

Educational Model Reform of Python Programming Course for Intelligent Technology: Practical Research Based on the Modern Information Industry College

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ABSTRACT

Against the deep integration of new engineering and artificial intelligence, traditional Python courses have difficulty meeting the needs of cultivating interdisciplinary talents in terms of content timeliness, practical coupling degree, and evaluation diversity. This paper, based on the project funded by the National Association of Computer Basic Education in Higher Education Institutions, constructs and implements a reform framework of the 'Three Dimensions, Three Layers, Three Cycles' educational model: ① Content dimension — integrating syntax foundation, data processing, machine learning, deep learning, and ethical security into 'Basic-Technology-Application' three-stage modules; ② Method dimension — hybrid teaching of 'micro-projects + major challenges' online and offline; ③ Evaluation dimension — dynamic evaluation with a five-dimensional radar chart of knowledge, skills, projects, innovation, and ethics. The study further discusses the tension between the speed of technological iteration and course stability, the convenience of tools and thinking training, and standardized evaluation and personalized development, and proposes balancing strategies.

KEYWORDS

Intelligent technology; Python; Education mode

1 Introduction

In the era of deep integration of the digital economy and artificial intelligence technology, Python language has become the core basic course for cultivating talents in computer and related majors in universities, thanks to its unique advantages in data analysis, machine learning, deep learning, and other fields. The 2024 edition of the 'Guidelines for New Engineering Construction' issued by the Ministry of Education clearly points out that universities should cultivate new engineering talents with strong cross-disciplinary innovation capabilities and profound professional foundations in the intelligent era. Python has become the preferred language for intelligent technology education due to its concise syntax and rich ecosystem. However, existing courses have a "triple disconnect": content lags behind technological iteration, lecture style teaching is detached from complex engineering scenarios, and a single exam mode evaluation suppresses innovation. These contradictions directly lead to students' insufficient ability to transform theoretical knowledge into engineering practice when facing complex intelligent technology projects.

The theoretical significance of this study lies in enriching the theoretical system of program design curriculum reform in the intelligent era by constructing a three-dimensional integrated model of "technology curriculum teaching". The practical value is reflected in: on the one hand, developing a curriculum content system that includes modules such as machine learning and deep learning to solve the problem of traditional courses lagging behind technological development; On the other hand, the teaching model that combines innovative project driven and blended learning enhances students' ability to solve practical intelligent technology problems. As demonstrated by DeepSeek's ethical practices in the development of intelligent healthcare systems, modern technology talent cultivation must balance technical skills and social responsibility, which provides important ideas for integrating ideological and political elements into the curriculum in this study.

The "Three Dimensional, Three Layered, and Three Closed Loop" education model proposed in this article is a systematic curriculum reconstruction framework aimed at the background of intelligent technology. The specific meaning is as follows:

2 "Three Dimensions": The Three Core Dimensions of Educational Models

(1) In terms of content dimension, the vertical layering of the course knowledge system divides Python teaching content into four progressive modules: "basic syntax - data processing - intelligent technology (machine learning, deep learning) - ethical safety", forming a dual track structure of "foundation+frontier". The basic syntax module covers Python

core syntax, basic data structures, process control, functions, and modular programming, with a focus on cultivating students' rigorous code thinking and ability to solve basic computational problems; The data processing module provides in-depth explanations of core libraries such as NumPy (efficient numerical computation), Pandas (data analysis and cleaning), Matplotlib/Seaborn (data visualization), etc. The goal is to enable students to proficiently acquire, organize, explore and present data, and prepare high-quality "fuel" for intelligent technology applications; Intelligent Technology Module: The machine learning section is centered around Scikit learn and covers the principles, implementation, and evaluation of classic supervised/unsupervised learning algorithms such as linear regression, decision trees, and clustering. The deep learning section introduces TensorFlow or PyTorch frameworks to explain the basics of neural networks, convolutional neural networks (CNN), recurrent neural networks (RNN), etc., enabling students to understand and construct intelligent models; Ethical safety runs through and enhances all technological content, focusing on the boundaries and responsibilities of intelligent technology. The content covers data privacy and security, algorithmic bias and fairness, model interpretability, and the social impact of AI. By treating ethical safety as an independent and continuous module, we ensure that technological capabilities and sense of responsibility develop synchronously.

(2) In terms of method dimension, teaching organization and implementation methods, a blended learning approach of "online+offline project driven+enterprise mentor participation" is adopted, emphasizing both real project cases and ethical thinking.

(3) Evaluation Dimension: Multi dimensional evaluation of learning outcomes. The evaluation dimension is the ruler of the curriculum, committed to comprehensively and dynamically measuring student growth. Build a five dimensional radar chart of "knowledge mastery, programming ability, project completion, innovative application, and ethical awareness" to achieve full process, multi-party, and visual evaluation. Whole process, multi-party evaluation: Evaluation runs through the entire process before, during, and after class, integrating teacher evaluation, peer evaluation, corporate mentor evaluation, and self reflection. Visual radar charts not only present the final results, but also track the evolution trajectory of students' abilities over a period of time, achieving the goal of promoting learning through evaluation.

3 "Three Levels": The Three Ability Levels of Course Content

(1) Basic cognitive layer: Building the foundation of knowledge and skills. Require students to master Python syntax and core libraries (NumPy, Pandas), including basic knowledge of Python, data structures, visualization, etc., and be able to use visualization libraries to clearly present data insights. The output of this level is the ability to independently complete data cleaning, transformation, and basic analysis tasks.

(2) Technical Application Layer: Implement intelligent model development and application. Students are required to independently complete machine learning/deep learning projects, with main modules including Scikit-learn, TensorFlow, and PyTorch related knowledge. Students should understand the applicable scenarios of different algorithms and be able to select and implement appropriate intelligent models for specific problems, solving typical tasks such as house price prediction, customer classification, and simple image recognition.

(3) Innovative practice layer: comprehensively solve complex real-world problems. This section emphasizes comprehensiveness, innovation, and a sense of responsibility. Require students to be able to comprehensively apply intelligent technology to solve complex problems, achieve comprehensive projects (such as image recognition, intelligent customer service), and conduct ethical reviews: be able to conduct systematic ethical risk assessments of their project proposals and design mitigation measures. Model deployment and operation awareness: Understand the basic process of model productization, such as API encapsulation, performance monitoring, etc. Technical solution demonstration: Able to demonstrate the rationality of technical solutions from multiple dimensions such as technical feasibility, economic benefits, and social impact.

4 "Three Closed Loop": Mechanism for Continuous Improvement of Teaching Quality

(1) Internal loop: project design → practical feedback → content optimization, achieving dynamic updates and adaptation of teaching content.

(2) External loop: Data collection → Effect evaluation → Mode iteration, adjust teaching strategies based on learning behavior data (such as debugging frequency, project completion rate).

(3) Ethical Loop: Case Introduction → Ethical Discussion → Internalization of Behavior, guiding students to form a sense of technical responsibility through real ethical cases (such as the DeepSeek medical data privacy incident).

The "Three Dimensional, Three Layered, and Three Closed Loop" education model is based on the core three-dimensional pillars of content stratification, method integration, and diversified evaluation. It gradually cultivates students through the three-level ability ladder of basic cognition, technology application, and innovative practice, and

relies on the overall framework of the internal closed loop (content optimization), external closed loop (mode iteration), and ethical closed loop (behavior internalization) feedback loop to drive the self-improvement and evolution of the system. The following three methods will be adopted.

Method 1: Build a "three-dimensional, three-layer, and three closed loop" education model. To solve the problems of fixed teaching models, difficulty in personalization, and slow technological iteration, deeply embed AI tools into the entire teaching process:

At the basic cognition level, use a smart teaching platform and AI study companions to conduct pre-class diagnostics for students and push forward pre-reading resources such as micro-video courses and documents matched to their needs. Teachers, with the help of AI systems, generate stratified challenge tasks to achieve personalized learning starting points for each student.

At the technology application level, the core is to introduce an intelligent programming assistant. During code writing and debugging, students can receive real-time syntax corrections, logical suggestions, and algorithm optimization tips, freeing teachers from repetitive basic Q&A so they can focus more on inspiring higher-order thinking in students. Meanwhile, through project tasks on practice platforms like Educoder, students are guided to learn by doing, deepening their understanding of core knowledge.

At the innovation practice level, use technologies such as verbal digital humans to create immersive works display scenarios, stimulating students' creativity. And through the Chaoxing AI homework review system, conduct multi-dimensional automatic evaluation and feedback on students' code quality, report logic, work creativity, etc., providing personalized improvement suggestions, forming a 'learning-output-feedback-optimization' closed loop.

Method 2: Implement a project driven mechanism, bridge the gap between learning and application, and solve the problem of disconnection between theory and practice, industry and application.

Project based reconstruction of teaching content: Breaking down course knowledge points and integrating them into a series of projects from shallow to deep. For example, understanding the basic algorithm of "buying a hundred chickens for a hundred dollars" to generate word clouds for different versions of "Romance of the Three Kingdoms" and "I Have a Dream", integrating comprehensive skills such as text preprocessing, data visualization, stop word filtering, and cross-cultural analysis. Propose a content strategy of "80% core+20% dynamic", with the core remaining unchanged for 2 years and the dynamic module being fine tuned every semester.

Method 3: Change the single assessment method and cultivate practical talents.

Competitive Enhancement of Comprehensive Literacy: Integrating the standards and requirements of events such as the Blue Bridge Cup and the Code Hoop Cup into daily teaching. The course project serves as a training ground for competitions, which not only greatly enhances students' sense of participation and achievement, but also exercises their innovative thinking, psychological qualities, and ability to solve complex problems in practical situations, achieving mutual promotion and common improvement between "learning" and "competition".

Teaching inspires scientific research: Encourage and attract outstanding students to join the teacher's research team, participate in project research under the guidance of the teacher, inject fresh vitality into the teacher's scientific research work, and form a good situation of mutual growth between teaching and learning.

Through the "three-dimensional three-layer three closed loop" teaching mode, the problem of disconnection between learning and application is solved through project mechanism, and the problem of single exam is solved through competitions and participation in scientific research activities. The three are interrelated and work together to solve the core teaching problem. Its application effect can be fully reflected from the five dimensions of "production, learning, research, training, and competition", and has already generated positive radiation and demonstration effects.

Deepening industry-education integration, significantly enhancing the ability to serve industries.

This practical research closely connects with the development needs of the digital economy in the Guangdong Hong Kong Macao Greater Bay Area, and successfully extends teaching practice to industrial services. The students trained through this model have gained recognition from enterprises for their solid programming and data analysis skills, which have directly contributed to the completion of two horizontal cooperation projects between schools and enterprises, with a cumulative budget of 1.02 million yuan. During the process of participating in real projects, students adapted to the workflow and technical standards of the enterprise in advance, achieving a smooth transition from "campus people" to "quasi professionals".

Students' learning outcomes and autonomy experience leapfrog growth.

The reform of teaching mode directly stimulates students' learning efficiency. It is not recommended to use AI assistance during the algorithm conception stage. AI assistance is used for coding implementation in class. After implementation, students' independent problem-solving rate and interpretation speed have increased. With the help of intelligent programming assistants and personalized learning paths, students' code writing and debugging efficiency has been improved by an average of about 40%. Course data shows that over 90% of students are able to independently solve early problems such as configuring development environments and debugging basic code, greatly enhancing their

self-learning ability.

Teaching and research collaboration mutually benefit each other, yielding fruitful teaching outcomes.

The achievements have effectively broken down the barriers between scientific research and teaching, forming a virtuous cycle. Based on the teaching practice of this model, we have successfully applied for 18 teaching and research projects at all levels, covering key projects such as the "14th Five Year Plan" for the development of philosophy and social sciences in Guangzhou and the Guangdong Provincial Education Science Planning Project. The team members have published a total of 15 related teaching research papers, which have been promptly transformed into teaching cases and experimental projects, continuously enriching the curriculum content and enhancing the depth and cutting-edge nature of teaching content.

Combining training and teaching, a high-level dual-competent teaching staff team is being developed.

The implementation of the results has effectively promoted the professional development of the teaching staff and the improvement of teaching innovation ability. Empowered by AI technology, the teaching team has proficiently mastered intelligent teaching tools and methods, and has recorded over a hundred minutes of new teaching resources such as spoken digital teaching videos, significantly enhancing the attractiveness of the course. The team members actively participate in teaching reform and have established a provincial-level demonstration team for ideological and political education in courses. Six of the main achievements have been promoted to senior professional titles, forming a high-level teaching team with a reasonable structure and innovative spirit. The combination of real projects and ethical review enhances professional responsibility; Teachers generally reflect that although the workload of lesson preparation has increased, the sense of teaching achievement has significantly improved.

Outstanding competition results, extensive demonstration and radiation effect.

The "learning competition" mechanism has achieved remarkable results, and teachers and students have repeatedly achieved excellent results in various competitions at all levels. The teaching team won the Excellent Award in the 5th National College Blended Teaching Design Innovation Competition and 2 first prizes in the school level teaching innovation competition; The teaching case "AI Empowered Personalized Teaching of Python Word Cloud" won the third prize in the CCEC2025 Second National Computer Teaching Case Competition. The students have won a total of 21 subject competition awards, especially in the authoritative competition "Blue Bridge Cup" National Software and Information Technology Professional Talent Competition. The Python group won the provincial first prize in the 15th and 16th editions, fully verifying the excellent effect of "promoting learning and teaching through competitions".

Through systematic reform and practice, the reform of the Python programming course education model for intelligent technology has achieved practical results in comprehensively improving the quality of talent cultivation on campus. Its core concept and implementation path have radiated outward through various channels such as provincial and national academic reform projects, academic conferences, and intercollegiate exchanges, providing valuable experience and paradigm references that have been tested and replicable for the teaching reform of computer basic courses in similar universities.

Funding

This research was funded by the Association of Fundamental Computing Education in Chinese Universities : Research on the Educational Model Reform of Python Program Design Courses Oriented Towards Intelligent Technology(NO: 2025-AFCEC-358)

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