# Research on the Teaching Reform Practice of College Fundamentals of Computer Science Courses

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## Abstract

**With the rapid development of information technology, the Fundamentals of Computer Science course in universities, as a core subject for cultivating students' information literacy, faces challenges regarding the adaptability of its teaching model. In response to current issues such as unclear course positioning, outdated content, and monotonous teaching approaches, this paper draws on reform practices at a particular university and proposes a reform pathway centered on "tiered objectives, dynamic content, diversified methods, platform support, and comprehensive evaluation." This approach effectively enhances students' practical abilities and information literacy. However, continuous optimization is still required in areas such as faculty development and dynamic resource updates. The study provides valuable reference experiences for similar reforms in computer fundamentals courses at other universities.**

## Keywords

**Teaching reform; information literacy; blended learning; tiered objectives; practical competence.**

## 1. Introduction

### 1.1. Research Background

Against the backdrop of digital transformation, information technology has deeply penetrated all areas of society, and information literacy has become a core competency for college students to meet future professional demands. China Education Modernization 2035 explicitly calls for "strengthening the construction of digital education resources and promoting the deep integration of information technology with teaching and learning." As a core component of general education, the Fundamentals of Computer Science course is tasked with cultivating computational thinking, digital tool application, and information ethics. Yet, with the rapid iteration of emerging technologies such as artificial intelligence, big data, and cloud computing, traditional teaching models increasingly appear misaligned with contemporary needs, thus necessitating reform to improve the course's effectiveness.

Private university students often demonstrate lively thinking yet lack initiative and motivation, which hinders the effectiveness of traditional computer courses in stimulating learning interest[1]. To enhance teaching effectiveness, educators should adopt competence-oriented content and methods that increase classroom engagement and guide students toward sustained after-class learning, thereby ensuring tangible improvements in learning outcomes.

### 1.2. Problem Statement

With the deep integration of information technology into all aspects of social production and everyday life, information literacy has become a fundamental competency for university students. As the principal vehicle for cultivating this competency, the Fundamentals of Computer Science course faces profound challenges in adapting its instructional models to contemporary demands. At present, many institutions continue to struggle with vague course positioning, outdated curricular content, and overly uniform, teacher-centered pedagogies. The absence of interactive and practice-oriented elements often leads students to passively absorb knowledge, hindering their ability to translate theoretical understanding into practical problem-solving skills and thereby constraining the effective development of information literacy. These deficiencies not only undermine the overall quality of instruction but also weaken students' competitiveness in addressing the challenges of an increasingly digital society. Consequently, the exploration of reform pathways for the Fundamentals of Computer Science course that align with evolving technological and societal needs has become an urgent and essential priority in higher education talent cultivation.

### 1.3. Research Objectives

Higher education institutions must persist in innovating teaching content, methods, and approaches based on student characteristics and course content. This will genuinely stimulate students' innovative thinking, enhance their practical skills, and ultimately elevate their overall competence [2]. Therefore, this study aims to address existing issues in university computer fundamentals courses through systematic teaching reform practices. It seeks to establish a new teaching model centered on students, guided by competency development, and supported by technology. Ultimately, this approach will achieve a comprehensive enhancement of students' information literacy and ensure precise alignment with professional demands.

## 2. Current Situation Analysis

### 2.1. Unclear Course Positioning and Objectives

In most universities, the Fundamentals of Computer Science course is simply designated as a "general compulsory subject," without adequate consideration of the differentiated needs of students across disciplines. Science and engineering majors typically require stronger programming capabilities, while students in the humanities and social sciences place greater emphasis on data analysis. Nevertheless, many institutional syllabi outline only broad objectives, such as requiring students to "master basic computer operations," without distinguishing, for instance, the advanced Excel applications necessary for business-related majors or the introductory Python training essential for computer science students. As a result, course objectives are insufficiently aligned with discipline-specific curricula, making it difficult to effectively address students' professional learning requirements.

### 2.2. Outdated Content

With the rapid advancement of computer and network technologies, information transmission efficiency continues to improve, and the pace of computer hardware and software updates accelerates. However, the content of foundational computer courses in many universities has failed to keep pace with these developments. Instruction remains primarily focused on the Windows 7 operating system and Office 2010 software, with insufficient coverage of cutting-edge topics such as Python programming, big data visualization (e.g., Tableau), and artificial intelligence fundamentals (e.g., introductory machine learning). This inadequacy struggles to meet students' demand for "practical skills." Simultaneously, certain computer knowledge has become severely disconnected from the practical demands of societal development. It fails to meet the requirements of enterprises and employers, lagging behind the pace of progress in the information age [3]. This disconnect between knowledge and reality also causes students to gradually lose interest in outdated content, thereby diminishing their motivation and enthusiasm for learning.

### 2.3. Monotonous Teaching Methods

The traditional classroom teaching mode usually involves the teacher demonstrating the operation steps on the podium through a projector, while students follow along on their computers for hands-on practice. The entire process is teacher-centered, with students passively following, lacking autonomous thinking and interactive communication. Online resources only play an auxiliary role, such as providing MOOC videos for students to review after class, but the video content is mostly a repetition of what was taught in class, lacking targeted Q&A and personalized guidance[4]. This teaching method lacks sufficient interactivity. Teachers find it difficult to grasp students' learning difficulties in real time, and students cannot get timely answers when they encounter problems, resulting in a dull classroom atmosphere, making it difficult to fully mobilize students' learning enthusiasm, gradually losing interest in learning, and ultimately affecting learning outcomes.

### 2.4. Insufficient Teaching Resources and Platform Support

At present, many universities have significant shortcomings in the construction of teaching resources and platforms, which are difficult to meet the application-oriented and cutting-edge requirements of computer basic courses. On the one hand, teaching resources still highly rely on traditional textbooks, with slow content updates and a lack of real cases and practical materials combined with various majors, making it difficult for students to effectively apply computer skills in their own fields. On the other hand, the supporting capacity of practical teaching platforms is insufficient. Most of them rely on closed local computer rooms, with severe restrictions on opening hours and physical space, leaving students without readily available experimental environments and conditions for continuous self-training. The problems of single resource forms and inconvenient platform access not only restrict the flexibility of teaching but also affect the systematic cultivation of students' practical abilities, making it difficult to meet the ability requirements of compound talents in the information age.

### 2.5. Evaluation Focused on Results over Process

The assessment and evaluation system of the basic computer course has a significant drawback of being overly "result-oriented", often neglecting "ability and process". Its evaluation method mainly relies on a one-time final written test, simplifying the complex assessment of computer skills into a test of theoretical knowledge and isolated operation points. This single model greatly weakens the students' initiative and sustainability throughout the learning process, making it difficult to stimulate their enthusiasm for in-depth exploration and practical innovation. More importantly, this terminal evaluation cannot truly and comprehensively reflect students' comprehensive qualities in using computational thinking to solve practical problems, project practice ability, and teamwork spirit, causing a serious disconnection between teaching evaluation and the goal of cultivating "applied talents", and ultimately failing to effectively measure and promote the achievement of students' key abilities.

## 3. Reform Ideas and Practice

To address these issues, this study proposes a reform framework emphasizing “tiered objectives, dynamic content, diversified methods, integrated resources, and comprehensive evaluation.”

### 3.1. Reconstruction of Teaching Objectives: From “Knowledge Transmission” to “Competence Orientation”

Break the traditional unified goal model and build a three-level goal system of "basic layer - application layer - expansion layer". The basic level is open to all students, focusing on general abilities such as information acquisition and application of office software. It consolidates the foundation through tasks like creating personal resumes and tallying class grades. The application layer is grouped in accordance with professional requirements. For example, the economics and management category focuses on Power BI sales data visualization, while the engineering category focuses on Python student performance analysis, cultivating the ability to apply professional tools and solve problems. The extension layer is designed for students with high interests and abilities. It introduces cutting-edge technologies such as artificial intelligence and big data, and enhances their innovative practical abilities through small projects of artificial intelligence image recognition, achieving a transformation from knowledge imparting to ability cultivation. (see Table 1).

**Table 1.** Three-Level Target System for Basic Computer Courses

| Objective Tier | Core Competencies | Target Group | Typical Tasks |
|---|---|---|---|
| Basic level | focusing on information retrieval and office software use | for all students, | resumes in Word, grade statistics in Excel |
| Application level | modular content based on majors | Students grouped by major | Excel data analysis for business, Python programming for engineering |
| Advanced level | introducing frontier technologies | for highly capable students | AI image recognition with TensorFlow Lite |

## 3.2. Content Reform: From “Static Tools” to “Dynamic Technologies”

Establish a dynamic content system integrating “fundamental, professional, and frontier” components. The fundamental section retains general topics such as file management and network applications. The professional section collaborates with various schools to develop modular case studies, such as webpage design in e-commerce and concept art design in digital media. The frontier section introduces a “Technology Express” module, updating two to three emerging topics each semester. Furthermore, cooperation with local technology enterprises can incorporate projects such as “intelligent customer service system development” into the advanced tier, enabling students to learn how to build simple dialogue systems and thereby achieving a transition from static tools to dynamic technologies.

## 3.3. Methodological Innovation: From “One-Way Teaching” to “Blended Learning”

A blended teaching model of “online self-directed learning + offline in-depth seminars” was adopted. In the online component, the Superstar Learning platform was used to upload micro-lecture videos (10–15 minutes each), learning guides, and extended reading materials. Gamified learning tasks were designed (e.g., “complete Excel function exercises to earn points”), while the system automatically recorded learning data and provided personalized learning recommendations. Complementing this, offline sessions were conducted for case discussions, project-based practice, and problem-solving. For example, in the “Data Visualization” unit, the instructor first presented real corporate sales data, then assigned tasks for students to discuss and analyze objectives in groups. Students subsequently completed visualization projects using Power BI, followed by group presentations and teacher feedback.

### 3.4. Resource and Platform Development: From "Single Textbook" to "Three-Dimensional Resource Pool"

Develop a three-pronged resource system integrating textbooks, digital resources, and practical platforms. First, create loose-leaf textbooks with reserved "professional case insertion zones." allowing each college to supplement teaching resources based on program needs. This forms the foundation for establishing a school-based resource repository, specifically including: - Over 500 instructional videos integrating professional knowledge with computer technology - Over 200 real-world enterprise application cases - 30 virtual simulation experiments (e.g., Excel data processing simulating corporate financial systems) Finally, integrate experimental platforms (e.g., lab buildings, Tencent Cloud labs) to support 24/7 student access, addressing the issue of insufficient traditional computer lab hours.

### 3.5. Evaluation Reform: From "Result-Oriented" to "Process-and-Competence-Oriented"

A three-dimensional comprehensive evaluation system is adopted, comprising: - Regular coursework (30%) - Project-based practice (40%) - Final assessment (30%) The criteria for assessing regular performance include online learning progress (10%), classroom participation (10%), and group collaboration contribution (10%). Project practice requires students to complete 2-3 comprehensive projects related to their major (e.g., "Annual Sales Report Analysis" for business/economics majors, "Experimental Data Statistics and Visualization" for engineering majors). Grading is based on the rationality of the solution, standardization of operations, and innovation. For final assessments, the proportion of theoretical questions has been reduced (from 50% to 20%), while practical tasks (e.g., "conducting data visualization analysis and writing reports based on provided datasets") and open-ended questions (e.g., "designing a tool to address campus life challenges") have been increased to emphasize hands-on application and innovation.

## 4. Conclusion and Prospects

This study effectively addressed core challenges in university computer fundamentals courses through systematic pedagogical reforms, establishing a model characterized by "tiered objectives, dynamic content, diverse methodologies, platform support, and comprehensive evaluation." However, further optimization is required in the following areas. First, deepening industry-education integration by co-establishing "curriculum advisory committees" with enterprises to track technological demands in real time and dynamically update teaching materials. Second, enhance faculty development by establishing "interdisciplinary workshops" that regularly organize teachers to participate in industry practice and professional training. Third, refine the tiered mechanism. Through entrance assessments and student needs surveys, more accurately categorize learning levels to provide personalized learning paths.

Reforming university computer fundamentals courses is a long-term endeavor. It requires continuous attention to technological advancements and evolving student needs to enhance the timeliness and effectiveness of the curriculum. Deepening the reform of computer fundamentals education will lay a solid foundation for cultivating high-caliber, versatile talents capable of thriving in the digital economy era.

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