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Ideological and Political Teaching Case Design of Computer Organization Course Based on BOPPPS Model—A Case Study of "Read-Only Memory" Teaching

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Abstract: *Teaching cases integrated with ideological and political elements serve as crucial carriers for realizing knowledge transmission, ability training, and value shaping. In response to the new requirements of ideological and political teaching reform in the Principles of Computer Organization course, this paper introduces the BOPPPS teaching model embedded with ideological and political elements, expounds on the overall ideological and political objectives of the Computer Organization course, and takes the teaching of "Read-Only Memory" in this course as a concrete example. It details the design of an ideological and political teaching case for read-only memory, which centers on "paying attention to the domestic and foreign research progress of USB flash drives and flash memory chips". The case aims to achieve the synchronous development of knowledge teaching, ability training, and value guidance, thereby promoting the construction of ideological and political education in the Computer Organization course and providing reference value for peers in the field.*

Keywords: *Ideological and Political Education in Curriculum; BOPPPS Model; Teaching Case; Computer Organization and Architecture*

1. Introduction

In May 2020, the Ministry of Education stated in the *Guidelines for the Construction of Curriculum Ideological and Political Education in Institutions of Higher Education*: "Comprehensively promote the construction of curriculum ideological and political education in colleges and universities, give full play to the educational function of all courses, and improve the quality of talent training". In July 2021, the National Textbook Committee further clarified in the updated guidelines : "Courses and textbooks in science, engineering, and medical disciplines should, in line with the characteristics of their respective fields, interpret the concept of 'putting people first and life first', cultivate students' patriotic spirit of caring for the motherland and serving the people, the innovative spirit of daring to scale new heights and take the lead, the pragmatic spirit of pursuing truth and conducting rigorous research, and the dedicated spirit of being indifferent to fame and fortune and focusing on academic exploration". These documents provide clear guidance for the teaching reform of college courses in the new era.

As a core professional course for computer majors in colleges and universities, Principles of Computer Organization covers complex and abstract content, with cumbersome and scattered knowledge points. Traditional teaching often adopts a "teacher-centered" model of theoretical lectures combined with student laboratory experiments, and teaching cases are mostly designed from a complex engineering perspective—focusing on rigorous circuit analysis and principle explanation. This approach often intimidates beginners, hindering their in-depth participation in classroom learning. Against the backdrop of the ideological and political reform of professional courses in colleges and universities, three key issues have become particularly prominent in the teaching of Computer Organization: how to balance theoretical teaching and curriculum ideological and political education, how to design teaching cases that integrate value shaping, knowledge impartment, and ability cultivation, and how to promote students' active engagement in teaching activities [1].

2. BOPPPS Teaching Model Integrated with Ideological and Political Education

Grounded in constructivism and the communicative approach, the BOPPPS teaching model

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emphasizes the construction of a student-centered teaching process. It effectively promotes participatory learning and has gained widespread attention from educators at home and abroad in recent years. The BOPPPS model, based on the characteristics of human attention, divides the course teaching process into six stages: classroom introduction (Bridge-in), classroom objectives (Objective), pre-assessment (Classroom pre-test), participatory learning (Participatory-learning), post-assessment (Classroom post-test), and summary (Summery). The English abbreviation for this model is BOPPPS. As an experiential teaching framework, BOPPPS highlights clear, achievable objectives, students' active participation, and reflective practice—making it an effective model for teaching design.

However, the key challenge lies in integrating the BOPPPS framework with curriculum objectives and ideological and political requirements based on students' actual learning situations. Notably, curriculum ideological and political education at the classroom level does not require a one-size-fits-all model. Teachers should enhance their awareness of ideological and political education, carefully study course content, design teaching plans meticulously, integrate ideological and political elements into professional teaching, and proactively assume the responsibility of "educating people through teaching".

Table 1 outlines the overall approach to integrating ideological and political elements into each stage of the BOPPPS model.

Table 1: Ideological and Political Integration in Each Stage of the BOPPPS Model

Stage	Main Tasks	Entry Points for Ideological and Political Elements	Ideological and Political Objectives
Bridge-in (B)	Introduce new content, arouse curiosity, and stimulate learning motivation	Scientific research progress, industry recruitment needs, real-life cases	Cultivate curiosity and a sense of urgency; ignite learning interest
Objective (O)	Define teaching objectives and clarify expected learning outcomes	Refine objectives into knowledge, ability, and value dimensions	Achieve the seamless integration of value shaping
Pre-assessment (P)	Assess students' prior knowledge to guide subsequent teaching	Preview questions and exercises with ideological elements	Promote self-directed learning through gap analysis and discussion
Participatory-learning (P)	Design interactive activities to facilitate in-depth learning	Teaching resources, group tasks, and inquiry-based activities	Cultivate a sense of responsibility, scientific spirit, and core literacy
Post-assessment (P)	Evaluate the achievement of teaching objectives and provide feedback	Multi-level questions (consolidation, extension, research-oriented)	Enhance knowledge internalization, ability improvement, and problem-solving skills
Summary (S)	Consolidate knowledge and reflect on the teaching-learning process	Concept maps, mind maps, and reflective questions	Help students construct knowledge systems and develop learning abilities

3. Current Teaching Situation of the Principles of Computer Organization Course

Principles of Computer Organization is a professional platform course. Domestic universities mainly adopt a centralized classroom teaching mode of "theory + experiment". When professional course teachers teach, in most cases, they simply embed ideological and political elements into the teaching process of the course, or they only focus on imparting professional knowledge to students and training them in specific skills, paying little attention to the cultivation of students' outlook on life and values. Or, theoretical knowledge is taught first, and then ideological and political content is "mixed" and embedded into the curriculum, making professional education and ideological and political education distinct and even disconnected. This has led to a phenomenon where ideological and political theory course teaching and professional course teaching are "two separate skins" in terms of value education, and even a situation

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where professional courses and ideological and political theory course education have "different paths and do not work together". Or, by adopting a rough "flooding" approach, the teaching of professional courses turns into traditional public ideological and political classes. Students passively accept big principles and theories, making the classroom inevitably dull and the rate of students looking up in class decreases.[5]

In fact, the essence of ideological and political education in courses is an implicit moral education course, which utilizes the rich moral education resources contained in professional courses to conduct ideological and moral education for students. The teaching content should not merely remain at the level of knowledge transmission. It is necessary to uncover the spiritual value contained in the subject knowledge, so that "moral cultivation" and "seeking knowledge" are intrinsically consistent, and the dissemination of knowledge and value guidance are organically unified. The teaching mode should shift from a "mixed" embedding to a "combined" integration. The teaching method has changed from the extensive "flood irrigation style" to the meticulous "immersion style". This not only achieves the teaching objectives of the course but also cultivates and practices the socialist "Four Confidences" and core values, inherits China's fine traditional culture, promotes the national spirit and the spirit of The Times, establishes a sense of social responsibility, and nurtures "red and professional, virtuous and competent" applied and compound talents.

4. Ideological and Political Objectives of the Principles of Computer Organization

As a highly theoretical science and engineering course, Principles of Computer Organization involves the types, working principles, and related standards of computer components. The integration of professional knowledge and ideological and political education in this course is implicit and requires in-depth exploration. Combined with the learning characteristics of students in our university, the ideological and political objectives of the course are defined as follows:

4.1 Enhance National Confidence and Cultivate Patriotic Spirit, Establish socialist core values

In recent years, China’s computer technology has developed rapidly—advancing from "following" to "keeping pace" and even "leading" in some fields. However, certain key technologies still face "bottlenecks". Through the course, students are guided to view the achievements and challenges of China’s computer industry from the perspective of dialectical materialism and historical materialism. This helps enhance their confidence in China’s path, theory, system, and culture, clarify their historical missions in the new era, and establish socialist core values.

4.2 Strengthen Professional Ethics and Social Responsibility

International standards in the field of computer hardware are crucial for technological innovation, high-level opening-up, and high-quality development. The course guides students to recognize the urgency and importance of formulating and applying international standards, as well as strengthening international cooperation in standardization. It also helps students understand and evaluate the impact of hardware engineering projects on society, culture, the environment, and sustainable development—fostering their awareness of abiding by engineering ethics and fulfilling social responsibilities.

4.3 Foster Lifelong Learning Awareness and Teamwork Ability

The computer industry evolves rapidly, with new technologies and equipment emerging constantly. Without the awareness of independent learning and lifelong learning, or the ability to collaborate in teams, individuals will struggle to adapt to the changing society. The course encourages students to develop new thinking to generate innovative ideas, seek new development paths through new ideas, promote new methods through new development, and solve new problems with new methods—laying a solid foundation for their long-term career development [2].

5. Design of BOPPPS Participatory Ideological and Political Teaching Case

Taking the chapter "Read-Only Memory" in the Computer Organization course as an example, this section details the practical application of the BOPPPS model integrated with ideological and political elements [3].

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5.1 Bridge-in: Spark Interest with Patriotic Cases

The Bridge-in stage aims to arouse students' curiosity and connect their daily experiences with new knowledge. At the start of the class, the teacher creates an ideological and political scenario by asking: "Which country and company first invented the USB flash drive that everyone uses? Was it a company in Silicon Valley, the United States?" After a short discussion, the teacher plays a video introducing China's Netac Technology Co., Ltd. as the inventor of the USB flash drive (holder of the core patent for USB flash drive technology). This case stimulates students' national pride and confidence in independent technological innovation. The teacher then links this real-life example to the course content: "The storage principle of USB flash drives and flash memory chips is exactly the core content we will learn today—'Read-Only Memory'", smoothly transitioning to the new chapter.

5.2 Objective: Integrate Knowledge, Ability, and Value Objectives

Based on the three dimensions of knowledge, ability, and value, the teaching objectives of the "Read-Only Memory" chapter are clearly defined as following Table2.

Table 2: Three-dimensional Classroom Teaching Objectives

Dimension	Specific Objectives
Knowledge	1. Familiarize with the functions, characteristics, and classification of read-only memory; 2. Understand the storage principles and performance of 5 types of read-only memory (MROM, PROM, EPROM, E2PROM, and flash memory).
Ability	1. Analyze and compare the circuit structures of different read-only memory types, and summarize their performance advantages and disadvantages; 2. Select appropriate read-only memory types for specific application scenarios.
Value	1. Cultivate the professional quality of daring to innovate and explore; 2. Stimulate internal motivation for continuous learning; 3. Enhance patriotic spirit by focusing on the development of China's science and technology; 4. Strengthen the sense of mission to study diligently for national prosperity and national rejuvenation.

5.3 Pre-assessment: Diagnose Prior Knowledge with Ideological and Political Elements

This stage aims to use appropriate testing methods to understand students' knowledge reserves, facilitating teachers to adjust and design targeted implementation plans. One week in advance, the teacher posted "Read-Only Memory" related pre-learning tasks on the SPOC online course platform of the school, and pushed key and difficult knowledge such as mask-type Read-Only Memory, programmable Read-Only Memory, erasable programmable Read-Only Memory, electrically erasable programmable Read-Only Memory, and the circuit structure of storage units, as well as domestic and international research progress literature on flash memory chips. Moreover, targeted online tests were set up. Students conducted online learning according to the pre-learning tasks on the online platform, completed the online tests, and finally formed a pre-class diagnostic evaluation. In this part, the teacher can understand the students' learning level based on the feedback data and promptly adjust the design of teaching key and difficult cases.

5.4 Participatory-learning: Implement Implicit Ideological and Political Education through Interactive Activities

The Participatory-learning stage is the core of the BOPPPS model, focusing on teacher-student collaboration and student-student interaction (primarily in the form of group inquiry). Combined with the content of "Read-Only Memory", four inquiry activities are designed, each integrating corresponding ideological and political objectives (as following Table 3).

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Table3: Design of Participatory Inquiry Activities and Ideological and Political Integration

Activity Theme	Teacher Activities	Student Activities	Ideological and Political Objectives
1. Compare the performance of MROM and PROM	1. Briefly introduce the circuit diagrams of MROM and PROM storage units; 2. Assign group tasks: Analyze the circuit differences between MROM and PROM and their impact on performance; 3. Guide students to discuss and supplement each other's viewpoints.	1. Conduct group discussions to identify circuit differences and summarize performance characteristics (e.g., programmability, cost); 2. Present group findings; 3. Respond to the teacher's questions (e.g., "Are there any omissions in the performance analysis?").	Cultivate problem-solving awareness and collaborative inquiry skills; Develop the rigorous scientific spirit of pursuing comprehensive and in-depth analysis.
2. Compare the performance of EPROM and E2PROM	1. Introduce the structural differences between EPROM and E2PROM storage units (e.g., erasure methods); 2. Guide groups to explore the relationship between structural differences and performance. 3. Question: Is the performance difference analysis conducted by this group of students comprehensive? Are there any omissions?	1. Analyze structural differences and their impact on performance; 2. Present and defend group conclusions; 3. Discuss and resolve disputes during the presentation.	Improve the ability to analyze the relationship between structure and function; Foster the spirit of rigorous research and critical thinking.
3. Learn about flash memory and China's research progress	1. Explain the storage principle and performance advantages of flash memory; 2. Guide students to summarize domestic and foreign research progress based on pre-class literature; 3. Summarize: China has made breakthroughs in flash memory technology (e.g., Yangtze Memory's 128-layer 3D NAND flash memory) but faces patent disputes with foreign enterprises (e.g., Micron).	1. Analyze and summarize the research progress of Chinese and foreign enterprises; 2. Discuss the challenges and countermeasures of China's flash memory industry; 3. Listen to the teacher's summary and reflect on national technological development.	1. Cultivate the ability to retrieve and analyze academic literature; 2. Enhance national pride and the sense of urgency to overcome technological bottlenecks; 3. Strengthen the mission of contributing to national technological independence.
4. Summarize and compare all types of read-only memory	Guide students to organize and compare the knowledge they have learned, and summarize the exploration activities.	Collective participation enables the organization of learned knowledge into a coherent system, facilitating mastery and absorption.	Cultivate students' ability to organize and summarize knowledge, and achieve value formation.

5.5 Post-assessment: Evaluate Learning Outcomes with Multi-level Questions

After students have completed their studies, they should assess what they have learned in this class, that is, evaluate the goals set for this lesson. Then, based on the evaluation results, teachers can help improve their teaching. In my teaching, I mainly use Rain Classroom to issue in-class quizzes based on the class content. Students provide feedback data on the in-class quizzes. Teachers, in response to the difficult problems in the students' quizzes, lead the students to discuss together and promptly solve the difficulties to cultivate students' ability to apply what they have learned and improve their ability to analyze and solve problems.

5.6 Summary: Consolidate Knowledge and Strengthen Value Shaping

The Summary stage includes two parts: homework assignment and teaching reflection.

5.6.1 Homework Assignment

To promote knowledge transfer and value internalization, the teacher assigns the following after-class

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tasks:

1) Knowledge consolidation: Summarize all types of read-only memory using a concept map or mind map, highlighting their performance differences and application scenarios;

2) Ideological and political reflection: Write a 200-word essay themed "China's Technological Independence in the Storage Field". The essay should integrate cases such as Netac Technology (inventor of the USB flash drive but later lagging due to technological stagnation) and Yangtze Memory (making continuous breakthroughs in flash memory technology and responding to foreign patent lawsuits).

5.6.2 Teaching Reflection

- **Student feedback**: The teacher releases an online questionnaire to collect students' opinions on the class (e.g., "To what extent did the class stimulate your interest in China's science and technology?");

- **Teacher self-reflection**: The teacher summarizes the effectiveness of ideological and political integration, student participation in group activities, and the achievement of teaching objectives—adjusting the teaching design for subsequent classes based on reflection results. [4]

6. Evaluation of the Effect of Ideological and Political Education

The improvement of students' ideological and political literacy is affected by many factors and is a long-term process. However, the advantages of ideological and political education in courses in terms of "collaborative education and all-round education" are obvious. [6]

The practice of ideological and political education in the teaching of *Computer Organization and Architecture* has not only enriched the course content and enlivened the classroom atmosphere, but also enabled students to receive ideological and political education while acquiring professional knowledge, thereby improving their comprehensive quality in a subtle way. Through teaching practice, students have become more conscious and proactive in learning. The number of students participating in extracurricular scientific and technological activities and various competitions has increased; more students have developed the qualities of patience, concentration, hard work and the pursuit of excellence; and uncivilized behaviors on campus have decreased.

Taking Class 2102 of the Big Data Department as an example, the implementation of ideological and political education in courses—through activities such as class meetings, extracurricular science and technology competition mobilization meetings, professional orientation lectures, as well as teaching activities including the comprehensive experiment project of Computer Organization and Architecture—has promoted the development of class work and the formation of a positive class spirit. In the 2024-2025 academic year, Class 2102 of the Big Data Department achieved satisfying results. Among the 30 students in the class, 7 are probationary Party members and 5 are Party activists; 1 student won the National Scholarship; 1 student was awarded the title of Excellent Class Cadre at the university level; and a total of 38 person-times won awards in various extracurricular competitions.

7. Conclusion

Ideological and political teaching cases are essential carriers for integrating ideological and political elements and conveying values and beliefs, laying a solid foundation for the implementation of ideological and political education. To meet the requirements of the ideological and political reform of specialized courses in Chinese colleges and universities, this study breaks through the traditional teaching case design that focuses solely on knowledge transmission. By combining the six stages of the BOPPPS model, creating ideological and political scenarios, and centering on "tracking the domestic and foreign research progress of USB flash drives and flash memory chips", it designs a teaching case for "Read-Only Memory" that integrates knowledge, ability, and value objectives. This case achieves the synchronous advancement of knowledge transmission, ability training, and value shaping. It not only promotes the development of ideological and political education in the Computer Organization course but also provides new ideas for the design of ideological and political teaching cases in similar science and engineering courses in colleges and universities.

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