

# Research on the Teaching Reform of College Physics Course under the Background of the Integration of Production and Education

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**Abstract:** With the rapid development of society and the continuous progress of technology, college education is facing unprecedented challenges and opportunities. Especially in the background of the integration of production and education, the teaching reform of college physics is particularly important as a compulsory basic course for science and engineering students. This paper aims to discuss the research and practice of the teaching reform of college physics under the background of the integration of production and education, in order to provide useful reference for improving the teaching quality and cultivating high-quality talents meeting the needs of society.

**Keywords:** Integration of production and education; College physics; Teaching reform

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## 1. Introduction

Since the reform and opening up, China's higher education vision has developed vigorously, has sent a large number of talents for socialist modernization construction, and has made significant contributions to the development and growth of the modern industrial system. While the development of higher education in China has achieved great achievements, influenced by the education system and the training of talents, the supply side of talents in terms of structure, quality, level and so on, still cannot fully adapt to the industry demand side. In order to deepen the integration of industry and education and promote the full docking of the personnel training mechanism with the industrial development model, The General Office of the State Council issued "Several Opinions on Deepening the Integration of Industry and Education" in 2017<sup>[1]</sup> identified the first batch of 209 pilot units for professional cooperation construction of industry-education integration, including 23 undergraduate colleges, 149 higher vocational colleges, 30 secondary vocational colleges and 7 technical colleges. To promote the further implementation of the integration of industry and education, colleges and universities at all levels have carried out the pilot construction of the integration of industry and education. However, on the whole, it still shows that the process of discipline construction is relatively fast and the results

are obvious, but for general courses such as physics and English, the teaching reform process based on the integration of production and education is relatively slow. In this regard, this paper takes the integration of production and education as the background, takes the college physics course as an example, analyzes the necessity of its teaching reform and the existing problems of course teaching, and makes an active exploration of its teaching reform path.

## **2. The necessity of college physics curriculum teaching reform under the background of the integration of production and education**

With the rapid development of society and the rapid change in science and technology, the teaching reform of college physics is particularly important. As one of the important directions of the current higher education reform, the integration of production and education has a positive significance for promoting the reform of college physics teaching<sup>[2]</sup>. Therefore, from the perspective of promoting teaching reform and innovation and improving the teaching effect, the teaching reform of college physics courses is also necessary.

### **2.1. Adapt to the needs of modern industry and improve the quality of talent training**

With the integration of industry and education, China's higher education is going through a profound change. As a basic discipline, the teaching content and teaching methods of college physics should keep up with the pace of the development of the era and combine closely with the needs of modern industry, to cultivate high-quality talents with practical ability and innovative abilities to meet the development needs of modern industry in China. On the one hand, physics is a basic and highly theoretical discipline, which provides rich theoretical support for all walks of life. Therefore, the teaching content of college physics courses must adapt to the development needs of modern industry and provide students with a beneficial physical knowledge system. On the other hand, under the background of the integration of production and education, college physics teachers should keep pace with the era and constantly innovate and improve their teaching methods. The traditional teaching mode emphasizes the teaching of theoretical knowledge and pays less attention to the cultivation of students' practical ability and innovative consciousness<sup>[3]</sup>. In order to meet the needs of modern industry, it is necessary to break the traditional shackles and combine practical teaching with theoretical teaching to improve students' hands-on ability and innovative thinking. In addition, the integration of industry and education provides enterprises with a wealth of practical engineering cases and cutting-edge scientific and technological knowledge, which can provide strong support for the teaching of college physics courses. In college physics teaching, through cooperation with enterprises, these practical engineering cases and cutting-edge scientific and technological knowledge can be introduced into the classroom, so that students can better understand and apply this knowledge while learning physics knowledge, and improve their practical ability and innovation ability.

### **2.2. Optimize the allocation of teaching resources and promote educational equity**

Under the background of the integration of production and education, the teaching reform of college physics courses also need to pay attention to the optimal allocation of teaching resources. At present, there are problems of uneven distribution and low utilization efficiency of physics teaching resources in some colleges and universities, which restrict the improvement of teaching effect to some extent. Therefore, through teaching reform, the allocation of teaching resources can be further optimized, realize resource sharing, and improve the fairness of education<sup>[5]</sup>. At the same time, the optimal allocation of teaching resources can also help improve

students' interest and enthusiasm in learning. For example, by introducing advanced experimental equipment and teaching software, a more intuitive and vivid physics learning experience can be provided to students, stimulating their desire for exploration and the spirit of innovation. This student-centered teaching method helps cultivate students' independent learning ability and innovative thinking, laying a solid foundation for their future career development.

### **2.3. Promote interdisciplinary integration and expand the space for the development of disciplines**

Under the background of the integration of production and education, the teaching reform of college physics courses should also pay attention to interdisciplinary integration. As the basic subject of natural science, physics has a close relation and cross with other subjects. Promoting interdisciplinary integration, can not only expand the research field and application scope of physics but also provide new ideas and methods for the development of other disciplines <sup>[6]</sup>. In addition, interdisciplinary integration also helps to cultivate students' comprehensive quality and innovative abilities. In interdisciplinary study, students can be exposed to knowledge and ways of thinking in different fields, thus broadening their horizons and improving their ability to solve problems. This comprehensive way of learning helps cultivate compound talents with innovative thinking and practical ability to adapt to the diversified needs of modern society.

### **2.4. Promote students' comprehensive development and enhance their comprehensive quality**

As a basic course for science and engineering students, college physics plays an irreplaceable role in cultivating students' scientific literacy, logical thinking and experimental ability. Through teaching reform, more attention can be paid to cultivating students' practical ability and innovative spirit, so that they can not only master physics knowledge, but also combine theoretical knowledge with practical application, and improve their ability to solve practical problems <sup>[7]</sup>.

- (1) In terms of teaching content, the introduction of physics knowledge related to practical application can be strengthened to guide students to understand the application and development trend of physics in modern industry. Some comprehensive and innovative experimental projects can also be added so that students can deepen their understanding of physics knowledge in practice, and cultivate their hands-on ability and innovative thinking.
- (2) In terms of teaching methods, more modern teaching means and methods can be introduced, such as multimedia teaching, online teaching, etc. to improve the teaching effect and students' learning interest. At the same time, it can strengthen the interaction and communication between teachers and students, encourage students to ask questions, discuss and share, and cultivate their ability of independent and cooperative learning.
- (3) In terms of the evaluation system, a more scientific and comprehensive evaluation system can be established, which not only pays attention to students' knowledge mastery but also pays attention to their ability development and the improvement of comprehensive quality. Through diversified evaluation methods, students' learning results and potential can be reflected more comprehensively, and strong support can be provided for their future career development and life planning.

### **3. Difficulties in the teaching of college physics**

In the current educational environment, college physics teaching is faced with a series of dilemmas, which restrict the promotion of teaching reform and the improvement of curriculum quality to some extent.

#### **3.1. Outdated course content and difficulty in adapting to the needs of modern industrial development**

At present, a major problem faced by college physics courses is that the course content is outdated and difficult to adapt to the development needs of modern industry. Many physics textbooks still stay in the traditional theoretical system, lack of attention to the emerging science and technology and industry fields, resulting in students in the process of learning to access to the frontier physics knowledge and technology.

#### **3.2. Single teaching methods, lack of innovation and pertinence**

In college physics teaching, the single teaching method is also an urgent problem to be solved<sup>[9]</sup>. Traditional lecturing teaching is still the mainstream, which often focuses on the indoctrination of theoretical knowledge, but neglects the cultivation of students' practical ability and innovative thinking. In addition, some teachers lack the spirit of innovation and awareness of exploration, and it is difficult to introduce new teaching concepts and methods into teaching, which makes the teaching process seem monotonous and difficult to stimulate students' interest and enthusiasm in learning. At the same time, due to the differences in the basic knowledge and learning ability of different students, a single teaching method is difficult to meet the needs of all students and lacks pertinence and individuation.

#### **3.3. Weak practical teaching links and lack of practical operation ability**

Practical teaching is an indispensable part of college physics teaching, which helps students combine theoretical knowledge with practical application and improve their ability to solve practical problems. However, at present, the practical teaching links of college physics courses in many colleges and universities are relatively weak, lacking of practical opportunities and platforms. On the one hand, it is difficult for some colleges and universities to meet the experimental needs of all students due to the lack of experimental equipment and limited experimental sites. On the other hand, some colleges and universities lack innovation and pertinence in the design and arrangement of experiment content, and it is difficult to truly achieve the purpose of practical teaching.

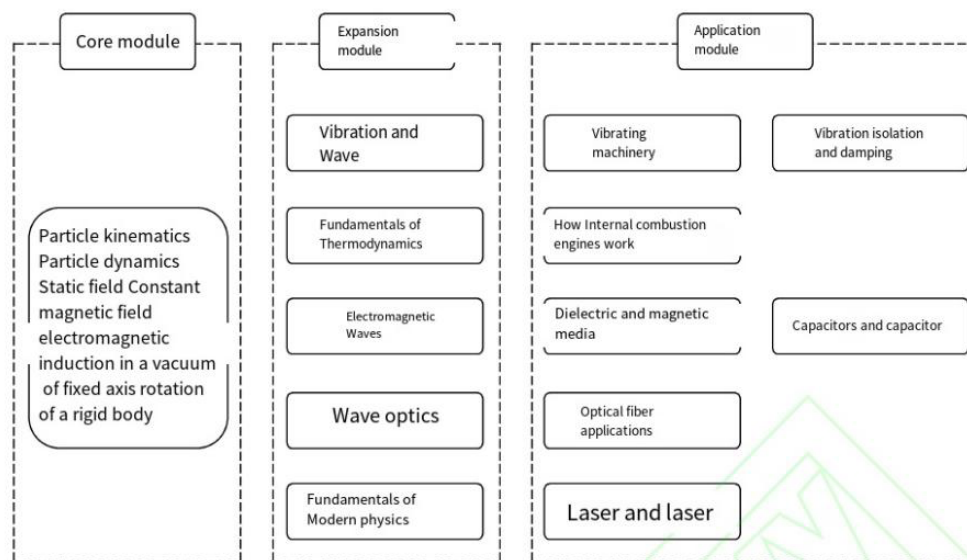
#### **3.4. Imperfect evaluation system and difficulty in fully reflecting the actual level of students**

In the current college physics course evaluation system, there are some imperfections, it is difficult to fully reflect the actual level of students. The traditional evaluation methods tend to pay too much attention to students' exam results but ignore the evaluation of their practical ability, innovative thinking and comprehensive quality. This single evaluation method tends to lead students to pursue scores too much and neglect the cultivation of the ability to truly understand and apply physics. Therefore, under the background of the integration of industry and education, the reform of college physics teaching needs to improve the evaluation system, establish diversified evaluation standards and methods, fully reflect students' knowledge mastery, ability development and comprehensive quality improvement, and provide strong support for students' comprehensive development.

## 4. College physics course teaching reform under the background of integration of industry and education

### 4.1. Suggestions on the reform of teaching content

For the college physics course under the background of the integration of production and education, the optimization and adjustment of teaching content is its basic requirement, which makes it the key link of teaching reform and an important way to train high-quality talents<sup>[10]</sup>. As an important carrier to implement the integration of production and education, the adjustment and optimization of teaching content should be centered on the talent training plan, according to the basic requirements of college physics teaching formulated by the Ministry of Education, combined with the needs of industrial development, professional construction and students' characteristics, science teaching syllabus and examination syllabus. Besides, teaching content should be divided into core modules, expansion modules, application modules and other modules. The specific framework is shown in **Figure 1**.



**Figure 1.** Teaching content framework design.

#### (1) Consolidate the foundation and strengthen the backbone core content

Physics is the cornerstone of natural science, so it is very important to strengthen the teaching of basic theory for the cultivation of students' professional quality. Therefore, in terms of laying a solid foundation, teachers need to pay more attention to the core content of college physics courses such as mechanics and electromagnetism to ensure that students can firmly grasp the basic concepts, principles and laws of physics. By strengthening the teaching of the main knowledge, through the explanation of the profound and simple, vivid cases and appropriate exercises, they can help students build a more complete physics knowledge system, lay a solid foundation for students in physics, and provide strong support for their subsequent professional learning and scientific research innovation. On this basis, teachers also need to pay attention to the frontier dynamics of physics and introduce the latest scientific research achievements and academic progress into teaching, so that students can timely understand and master the development dynamics and trends of physics.

#### (2) Flexible docking to meet the needs of industrial development

In the higher education system, different majors have different knowledge structures and skill

requirements, and different industries have different needs for talents. Therefore, the optimization of the teaching content of college physics under the background of the integration of industry and education should fully consider the characteristics of students' majors and the trend of industrial development, and carry out scientific selection and dynamic adjustment of the teaching content. For example, physics teaching for mechanical majors should emphasize mechanics, thermodynamics, mechanics of materials and other related knowledge, and help students understand the application of physical principles in mechanical design and manufacturing by introducing engineering examples and case studies. On this basis, given the emerging fields in the current industrial development, such as new energy, intelligent manufacturing, etc., college physics courses should appropriately increase the teaching content related to it, such as physical principles in new energy technology, physical applications in intelligent manufacturing, etc., to meet the demand for talents in the industry.

(3) Refine the content and focus on the essence of modern physics

As the frontier field of physics, although the content of modern physics is profound, many knowledge points contained in it are closely related to the future career development of students. Therefore, the adjustment of college physics course content under the background of the integration of production and education should pay attention to the selection of the representative and easy to understand content such as energy quantum and light quantum hypothesis, dynamics basis of special relativity, time and space view of special relativity, so that students can understand the frontier progress and development trend of physics. By refining the content, teachers can avoid over-in-depth and complex theoretical derivation, but focus on physical ideas, physical methods and physical applications, and help students establish an overall understanding of modern physics. At the same time, combined with the development of related industries and the application of cutting-edge technologies, teachers can further guide students to understand the application and value of modern physics in practical problems and stimulate students' learning interest and motivation.

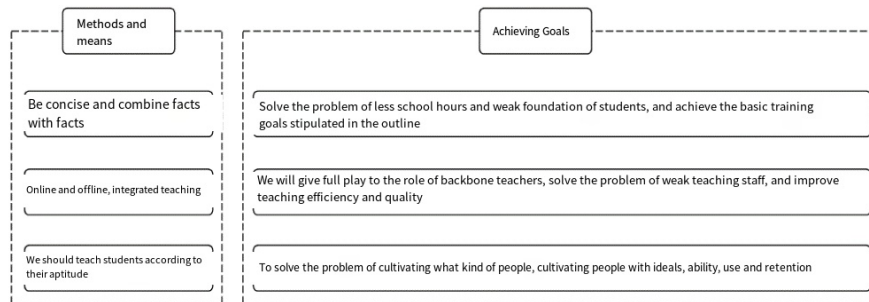
(4) Keep pace with the era and update teaching content according to scientific developments

With the continuous development of science and technology, new knowledge and technology in the field of physics are constantly emerging. Therefore, under the background of the integration of production and education, the content of college physics teaching should be updated from time to time with the update of knowledge and the development of technology, the latest scientific research results and technology applications should be incorporated into the physics knowledge system on time, and the presentation of new knowledge and new technology should be flexibly selected. For example, by introducing the latest physics experiments and research results, teachers can let students understand the important role of physics in solving practical problems. They can also use modern teaching means such as multimedia and network resources to show physical phenomena and principles in the form of videos and animations, to make the teaching content more vivid <sup>[12]</sup>. In addition, teachers should also encourage students to pay attention to the latest developments in the field of physics, broaden their knowledge horizons and cultivate their innovation awareness and practical ability by reading academic papers and attending academic lectures.

## 4.2. Suggestions for reform of teaching methods

According to the survey, the total number of class hours of college physics courses in various colleges and universities is mostly between 32 and 72 class hours, which is lower than the reference class hours given by

the basic requirements of college physics teaching designated by the Ministry of Education. In addition, due to the weak physics foundation of some students and the lack of physics teachers in schools, the development of physics teaching is faced with many difficulties. Under the background of the integration of production and education, to solve the difficulties in college physics teaching, teachers need to further reform the teaching mode, teaching methods and means of physics. Refer **Figure 2**.



**Figure 2.** Reform of college physics teaching methods.

(1) Concise, combining science and practice

Under the background of the integration of production and education, because of the reality that physics is limited in college and students' foundation is weak, teachers can adopt concise teaching strategies in the process of teaching reform to realize the close combination of theory and practice. In essence, teachers need to conduct an in-depth analysis of the teaching content, extract the core concepts, basic principles and key knowledge points, explain in concise and clear language, avoid a lengthy theoretical deduction, and ensure that students can accurately understand the concepts and principles of physics. Elaboration refers to the design of targeted exercises and experiments so that students can consolidate and apply what they have learned in practice, and improve their ability to analyze and solve problems. In the teaching process, teachers should pay attention to the combination of theoretical knowledge and practical application, through case analysis, project-driven and other ways, so that students can apply the knowledge to practical problems. For example, in the mechanics section, practical cases such as bridge design and vehicle movement can be introduced so that students can understand the application of mechanics principles in the process of analyzing problems. In the electromagnetics part, it can be combined with the design and manufacture of electronic equipment, so that students can understand the important role of electromagnetics in electronic information technology.

(2) Integrate teaching online and offline

With the continuous development of information technology, online and offline integrated teaching has become an important trend in the field of higher education. Under the background of integration of production and teaching, college physics courses should also actively explore the teaching mode of integration of online and offline to improve teaching efficiency and students' learning experience. In terms of online teaching, teachers can make use of network platforms and teaching resources to build online learning communities and provide students with rich learning resources and interactive platforms. By recording teaching videos, uploading courseware materials and organizing online discussions, teachers can guide students to learn independently, answer students' questions in time, and promote students' in-depth understanding and application of physics knowledge<sup>[13]</sup>. In offline teaching, teachers should pay attention to the interaction and effectiveness of face-to-face classes, and stimulate

students' learning interest and enthusiasm by designing a variety of teaching activities and practical projects. At the same time, teachers should also pay attention to students' differences and learning needs, provide personalized tutoring and guidance, and help students solve difficulties and problems in learning.

(3) Teach students according to their aptitude

Course ideology and politics is one of the important tasks of higher education, aiming at cultivating students' ideological quality, moral sentiment and feelings of family and country through the teaching of professional courses. Under the background of the integration of industry and education, college physics courses should also actively integrate ideological and political elements to realize the organic combination of professional education and ideological and political education. Specifically, teachers can guide students to establish a correct view of science and values by combining the development history of physics, scientific spirit and deeds of physicists. On this basis, teachers can also explore the philosophical thoughts, aesthetic values and social significance in physics, so that students can improve their humanistic literacy and comprehensive quality while mastering physics knowledge. In terms of teaching students according to their aptitude, teachers should formulate personalized teaching plans and strategies according to students' professional characteristics, learning basis and interests. For students with weak foundations, teachers can strengthen the teaching and consolidation of basic knowledge. For students with a strong interest in learning, teachers can guide them to deeply explore the frontier fields and application directions of physics, and promote their all-round development.

(4) Industry-university-research and application with innovative practice

The core of the integration of industry and education is to realize the deep integration of education and industry and promote the seamless docking of talent training and industrial needs. Therefore, in college physics teaching, teachers should actively introduce the teaching mode of integrating production, study, research and application, and guide students to participate in actual scientific research projects, industrial practices and innovative activities. Through cooperation with the industry, teachers can obtain the latest industry information and technological trends and integrate them into the teaching content, making the teaching more targeted and practical. At the same time, students can also improve their ability to solve practical problems by participating in practical projects to understand industry needs and technology applications. In terms of innovation practice, teachers can encourage students to participate in discipline competitions, innovation and entrepreneurship and other activities to cultivate their innovation awareness and practical ability. By setting up innovation and entrepreneurship platforms, and providing guidance and support, teachers can help students apply physics knowledge to practical projects and realize knowledge transformation and value enhancement<sup>[14]</sup>. In addition, the teaching mode of integrating production, university, research and application can also help strengthen the contact and cooperation between the school and the industry and promote the deep integration of production, university, research and application.

### 4.3. Optimize evaluation and all-round development

The evaluation mechanism is an important means to test the teaching effect and students' learning results. Under the background of the integration of production and education, the evaluation mechanism of college physics courses should be further optimized, focusing on the comprehensive evaluation of students' knowledge mastery, ability improvement and quality development. To be specific, teachers can take the following measures:



- (1) Build a diversified evaluation system. In addition to the traditional closed-book examination, open book examination, course design, experiment report, classroom performance and other evaluation methods can be introduced to fully reflect students' learning and comprehensive quality.
- (2) Focus on process evaluation. Process evaluation emphasizes the attention to students' learning process, which helps to find the problems and shortcomings of students in the learning process. Teachers can learn about students' learning progress and difficulties from time to time and provide timely feedback and guidance through classroom observation, homework correction and group discussion.
- (3) The assessment of practical ability should be strengthened. Under the background of the integration of production and education, college physics courses should pay more attention to the assessment of students' practical ability. Teachers can design challenging experimental projects or innovative tasks, requiring students to apply their knowledge to solve practical problems and display before evaluating them through experimental reports and project results <sup>[15]</sup>. Through the assessment of practical ability, teachers can test students' ability to apply theoretical knowledge to practical problems and promote their organic integration of theory and practice.

## 5. Conclusion

The reform of college physics teaching under the background of the integration of industry and education is a process of constant exploration and practice. In the process of college physics teaching reform, teachers should promote college physics courses to better meet the needs of industrial development and train more high-quality talents with innovative spirit and practical ability through the combination of theoretical knowledge and practical application, online and offline integrated teaching, curriculum thinking and politics and teaching following aptitude, innovative practice of industry-university-research and optimization of evaluation mechanism. On this basis, teachers should constantly update their educational concepts and methods, improve their professional quality and teaching ability, and make their contributions to the reform and development of college physics teaching.

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