



# A Brief Discussion on the Integration Path of Ideological and Political Elements in College Physics Teaching

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## Abstract

Against the backdrop of “Greater Ideological and Political Education”, the systematic integration of ideological and political elements into classroom teaching has become a core educational task for colleges and universities. However, college physics courses are characterized by high abstraction and long logical chains. The traditional “story + slogan” model of ideological and political instruction often leads to issues such as rigid “labeling” and disconnection from real life, resulting in low student engagement. Based on situated cognition theory, this paper defines four core concepts: life-oriented integration, three-stage six-dimension, value identity, and perception of ideological and political elements. It constructs a theoretically robust “Three-Stage and Six-Orientation” pathway for integrating life-based ideological and political elements into courses, clarifies the research design, implementation procedures and evaluation methods, and conducts a two-academic-year non-random group comparative teaching experiment. Multi-dimensional data are collected through standardized assessment tools to distinguish the educational effects of traditional teaching and ideological and political design, and to objectively verify the teaching reform. The results show that the introduction of life-aligned ideological and political elements can significantly strengthen students’ value identity and academic performance while maintaining the depth of knowledge teaching, providing a replicable and scalable framework for ideological and political teaching in science and engineering courses.

## Subject Areas

Pedagogy

## Keywords

College Physics, Curriculum Ideological and Political Education, Life Cases, Three Stages and Six Dimensions, Action Research

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## 1. Introduction

In the new era of higher education reform, college physics shoulders dual fundamental missions: inheriting physical knowledge and cultivating scientific thinking, as well as guiding students to establish a correct worldview, outlook on life and values. The Guidelines for the Construction of Curriculum Ideological and Political Education in Institutions of Higher Education issued by the Ministry of Education of China in 2020 emphasizes that value shaping should be subtly and organically integrated into the whole process of knowledge imparting and ability cultivation [1]. As a compulsory basic course for science, engineering, agriculture and medicine disciplines, college physics features extensive knowledge coverage and rich teaching connotations. It not only supports the cultivation of students' scientific research literacy, but also endows the course with inherent advantages for comprehensive ideological and political education [2] [3].

Nevertheless, frontline teaching practice faces two prominent bottlenecks. First, the formalization and abstraction of physical theoretical knowledge disconnect classroom teaching from real-life scenarios and social practice, hindering the internalization of students' knowledge. Second, most teachers conduct in-depth excavation of ideological and political elements but adopt rigid and inappropriate teaching methods, leading to students' aesthetic fatigue and low acceptance of ideological education, which greatly weakens the practical effect of curriculum ideological and political teaching [4]-[7]. Therefore, realizing the organic integration of professional knowledge and value guidance through down-to-earth and vivid ideological and political teaching design has become an urgent problem to be solved in the reform of college physics teaching.

In this context, this study constructs a standardized and systematic curriculum ideological and political integration model based on situated cognition theory, and empirically verifies the educational effectiveness of the model through long-term controlled teaching practice. The research findings provide practical references and feasible optimization paths for improving the quality of ideological and political education in science and engineering courses.

## 2. Definition of Core Concepts

To clarify the research scope and unify evaluation criteria, this paper standardizes the definitions of core research concepts, and links them with specific teaching activities and measurable evaluation indicators to ensure that all concepts are practical, observable and assessable.

## 2.1. Integration with Daily Life

Integration with daily life refers to a teaching mode that breaks the barriers between college physics theoretical teaching and real life as well as social practice. Taking life scenarios, social hot topics and industrial applications that students can easily perceive and participate in as carriers, it seamlessly integrates abstract physical knowledge with ideological and political elements. In practical teaching, daily mechanical phenomena such as food delivery inertia and subway emergency stops are adopted to introduce mechanical principles; major domestic scientific and technological achievements including Beidou Navigation and EAST are combined to interpret physical laws; and smart phone sensors are used to carry out daily physical experiments. Its main evaluation indicators cover students' learning satisfaction and classroom participation rate. This model effectively solves the disconnection problem in traditional ideological and political teaching, and enhances students' classroom engagement and learning sense of gain.

## 2.2. Three-Stage & Six-Dimensional Model

The three-stage & six-dimensional model is a systematic ideological and political education implementation framework tailored for college physics courses, running through knowledge imparting and value cultivation. It consists of three implementation stages and six supporting dimensions. The three stages are daily-life-oriented introduction, in-depth practical exploration and value-oriented sublimation, forming a complete educational closed loop of cognition, practice and moral cultivation. The six dimensions include student-oriented orientation, systematic construction, regular implementation, integrated penetration, three-dimensional development and diversified assessment, which provide comprehensive guarantees for the effective implementation of value education. The three stages correspond to the complete classroom teaching process, while the six dimensions optimize teaching resources, operating mechanisms and evaluation systems, serving as the core carrier of curriculum ideological and political reform in this research.

## 2.3. Value Identity

Value identity means that in the process of physics learning, experimental practice and situational experience, students gradually form recognition and practical awareness of national scientific and technological development, rigorous scientific research spirit, social responsibility and scientific ethics. This indicator is comprehensively evaluated through questionnaires, practical achievements and cognitive performance. Specifically, it is manifested in students' active attention to domestic cutting-edge scientific and technological achievements, establishment of the aspiration to serve the country through science and technology, adherence to academic integrity, and formation of the awareness of serving society with science and technology, which constitutes the core educational output of curriculum ideological and political education.

## **2.4. Perception of Ideological and Political Elements**

As a quantifiable teaching evaluation indicator, perception of ideological and political elements refers to students' recognition, understanding and acceptance of patriotic education, scientific research spirit, scientific and technological confidence, social responsibility and academic ethics integrated into classroom lectures, experimental operations and after-class practices. Measured by a special quantitative questionnaire, it directly reflects the naturalness and effectiveness of ideological and political integration. Different from pure knowledge mastery assessment, this indicator effectively avoids the rigid and labeled embedding of ideological and political contents in teaching.

## **3. Theoretical Basis and Model Design Logic**

### **3.1. Core Connotation of Situational Cognition Theory**

Situational cognition theory holds that learning is not a passive process of knowledge reception, but a dynamic process in which learners internalize knowledge, improve abilities and construct values through practical participation and interactive experience in real learning situations. Situational creation, practical exploration, classroom interaction and ideological sublimation are four core elements of effective learning. Breaking away from the one-way indoctrination mode of traditional classrooms, this theory fits well with the characteristics of science and engineering courses which emphasize logic, practice and application. It provides solid theoretical support for transforming superficial slogan-style ideological and political integration into immersive value education in science and engineering courses.

### **3.2. Adaptation Logic between Theory and the Model**

Based on situated cognition theory, this study realizes the transformation from theoretical framework to practical teaching model. The core logic of situational construction, practical empowerment and value generation supports the three-stage teaching process; while the concepts of student-centered education, closed-loop learning and diversified evaluation underpin the six-dimensional guarantee system, ensuring scientific and rational model construction.

In the daily-life-oriented introduction stage, real situational construction is adopted to build concrete learning scenes with life cases and scientific and technological hot issues, simplifying abstract physical knowledge and laying a foundation for the natural integration of ideological and political elements. In the in-depth practical exploration stage, participatory practical learning is highlighted. Students consolidate professional knowledge and comprehend scientific and technological connotation through independent experiments, data calculation and problem discussion. In the value-oriented sublimation stage, situational value construction is realized via academic exchanges, social practices and achievement application, promoting students' development from knowledge mastery to responsibility cultivation.

Among the six supporting dimensions, student-orientation and regular implementation conform to the student-centered and continuous immersive learning concept; systematization and integration meet the requirements of situational linkage and closed-loop education; three-dimensionalization and diversification fit the multi-scene and multi-subject collaborative education concept, fully ensuring the implementation effect of situational education.

## **4. Research Methods and Implementation Design**

### **4.1. Research Participants**

The research objects are undergraduate students majoring in science and engineering from Grade 2022, 2023 and 2024 in Yangtze University, covering 13 majors including Mechanical Engineering, Civil Engineering, Electronic Information, Chemical Engineering and Computer Science. The experimental group consists of 1127 students from Grade 2023 and 2024, while the control group includes 736 students from Grade 2022 and randomly selected parallel classes of Grade 2023 and 2024. There is no significant difference in senior high school physics foundation and student source quality between the two groups, ensuring sample consistency.

### **4.2. Curriculum Setting and Baseline Consistency**

This study adopts a non-random cluster controlled trial with consistent basic teaching conditions to eliminate irrelevant variable interference. Both groups follow the same teaching syllabus with identical core knowledge points, key and difficult points and knowledge framework. All courses are arranged with 96 class hours per academic year with equal class hour distribution. Unified standards are implemented in final examination question types, score proportion, marking criteria, difficulty coefficient and formative evaluation. In addition, the teaching staff are evenly allocated with balanced professional titles, teaching years and teaching capabilities. The only difference lies in teaching mode: the control group adopts traditional teaching without systematic ideological and political design and AI-assisted teaching, while the experimental group applies the three-stage & six-dimensional ideological and political teaching mode combined with AI-based precise teaching.

### **4.3. Implementation Schedule**

The whole teaching reform lasts for two academic years. The pilot reform was launched in September 2023, including syllabus optimization, ideological and political case database construction and AI teaching platform debugging. Two rounds of complete teaching practice were carried out from December 2023 to January 2026. Afterwards, all research data were summarized, statistically analyzed and effectiveness verified to form systematic research achievements. The control group kept the traditional teaching mode from September 2023 to January 2026 throughout the whole period.

#### 4.4. Teaching Staff Arrangement

A total of 12 full-time teachers undertake teaching tasks for both groups. All teachers participate in unified basic teaching training. Teachers in the experimental group receive special training on three-stage & six-dimensional ideological and political teaching methods and AI teaching platform operation, while teachers in the control group remain unchanged without participating in reform-related training, so as to guarantee the uniqueness of experimental variables. An interdisciplinary teaching team is also established: physics teachers are responsible for professional knowledge teaching, and teachers from economics and management majors assist in value evaluation and data analysis to ensure professionalism in teaching implementation and effect assessment.

#### 4.5. Data Sources and Anonymity Processing

All research data are authentic and traceable, mainly divided into four categories: daily teaching management data, background data from AI intelligent teaching platform, online questionnaire survey data and professional physics competence test data.

All questionnaires are filled in anonymously online without collecting students' names, student IDs, classes and other private information. The platform automatically desensitizes data and only retains macro statistical information such as grade and major category. All data are only used for overall teaching effect analysis rather than individual comparison, which fully protects students' privacy, reduces answering concerns and improves data authenticity. The valid sample size of each survey exceeds 800 with an effective recovery rate above 95%, satisfying statistical research requirements.

#### 4.6. Measurement Tools and Reliability Verification

All quantitative indicators are measured by standardized and reliable assessment tools:

- **Learning Satisfaction Questionnaire:** Adopts 5-point Likert scale with 12 items covering classroom experience, knowledge harvest and learning initiative. Its Cronbach's  $\alpha$  coefficient is 0.87, indicating good reliability.
- **Ideological and Political Element Perception Scale:** Self-developed scale containing 10 items focusing on recognition, understanding, acceptance and identity, scored by 5-point system with Cronbach's  $\alpha$  coefficient of 0.85, achieving qualified reliability.
- **Physics Concept Comprehension Test:** Standard test questions selected from core university physics question bank cover mechanics, electromagnetism and modern physics with a full score of 100 points. All test papers are verified by professional teachers with good content validity.
- **Academic Achievement Indicators:** Based on unified school final examination results with unified proposition, marking and review, the data are objective and accurate.

#### 4.7. Functional Division between AI-Assisted Teaching and Ideological and Political Design

To accurately distinguish different teaching effects, this study clarifies the respective functions of AI-assisted teaching and three-stage & six-dimensional ideological and political design for collaborative education.

- **Core Functions of AI-assisted Teaching:** Focus on improving teaching efficiency without ideological and political guidance attributes, including personalized knowledge push, intelligent error sorting, learning situation analysis, virtual simulation experiment and automatic data statistics. It aims to reduce teachers' workload and improve students' professional learning efficiency.
- **Core Functions of Three-stage & Six-dimensional Ideological and Political Design:** All core educational links are independently designed by teachers without automatic intelligent intervention, including situational introduction, practical inquiry design, value sublimation, ideological case application and diversified value evaluation. It serves as the core approach to improve students' ideological perception, value identity and social responsibility.

#### 4.8. Data Analysis Explanation

This research mainly adopts descriptive statistical analysis to sort out and analyze research data. The teaching reform effects are intuitively presented by comparing the mean values and improvement ranges of various indicators between the experimental group and the control group. No independent sample t-test, variance analysis and other significant difference tests are conducted. Therefore, all effect descriptions in this paper adopt objective descriptive expressions without defining statistically significant differences, only stating the actual improvement of various indicators after the implementation of teaching reform.

### 5. Implementation Path of Ideological and Political Element Integration

Combined with situated cognition theory and the three-stage and six-dimensional model, this study optimizes the teaching system from five dimensions: teaching objectives, teaching content, teaching methods, teacher team construction and evaluation mechanism, realizing the deep integration of life practice and curriculum ideological and political education.

#### 5.1. Reconstruct Three-Dimensional Integrated Teaching Objectives

This study integrates knowledge objectives, ability objectives and ideological and political objectives into a unified teaching system to solve the problem of disjointed knowledge teaching and value guidance. In specific teaching, typical cases are matched with key knowledge points. For example, when teaching the Doppler effect, the GPS velocity measurement principle in daily life is combined with the development history of the Beidou Navigation System. By comparing the techno-

logical dilemma in the “Yinhe Incident” and the current global leading positioning accuracy of Beidou, students can intuitively perceive the hardships and achievements of national scientific and technological development, so as to cultivate national pride and technological self-confidence. In the teaching of circular motion, the Phyphox mobile sensor application is used for on-site acceleration measurement experiments, realizing the organic integration of life scenarios, physical principles and practical exploration.

In addition, targeted ideological and political elements are accurately anchored for each chapter based on the principles of life-orientation, adaptability and contemporaneity. In the teaching of particle motion in magnetic fields, the physical principle of magnetic confinement is visualized through the water film magnetic confinement experiment, combined with the breakthrough of China’s EAST artificial sun device in realizing long-term high-temperature steady-state operation. The case intuitively reflects the leap of China’s nuclear fusion energy research from theoretical exploration to engineering application, strengthening students’ awareness of scientific and technological responsibility and patriotism.

## **5.2. Optimize Teaching Content and Diversify Ideological and Political Resources**

First, infiltrate scientific research spirit through physics history. In the interpretation of physical laws and principles, the dedication, rigor and innovation spirit of outstanding physicists at home and abroad are integrated into teaching. Combined with the scientific research cases of school teachers and excellent students, the study distance is shortened to guide students to form rigorous academic attitudes and innovative thinking.

Second, enhance contemporary identity through cutting-edge scientific and technological hotspots. Frontier domestic technological achievements such as quantum communication, controllable nuclear fusion and aerospace technology are integrated into professional teaching. In quantum theory teaching, the technical advantages and global leading status of the Micius Quantum Science Satellite are emphasized, enabling students to recognize the strong strength of China’s basic physical research and enhance national scientific and technological confidence.

Third, cultivate social responsibility through scientific research ethics education. Combined with the application scenarios and potential risks of physical technology, this study carries out academic integrity and social responsibility education. Through classroom discussion of typical ethical cases, students are guided to clarify the application boundary of physical technology, establish the core concept of “technology benefiting mankind”, and abide by academic integrity norms.

## **5.3. Innovate Teaching Methods and Implement the Three-Stage and Six-Dimensional Model**

Based on situated cognition theory, this study innovates the whole-process im-

mersive teaching mode to realize closed-loop value education. Taking the life scenario of food delivery shaking as a typical teaching case, the implementation process is demonstrated as follows:

**Three-stage core implementation process:**

1) Life-oriented introduction stage: Typical life scenario videos such as food delivery shaking and subway emergency braking are adopted to create cognitive conflicts, guiding students to analyze real social phenomena through physical knowledge such as momentum conservation and overload and weightlessness. The design strengthens the connection between abstract theories and real life, improving classroom immersion.

2) In-depth practical stage: Based on the practical learning concept of situated cognition theory, smartphones and Python programming are used to build portable life laboratories. Students calculate the critical acceleration of anti-shake for food delivery boxes and compare it with industrial patent standards, transforming theoretical knowledge into practical problem-solving ability.

3) Value-oriented sublimation stage: Combined with social issues such as traffic safety, rider rights protection and low-carbon development, cross-industry exchanges with traffic police, engineers and social workers are carried out. Students put forward social governance suggestions based on experimental data, realizing the value upgrading from knowledge learning to social responsibility undertaking.

**Six-dimensional guarantee system:**

1) Student-centered orientation: All teaching cases are derived from students' daily life to adapt to their cognitive rules;

2) Systematization: Build a four-level mapping system of "knowledge-standard-industry-country" to realize systematic value guidance;

3) Normalization: Set up a 5-minute daily "data-story-action" classroom check-in link to accumulate persistent educational effects;

4) Integration: Integrate online MOOC resources, virtual simulation experiments and offline practical teaching to build a full-time teaching system;

5) Three-dimensional construction: Evaluate students' growth from multiple dimensions such as classroom performance and practical achievements;

6) Diversification: Introduce social practitioners and public evaluation subjects to build a collaborative home-school-society education system.

#### 5.4. Strengthen Teacher Team Construction

Teacher literacy is the core guarantee for the effective implementation of curriculum ideological and political education. First, carry out special training on situational teaching and ideological element excavation to improve teachers' comprehensive teaching ability. Second, build an interdisciplinary teaching team integrating physics, ideological education and management disciplines to jointly develop high-quality teaching cases and resources. Third, optimize the assessment and incentive mechanism to fully mobilize teachers' initiative and innovation enthusiasm in curriculum ideological and political reform.

## 5.5. Improve Quantifiable Evaluation Mechanism

This study constructs a multi-dimensional, process-oriented and quantifiable comprehensive evaluation system covering student self-evaluation, peer evaluation, teacher evaluation and data intelligent evaluation. The evaluation scope covers professional knowledge mastery, practical innovation ability and ideological and political literacy. Indicators such as ideological element perception, value identification and social responsibility performance are included in the formal evaluation system to avoid the separation of ideological education and professional teaching. Based on daily check-in data, experimental achievements and questionnaire data, students' personal ideological growth curves are formed, realizing dynamic monitoring and continuous optimization of educational effects.

## 6. Conclusion

Aiming at the problems of rigid integration and poor student acquisition in traditional college physics curriculum ideological and political teaching, this study constructs a three-stage and six-dimensional life-oriented ideological and political integration model based on situated cognition theory. Verified by two-year controlled teaching experiments with large sample data, the research proves that life-oriented situational teaching design can organically combine professional knowledge teaching and value guidance without reducing the depth of academic teaching. The proposed teaching model can significantly improve students' classroom learning experience, enhance their national scientific and technological confidence and social responsibility awareness, and effectively optimize their academic performance. This study solves the practical dilemma of disjointed curriculum ideological and political education in physics courses, and provides a standardized, replicable and promotable teaching framework for high-quality ideological and political teaching reform in science and engineering higher education (Table 1).

**Table 1.** Comparison of teaching quality indicators before and after reform.

Evaluation Indicators	Pre-Reform (2022 Cohort)	Post-Reform (2023, 2024 Cohort)	Improvement Range
Classroom Attendance Rate	88.6%	98.2%	9.6%
Classroom Interaction Rate	Less than 30%	82.5%	52.5%
Final Exam Average Score	67.2	74.3	7.1 points
Course Pass Rate	79.5%	93.8%	14.3%
Excellent Rate ( $\geq 85$ points)	8.3%	22.7%	14.4%
Learning Satisfaction	17.9%	86.3%	68.4%
Perception of Ideological and Political Elements	23.6%	91.5%	67.9%
Teachers' Weekly Workload	18.5 hours	11.2 hours	-7.3 hours
Excellent Rate of Experimental Reports	12.8%	42.1%	29.3 percentage points
Physics Concept Comprehension	—	Increased by 24.1%	24.1 percentage points

## 7. Suggestions

The “Three-Stage and Six-Orientation” life-oriented ideological and political integration model based on situated cognition theory effectively solves the problems of “labeling” and “divorce from reality” in traditional teaching. It significantly improves students’ knowledge mastery, practical ability and ideological and political literacy while maintaining teaching depth. AI-assisted teaching and ideological and political design achieve dual empowerment of efficiency and quality.

Suggestions:

- 1) Include ideological and political achievements in teacher performance assessment.
- 2) Build campus living labs to sustain life-oriented teaching resources.
- 3) Establish a national case-sharing platform for standardized promotion.

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## Conflicts of Interest

The authors declare no conflicts of interest.

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