vary widely. Some micro-courses are simply recordings of classroom clips without targeted practical-operation design.

3.2. Disconnection between contents and new-quality industrial new technologies and insufficient industry-education collaboration

Lagging contents of micro-courses constitute a core shortcoming. A large number of resources still focus on traditional software and basic network technologies, while micro-courses for new-quality technologies such as AIGC applications, multimodal large-models, industrial digital twins and HarmonyOS distributed development account for an extremely low proportion. Development is mainly undertaken by on-campus teachers with low participation of enterprise technical personnel. Most cases are fictional simple examples, lacking real-world enterprise big-data projects and intelligent-operation-and-maintenance scenarios. There exist obvious barriers between what students learn and actual enterprise-post work, making it difficult to meet demands of digital-industry posts. There is a lack of a school-enterprise collaborative-development mechanism and regular resource-iteration channels, so new industrial technologies cannot be rapidly transformed into teaching micro-courses.

3.3. Shallow integration of new technologies such as AI and virtual simulation and inadequate intelligent empowerment

At present, most micro-courses are confined to video display, and the application of AI technologies remains superficial: AI is only used to generate simple courseware, while real-time Q&A by AI digital humans, intelligent code error correction and personalized micro-course push are not realized. There are very few micro-courses adopting digital twins and virtual simulation. Practical operations for hardware and servers still rely on physical computer labs, and the supply of online immersive practical-training resources is insufficient. Learning platforms merely support video playback, without functions for learning-data collection and learning-situation analysis. It is impossible to push targeted remedial micro-courses accurately according to students’ code errors and viewing duration, which hinders the implementation of personalized adaptive learning^[6-8].

3.4. Single teaching-application scenarios and failure to integrate into the whole educational process

Micro-courses are generally only used as supplementary resources for pre-class preview or after-class review, without reconstructing the blended-teaching mode of “pre-class autonomous learning via micro-courses — in-class project-practice seminars — after-class expansion and improvement via micro-courses”. Teachers’

lectures still dominate classroom teaching. Micro-courses are separated from offline practical training, project development, competition training and certificate tutoring, failing to form a closed-loop application system. Meanwhile, there is a lack of channels for exporting micro-courses to on-the-job enterprise employees. The social value of high-quality digital resources from colleges in serving regional new-quality industries is not fully released.

3.5. Absence of diversified evaluation system and insufficient incentives for development and application

Existing evaluations are only based on micro-course viewing volume and final written-examination scores, ignoring core competencies of new-quality talents such as students' code works, project-innovation capabilities and autonomous-learning processes. Colleges lack standardized micro-course review mechanisms and multi-dimensional evaluation criteria covering industrial adaptability of contents, practical operability and technical advancement. Incentive policies, including class-hour conversion and merit-evaluation for teachers' micro-course development and school-enterprise co-construction of resources, are imperfect. Teachers lack initiative to develop high-quality dynamic micro-courses, and resources lack driving force for continuous iteration^[9-10].

4. Construction of a systematic development system for computer-major micro-courses oriented toward new-quality productivity

Based on talent demands of new-quality industries, this paper constructs the six-step standardized micro-course-development procedure: “demand investigation — top-level planning — hierarchical content development — digital-intelligent technology empowerment — school-enterprise joint review — dynamic iterative updating”.

4.1. Step one: Precise investigation of industrial demands to anchor core development directions

Set up an investigation team consisting of professional leaders, backbone teachers, technical directors from leading digital enterprises and experts from industrial associations to carry out two-way investigation. First, sort out post demands in the local digital economy, intelligent-manufacturing, and artificial-intelligence industries, and extract core new-quality skill points such as large-model development, intelligent operation-and-maintenance, and digital twins. Second, analyze assessment criteria for vocational certificates such as AI trainers and software designers as well as competition requirements for national computer-skill contests, and formulate *Skill-Demand Atlas for Computer-Major Micro-Courses*. Clarify the total quantity and content directions of micro-courses at the basic, improvement and innovation layers to avoid aimless scattered development.

4.2. Step two: Top-level planning based on knowledge graphs to solve fragmentation problems

Leverage AI knowledge-graph tools to sort out logical contexts of core computer-major courses, and decompose all professional skills into standardized “micro-skill units”. Each unit corresponds to one complete micro-course resource package (micro-course video + code materials + virtual-simulation practical training + in-class test + project tasks). Build the overall framework of the micro-course resource

library following “basic module — post-oriented module — cutting-edge-innovation module”, and set linking comprehensive-project micro-courses to get through logical connections among scattered knowledge points. For example, for the *Big-Data-Technology-Application-Development* resource library, the comprehensive-project micro-course of “development of massive-user-behavior-data analysis and visualization system” links independent-skill micro-courses including data collection, data preprocessing, distributed computing, data modeling and visualization large-screen development. After learning single-point big-data professional skills, students realize integration of fragmented knowledge and implementation of full-process projects through comprehensive-project micro-courses. Meanwhile, formulate unified big-data-project-development specifications, and strictly stipulate standards for micro-course video duration, proportion of practical-operation-code and project-demonstration pictures, formats of courseware materials and datasets, industrial authenticity of practical-training cases and project implementability. Consolidate the quality bottom line of digital-teaching resources and guarantee students’ solid mastery of single-point skills and qualified comprehensive-application capabilities.

4.3. Step three: Hierarchical and classified development of micro-course contents adapted to new-quality productivity

Develop content in three gradients to fully cover traditional basic skills and cutting-edge new-quality technologies.

- (1) Basic-layer micro-courses (compulsory for all students): Oriented toward freshmen and sophomores, they cover general fundamentals including Python programming, database principles, computer networks and operating systems. They focus on demonstrations of basic code practice and software tool usage and resolve comprehension difficulties in basic knowledge points in class.
- (2) Improvement-layer micro-courses (post-targeted): Targeting mainstream posts of software development, big-data operation-and-maintenance and Internet-of-Things development. Enterprise engineers take the lead in case design, and real-world enterprise project fragments are adopted as practical-training cases, such as e-commerce big-data cleaning and smart-park Internet-of-Things deployment, so as to fit post-work workflows.
- (3) Innovation-layer micro-courses (special topics for new-quality technologies): Focus on cutting-edge technologies including AIGC, multimodal large-models, digital twins, HarmonyOS ecological development and industrial intelligent systems. Keep up with industrial-technology updates in real time and iterate and add micro-course content every quarter for students participating in competitions, upgrading from junior-college to undergraduate education and pursuing high-end employment.

Meanwhile, develop supporting ideological-and-political integrated micro-courses. Embed content such as digital security, self-reliance and self-improvement in science and technology, and AI ethics into technical micro-courses, so as to cultivate new-quality digital talents with both technical competence and correct values.

4.4. Step four: In-depth empowerment of micro-course production and resource carriers by digital-intelligent technologies

- (1) AIGC-assisted rapid micro-course production: Adopt AI digital humans to generate theoretical-explanation clips; apply AI animation tools to visualize abstract hardware principles and algorithm logic; use code-screen-recording tools to record the whole practical-operation process with one click, greatly shortening development cycles. For complex algorithms, generate dynamic deduction

animations to lower comprehension barriers for abstract content.

- (2) Development of digital-twin virtual-practical-training micro-courses: For high-cost practical-training equipment such as servers and embedded hardware, develop virtual-real integrated micro-courses. After videos explain hardware architectures, supporting online virtual-simulation-operation packages are provided. Students can finish hardware debugging and system-deployment practice without physical equipment.
- (3) Build an intelligent micro-course-learning platform: Integrate AI teaching assistants, online code-running modules, and learning-situation-analysis modules. Automatically collect data including students' micro-course viewing progress, code-error types and test scores, generate personal-competency portraits, and intelligently push remedial micro-courses for weak skills to realize personalized adaptive learning.

4.5. Step five: School-enterprise joint review to guarantee industrial-adaptation quality

Establish a dual-subject review mechanism of “on-campus professional teachers + enterprise technical experts”. After the first draft of a micro-course is completed, enterprise experts mainly review the industrial authenticity of cases, technical advancement, and post-adaptability. On-campus teachers review teaching design, knowledge logic and teaching adaptability. A micro-course can be put into the resource library only after passing both reviews. Micro-courses with outdated content or cases divorced from industrial reality shall be directly rejected for revision, so as to avoid disconnection between resources and new-quality industries from the source.

4.6. Step six: Establish a quarterly dynamic-iteration-and-update mechanism

Rely on the school-enterprise industry-education-integration community; enterprises provide lists of the latest technical projects and updated post-related skills every quarter. Professional teams iterate and add micro-courses according to such lists. Carry out comprehensive upgrading of resource libraries jointly with digital enterprises every year, phase out outdated-technology contents, and supplement micro-courses for new-quality technologies such as large-models and intelligent computing power. Guarantee that resource libraries always keep pace with changes in industrial technologies.

5. Conclusions and prospects

5.1. Research conclusions

Driven by new-quality productivity, the digital industry has undergone comprehensive transformation, setting higher standards for computer-major talents in terms of practical capabilities for cutting-edge technologies, comprehensive-project innovation and lifelong autonomous-learning abilities. As lightweight, iterative, and intelligent digital-teaching resources, micro-courses constitute key carriers for promoting computer-major teaching reform and cultivating digital talents adapted to new-quality productivity. At present, the development and application of computer-major micro-courses suffer from multiple problems, including lack of top-level planning, disconnection from industrial content, insufficient integration of intelligent technologies, single application scenarios, and imperfect guarantee mechanisms.

This paper constructs a complete system of “six-step standardized-development procedure + five full-scenario application paths + four-dimensional collaborative-guarantee mechanisms”. Through pre-investigation of industrial demands, unified planning by knowledge graphs, hierarchical school-enterprise

joint development, and in-depth empowerment of AIGC and virtual-simulation technologies, it addresses pain points including fragmentation, content lagging and uneven quality of micro-courses. Relying on the closed-loop application covering pre-class, in-class, after-class, post-course-competition-certificate and social-service scenarios, it gives full play to micro-courses' advantages in hierarchical teaching, autonomous practical training and industrial connection. Four guarantee measures of school-enterprise collaboration, teacher training, diversified evaluation and fund incentives support long-term dynamic iteration of micro-course resources, providing implementable practical schemes for the digital-educational reform of computer majors.

5.2. Future prospects

With continuous iteration of large-models, digital-human and digital-twin technologies, micro-courses for computer majors will develop toward high intelligence, immersion and interactivity. In the future, we can further explore fully-AI automatic micro-course-generation systems, which automatically disassemble skill points and generate practical-operation videos and virtual-practical-training packages according to enterprise post demands. Build regional inter-collegiate computer-micro-course-sharing alliances to realize inter-collegiate circulation of high-quality new-quality-technology resources. Deepen the integration between micro-courses and meta-universe virtual-practical-training scenarios, construct immersive online practical-teaching systems, continuously optimize the cultivation mode for new-quality digital talents, and better serve the high-quality development of the digital economy and the strategy of fostering new-quality productivity.

Disclosure statement

The authors declare no conflict of interest.

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