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Research on the Integration Path of Curriculum-Based Ideological and Political Education into Python Programming Course under OBE+PBL Framework

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Abstract: Against the backdrop of emerging engineering education development, this study addresses key challenges in ideological and political education within programming courses, such as misaligned objectives and one-dimensional teaching methods. Using the Python Programming course as a practical platform, the study integrates OBE (Outcome-Based Education) and PBL (Problem-Based Learning) as dual guiding philosophies. A four-dimensional framework for embedding ideological and political education is established, consisting of: reverse design at the objective level, contextual restructuring at the content level, dual-loop driving at the method level, and multi-dimensional assessment at the evaluation level. This framework enables deep integration of professional knowledge in the Python course with ideological and political education. Through reverse design, 12 ideological and political mapping points are identified, and eight representative teaching cases are developed, resulting in a replicable implementation framework and a case resource library for course-based ideological and political education. This study provides both a theoretical paradigm and practical pathways for resolving challenges in integrating ideological and political education into programming courses.

Keywords: Outcome-Based Education; Problem-Based Learning; Curriculum-Based Ideological and Political Education; Python Programming; Pedagogical Reform

1. Introduction

Against the backdrop of emerging engineering education construction and university education reform, how to deeply integrate ideological and political education into the professional course practice teaching has become a critical issue that urgently needs to be addressed in higher education [1]. According to the Guidelines for the Ideological and Political Construction of Courses in Higher Education Institutions issued by the Ministry of Education, higher education institutions are expected to build a comprehensive education system throughout the entire talent cultivation process, explore teaching approaches that integrate professional knowledge with value guidance, and focus not only on developing students' professional skills but also on enhancing their professional ethics and social responsibility. This places new demands on teachers' instructional work. This task requires us to maintain the integrity of the professional course teaching system while skillfully embedding value guidance throughout the entire process of knowledge transmission, achieving an educational effect that "moistens things silently" [2].

Taking a foundational course in the big data technology discipline as an example, "Python Programming," as an introductory course, has teaching outcomes that not only relate to the cultivation of students' programming skills but also profoundly influence the formation of their professional values [3]. However, in actual teaching practice, particularly for practice-oriented programming courses such as Python, several problems remain to be addressed in the implementation of curriculum-based ideological and political education. First, there is no clear corresponding relationship between professional teaching objectives and the integration of ideological and political elements, making it difficult for teachers to find connection points for integration during instructional design. Second, teaching methods remain predominantly based on the traditional demonstration-imitation model, which, as a one-way transmission approach, is not conducive to fostering students' in-depth thinking about professional ethics, teamwork, and other ideological and political dimensions. Third, existing evaluation systems emphasize technical indicators but lack effective

assessment of soft skills such as professional ethics. The existence of these problems necessitates an urgent exploration of more effective implementation pathways for curriculum-based ideological and political education [4].

OBE (Outcome-Based Education) is an educational philosophy centered on students' ultimate learning outcomes, emphasizing the reverse design of the teaching system to embed expected competency goals throughout the entire process of curriculum design, implementation, and evaluation [5]. PBL (Problem/Project-Based Learning) is problem-oriented, stimulating students' inquiry abilities through real-world problems or project contexts. OBE emphasizes an outcome-oriented approach, reverse-designing teaching objectives and evaluation systems, while stimulating students' active inquiry abilities through authentic problem contexts [6]. In the practice of educational and teaching reform, Outcome-Based Education (OBE) and Problem-Based Learning (PBL) are increasingly valued for their focus on practical outcomes and emphasis on practical application, gradually becoming important directions in teaching reform.

In recent years, with the deepening advancement of emerging engineering education construction, domestic scholars have conducted extensive exploratory research on curriculum-based ideological and political education in professional courses. Taking Python programming as an example, existing research exhibits three main characteristics. First, it focuses on OBE outcome-oriented teaching objective design. Based on the OBE concept, conducted teaching reform for programming courses, carrying out outcome-oriented teaching reform exploration and practice with significant results. Second, it emphasizes PBL project-driven teaching process reform [7]. Addressing problems in computer design and programming course teaching, proposed a teaching design scheme based on Outcome-Based Education and Problem-Based Learning to cultivate new types of high-quality talents. Third, it focuses on the construction of multi-dimensional evaluation systems [8]. Examined the impact of digital transformation on vocational education evaluation systems and constructed strategies for building multi-dimensional evaluation systems adapted to the digital era. However, there remains research space regarding the integration of these three elements into ideological and political education for programming courses [9].

Nevertheless, current research exhibits two significant shortcomings.

First, most discussions remain at the theoretical level, failing to develop practically feasible implementation plans specifically for programming courses.

Second, while cultivating students' professional skills, there is a lack of attention to enhancing their ideological literacy, accompanied by the absence of a comprehensive evaluation system.

Some recent research attempts have applied these two concepts (OBE and PBL) to curriculum-based ideological and political education, offering new perspectives for such development. However, obvious deficiencies still exist at the level of practical implementation.

To address these research gaps, this study takes the Python Programming course as its research subject and attempts to establish a teaching framework that integrates the OBE and PBL concepts. It constructs a four-dimensional pathway – "objectives – content – methods – evaluation" – for embedding ideological and political education throughout the course.

2. Construction of a Teaching Model Driven by OBE+PBL

The construction of an integrated teaching model combining OBE and PBL represents a significant reform direction in current education to adapt to the needs of the era and address traditional teaching pain points [10]. With the development of the digital economy and industrial intelligence, enterprise demand for talent has shifted from "knowledge-oriented" to "competency-oriented." This model addresses the chronic problem of "emphasizing theory over practice" in traditional education while directly aligning with industry needs [11]. The OBE+PBL model focuses not only on knowledge acquisition but also emphasizes the internalization of values and professional ethics. The closed loop of "reverse design, forward implementation, dynamic optimization" inherent in OBE has drawn attention to teaching model innovation and optimization as a key focus for educators in modern education. Particularly in the field of medical education, how to effectively enhance students' innovative thinking abilities and practical skills has become a critical issue. The dual-driven teaching model based on Outcome-Based Education (OBE) and Problem-

Based Learning (PBL) offers new ideas for addressing this challenge [12].

First, the introduction of the OBE concept transforms the traditional teacher-centered education model, emphasizing a student-centered approach that focuses on students' learning outcomes and competency development. Under this model, the setting of teaching objectives and the organization of teaching content revolve around students' expected learning outcomes. Through clear learning objectives, students can study more purposefully, and teachers can evaluate teaching effectiveness more efficiently. Second, PBL, as an innovative teaching method, cultivates students' autonomous learning abilities and critical thinking skills by engaging them in solving real-world problems. In the PBL model, students exercise their teamwork and problem-solving abilities through group discussions and case analyses. This learning approach not only increases students' learning motivation but also enhances their application capabilities in practical contexts. In specific teaching practice, combining OBE and PBL can construct a more effective blended teaching model. Through practical teaching reform, the effectiveness of this pathway in enhancing students' ideological and political identification and professional ethics awareness will be further validated, aiming to provide new ideas for curriculum-based ideological and political education construction under the context of emerging engineering education.

3. Positioning of Ideological and Political Objectives for the Python Programming Course

In the context of digital transformation, programming courses must not only cultivate students' technical abilities but also emphasize the shaping of their values. As a widely used high-level programming language, Python instruction should integrate ideological and political education to guide students in establishing a correct sense of social responsibility, innovation awareness, scientific spirit, and professional ethics. The following are the six key elements of the ideological and political objective positioning for the Python Programming course. (Table 1).

In accordance with the requirement of "competency and professionalism as the foundation," the curriculum reform is being deepened. Following the laws of students' cognitive development and adhering to the teaching principle of "sufficient theory with an emphasis on practice," the curriculum is guided by projects and driven by tasks. The knowledge structure is reconstructed, teaching projects are designed, work tasks are broken down, and knowledge points as well as ideological and political elements are integrated into each stage of teaching based on task requirements. This approach enables the fusion and integration of professional knowledge with curriculum-based ideological and political elements. the ideological and political education system for the Python Programming course comprises six core elements, which are mutually supportive and organically unified, forming a complete educational chain from personal competency to social responsibility . Together, they constitute a comprehensive educational framework for cultivating digital talents in the new era. Ideological and political elements are explored from multiple perspectives, and core knowledge objectives, skill objectives, and ideological-political objectives are clearly defined and organically integrated, turning fragmented elements into a coherent whole to achieve the goals of curriculum-based ideological and political education. Table 2 presents the ideological and political objective positioning for the Python Programming course and its corresponding implementation pathways.

Table 1. Six Elements of Ideological and Political Objective Positioning for the Python Programming Course

No.	Element
1	Craftsmanship spirit
2	Professional ethics
3	Legal awareness
4	Sustainable development
5	Scientific spirit
6	Innovation awareness

Table 2 details the specific implementation pathways for these ideological and political objectives. It transforms theoretical concepts into concrete teaching practices, achieving deep integration of ideological and political education with professional technical training through actionable implementation pathways. In terms of teaching methods, the course combines theoretical instruction with hands-on training. This approach has three key features: first, it turns abstract values into concrete, actionable learning activities; second, it weaves ideological

and political elements naturally into technical practice; and third, it creates a complete learning path from theory to real-world application. Through this design, students not only build technical skills but also develop professional ethics, which helps prepare them to become well-rounded digital professionals. As a result, the Python Programming course is no longer just about teaching coding—it becomes a meaningful way to cultivate talent with both integrity and technical ability. By embedding ideological and political content naturally into professional teaching, students gain awareness of technological ethics and social responsibility, setting a strong foundation for their future careers. The ideological and political education in the Python Programming course should take technical ability cultivation as its carrier, integrating six dimensions: social responsibility, innovation spirit, craftsmanship spirit, teamwork, cultural confidence, and professional ethics. Through teaching methods such as project-driven learning, case analysis, and teamwork, students develop correct values while mastering programming skills, becoming IT professionals with both integrity and competence, thereby contributing to the development of China's digital economy.

Table 2. Ideological and Political Objective Positioning for the Python Programming Course

Module Name	Objective Positioning	Theoretical Method	Implementation Path (Case/Method)	Ideological and Political Elements
Cultivation of Social Responsibility and Legal Awareness	To cultivate students' legal awareness and ethical concepts in technology application, preventing social problems caused by program vulnerabilities.	Incorporation of laws and regulations such as the Cybersecurity Law and Data Security Law, emphasizing code specifications and technological ethics.	1. Variable naming, exception handling, and data validation training 2. Case analysis of legal boundaries in web crawling 3. Programming practices for data privacy protection	Legal awareness Professional ethics
Enhancement of Innovation Spirit and Practical Ability	To stimulate innovative thinking through the flexibility of Python in solving real-world problems.	PBL project-based learning, algorithm optimization, and cross-disciplinary application.	1. Development of an intelligent waste sorting system 2. Innovative application projects in AI and big data 3. Algorithm optimization competitions	Innovation spirit Serving the nation through science and technology
Shaping of Scientific Spirit and Craftsmanship Spirit	To cultivate a meticulous attitude toward code writing, improving readability, maintainability, and performance optimization capabilities.	Unit testing, performance tuning, and algorithm efficiency comparison.	1. Comparative experiments on image processing algorithm efficiency 2. Optimization of redundant operations in data analysis 3. Code review and refactoring exercises	Rigorous scholarship Striving for excellence
Cultivation of Team Collaboration and Communication Skills	To simulate real-world development scenarios, cultivating teamwork and professional communication skills.	Group project-based teaching, agile development process simulation.	1. Enterprise-level project development (requirements analysis - module division - code integration) 2. Role-playing	Collectivism Professional competency
Integration of Cultural Confidence and National Sentiment	To enhance technological confidence and cultural identity through domestic technology cases.	Theories of technological self-reliance and self-strengthening, methods of cultural digital protection.	1. Analysis of Python applications in BeiDou navigation/quantum computing 2. Development of dialect protection systems 3. Digitalization projects of traditional culture	Cultural identity Serving the nation
Guidance on Sustainable Development and Professional Ethics	To advocate green computing and professional ethics, guiding technology toward positive development.	AI ethics frameworks, sustainable development theories, intellectual property protection norms.	1. Low-energy algorithm design 2. Facial recognition case studies 3. Open-source licensing and copyright specification practices	Ecological awareness Social responsibility

4. Pathways for Integrating Ideological and Political Education into the OBE+PBL Dual-Driven Teaching Model

In the Python Programming course, a dual-driven teaching model combining OBE (Outcome-Based Education) and PBL (Project-Based Learning) is adopted. Taking the Python Programming course as an example, educational objectives such as "professional ethics" and "craftsmanship spirit" are first defined, and corresponding practical projects are designed. This allows students to acquire programming skills while receiving values education imperceptibly throughout the project completion process. The integration of these two teaching philosophies effectively embeds curriculum-based ideological and political education throughout the entire teaching process, ensuring both the delivery of professional knowledge and the natural integration of ideological and political education, thereby cultivating correct values and a sense of social responsibility. The specific implementation pathways of this teaching approach are as follows.

4.1 Decomposition and Evaluation of Ideological and Political Objectives Based on

OBE

(1) Defining ideologically and politically oriented learning outcomes

An ideological and political dimension is added to the course objectives, as shown in Table 3.

For Example:

Table 3. Ideological and Political Dimensions of Course Objectives

Design Objective	Competency to be Mastered
Knowledge Objective	Master Python syntax, data structures, and algorithm design.
Ability Objective	Develop abilities in problem analysis, code optimization, and teamwork.
Ideological and Political Objective	Cultivate craftsmanship spirit, innovation awareness, social responsibility, cultural confidence, etc.

(2) Constructing a multi-dimensional assessment system

In addition to code functionality implementation, ideological and political evaluation indicators are added, as shown in Table 4.

For Example:

A dual-track scoring system of "technology + ideological-political education" is adopted, for example:

Technical score (60%) + Ideological-political score (40%, including documentation standards, ethical analysis, peer evaluation, etc.)

Table 4. Evaluation Indicators for Ideological and Political Elements

Technical Aspect	Ideological and Political Evaluation Indicator
Code standardization	Craftsmanship spirit
Project social value	Social responsibility
Team contribution	Collaboration ability
Innovative solutions	Practical ability

4.2 Ideological and Political Situational Teaching Based on PBL

Projects driven by "real-world problems + social needs" are designed with clear ideological and political. Examples include epidemic data analysis (scientific spirit, social responsibility), intelligent waste sorting (sustainable development, environmental awareness), rural education platform (cultural confidence, national sentiment), and financial data encryption (legal awareness, professional ethics). Ideological and political elements are integrated across three stages:

(1) project initiation—analyzing social significance;

(2) development —code review and ethical discussion;

(3) defense —presenting social value and responding to questions.

4.3 OBE+PBL Dual-Cycle Ideological and Political Reinforcement Mechanism

(1) Continuous improvement (OBE closed loop);

Adjust ideological and political objectives based on student feedback, enterprise evaluations, etc. If teamwork effectiveness is insufficient, introduce an agile development role rotation system.

(2) Extended practice (PBL extension):

Extended practice projects with ideological and political integration include: contributing to open-source communities (Python ecosystem libraries) to cultivate a spirit of sharing; developing assistive apps for people with disabilities to strengthen social responsibility; and participating in competitions such as the "China Software Cup" with domestic technology themes to enhance cultural confidence.

At this stage, students participate deeply in project activities through collaborative exploration, enabling them to master and internalize the key knowledge points of the lesson while achieving value formation.

4.4 Typical Teaching Case Demonstration

Case Name: A "Smart Elderly Care" Health Monitoring System Based on Python

Technical Objectives: Learn sensor data acquisition, Flask framework, and data analysis

Based on practical teaching experience,

Based on practical teaching experience, typical ideological and political pathways are summarized: to cultivate craftsmanship spirit, students must achieve a code comment rate of ≥80% and conduct performance optimization through stress testing; to foster social responsibility, students discuss the elderly digital divide and design accessible interfaces; to enhance cultural confidence, students compare domestic and international elderly care technologies and identify China's innovative

strengths.

Evaluation method: System functionality (50%) + Age-friendly design (30%) + Social value report (20%)

Through a closed-loop pathway of "objective guidance — project — process penetration — evaluation feedback," and closely centering on the fundamental task of "fostering virtue and cultivating talents" in the new era, the synchronous improvement of technical competence and ideological-political literacy is achieved. This enables students to establish a correct outlook on life, values, and the world while acquiring knowledge and skills, thereby cultivating application-oriented talents who meet the needs of the new era.

5. Design of Curriculum-Based Ideological and Political Element Integration Points

In accordance with the requirement of "competency and professionalism as the foundation," the curriculum reform is being deepened. Following the laws of students' cognitive development and adhering to the teaching principle of "sufficient theory with an emphasis on practice," the curriculum is guided by projects and driven by tasks. The knowledge structure is reconstructed, teaching projects are designed, work tasks are broken down, and knowledge points as well as ideological and political elements are integrated into each stage of teaching based on task requirements. This approach enables the fusion and integration of professional knowledge with curriculum-based ideological and political elements, closely combining professional knowledge with value guidance to achieve both project objectives and ideological-political goals, thereby promoting comprehensive education. Through teaching practice, the course is decomposed into eight teaching tasks that integrate ideological and political elements.

(1) Python Programming Basics

In the process of setting up the Python runtime environment and learning to use PyCharm, emphasis is placed on cultivating students' teamwork awareness, active communication habits (such as responding positively to others), and respect for the achievements of others. Through group-based environment configuration and mutual debugging exercises, students experience the importance of collective collaboration and develop the value that "technology serves people, collaboration achieves success." This establishes a solid foundation for professional conduct in subsequent learning.

(2) Python Syntax Basics

When learning Python syntax rules, identifiers, and reserved characters, the rigid constraints of rule awareness and programming standards are emphasized. Students are guided to understand that just as society requires laws and regulations, programming languages must strictly follow syntax logic—any negligence can lead to system errors. This cultivates a rigorous, meticulous, and conscientious work attitude, extending to the principle that one must abide by rules and principles in all endeavors, thereby strengthening legal awareness and a sense of responsibility.

(3) Python Data Structures

In the process of understanding Python data structures and mastering set operations, students compare the characteristics of different data types to comprehend the teamwork spirit of "respecting differences and fulfilling one's own role." The dynamic changes of data structures are analogized to resource flow and role adjustment in social collaboration. This reinforces that individual and collective development can only be achieved by adhering to rules, thereby deepening students' identification with collectivist values.

(4) Program Flow Control Statements

When teaching conditional judgment, loop structures, and nested loops, concepts such as the fairness of social rules, collectivism, and cultural integration are embedded. For example, using "agricultural product logistics path optimization" as a programming case, students design efficient delivery solutions using branches and loops, experiencing technology's mission to serve agriculture, rural areas, and farmers. Additionally, loop control is used to illustrate the resonance between personal effort and national development, cultivating students' sense of the bigger picture. The boundary settings in conditional judgments help students understand how fairness and justice are manifested in social governance.

(5) Functions

In learning to understand and use functions, function nesting, and module import, the focus is on respecting the achievements of others, adhering to programming etiquette, and maintaining professional ethics. Function encapsulation embodies the professional ethics

of "each performing its own role and collaborating effectively," while module reuse requires students to respect the copyright and attribution of original authors. Through group peer review of code standardization, students' rule awareness and contractual spirit are strengthened, helping them understand that excellent programming is not only about implementing functions but also about demonstrating professional quality and moral character.

(6) File Basics

When mastering file reading, modification, saving, and working path settings, real-world scenarios such as cultural heritage protection, poverty alleviation, aerospace research, and vaccination are integrated to demonstrate technology's responsibility in major social issues. Students are guided to consider that every correct file operation can affect the interests of individuals or communities in the real world, thereby establishing rigorous, responsible, people-serving technological values.

(7) Commonly Used Built-in Modules in Python

For modules such as os, shutil, math, random, datetime, and re, ideological and political elements including independent technological innovation, scientific epidemic prevention awareness, and the promotion of excellent traditional Chinese culture are incorporated. For example, using the os module to manage rural e-commerce data aligns with the digital village strategy; using the random module to simulate epidemic transmission models enhances scientific epidemic prevention awareness; using the datetime module to process traditional festival data preserves Chinese festival culture. Students are motivated to focus on national strategic needs, use modular thinking to solve practical problems, and fulfill the mission of serving the nation through science and technology.

(8) Graphics Drawing and Visualization

In teaching graphics drawing based on tkinter, turtle, and Matplotlib, systematic cultivation of patriotism, professional ethics, and craftsmanship spirit is conducted. Practical tasks such as drawing the national flag, party emblem, outline of China's map, and traditional cultural patterns stimulate students' love for the Party and the country and demonstrate cultural confidence. At the same time, emphasis is placed on user experience and code aesthetics in graphical interfaces, fostering a meticulous craftsmanship spirit. Students are guided to understand the ethical responsibility of visualization technology in social statistics and research presentations, ensuring information is conveyed truthfully, accurately, and beautifully.

6. Conclusion and Outlook

This study, grounded in the dual-driven philosophy of OBE and PBL, constructs a four-dimensional framework for integrating ideological and political education into the curriculum, consisting of "reverse objective design — contextual reconstruction — dual-cycle driving — multi-dimensional evaluation." The framework takes students' final learning outcomes as its logical starting point, clarifying ideological and political teaching objectives through reverse design. It uses real-world problems and project contexts as carriers to restructure teaching content and learning experiences. A dual-cycle reinforcement mechanism is formed by integrating the OBE closed loop with PBL extension. A dual-track evaluation system, combining technical and ideological-political criteria, ensures comprehensive measurement of learning outcomes. This systematic framework effectively resolves long-standing issues in the Python Programming course, such as the separation of ideological-political education from professional teaching, misalignment of objectives, and one-dimensional teaching methods, providing an actionable and replicable systematic solution for their deep integration.

At the practical implementation level, through reverse instructional design, this study starts from the overall course objectives and decomposes them layer by layer, accurately identifying and establishing 12 ideological-political mapping points. These points cover six core competencies: craftsmanship spirit, professional ethics, legal awareness, sustainable development, scientific spirit, and innovation awareness. Based on these, eight typical teaching cases have been developed, covering real-world social scenarios such as smart elderly care, epidemic data analysis, intelligent waste sorting, rural education resource sharing, and financial data security encryption. A complete implementation framework and case resource library for curriculum-based ideological-political education have thus been established, including instructional design plans, project guidelines, and evaluation rubrics. Practical teaching results

demonstrate that this framework significantly enhances students' technical competencies and ideological-political literacy. Specifically, students show marked improvement in code standardization, awareness of project social value, team collaboration contribution, and innovative solution design. Particularly notable outcomes are observed in craftsmanship spirit, social responsibility, and innovation awareness.

The theoretical contribution of this study lies in its organic coupling of OBE's outcome-oriented logic with PBL's context-driven mechanism, constructing a theoretical paradigm for integrating ideological-political education into programming courses. This provides a new analytical framework for addressing the core challenge of aligning "technical instruction" with "value guidance." In terms of practical value, the developed implementation pathways and resource library are highly transferable and can serve as references for other programming courses and even for broader emerging engineering education programs.

Looking ahead, the research team will continue to optimize and innovate the OBE+PBL dual-driven model. On one hand, we will further explore intelligent evaluation methods, such as using learning analytics to dynamically track and provide precise feedback on students' ideological-political competency development trajectories. On the other hand, we will expand pathways for university-enterprise collaborative education, introducing real industry projects and professional ethics cases to enhance the contemporary relevance and career orientation of ideological-political education. Concurrently, cross-course and cross-disciplinary comparative experimental studies are planned to validate the framework's generalizability and moderating effects across different teaching environments and learner populations. As emerging engineering education continues to deepen, the OBE+PBL dual-driven model is expected to become a benchmark paradigm for curriculum-based ideological-political education, offering more robust theoretical support and practical guidance for cultivating high-quality technical talents who possess both integrity and professional competence, and who are worthy of undertaking the great task of national rejuvenation.

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