



Exploration and Research of Curriculum Ideological and Political Education into College Physics

Xiaomin Zhang^(✉) and Xiyang Gao

School of Artificial Intelligence, Wuhan Technology and Business University, Wuhan 430065, Hubei, China

zhangxiaomin@wtbu.edu.cn

Abstract. Ideological and political education (IPE) is the fundamental task for colleges to implement moral education, and teachers should integrate it into the college physics curriculum education. The college physics is an important course for science and engineering majors in universities, which is theoretical and hard to understand. This paper introduces classical teaching cases, and excavates IPE elements, by adopting the online and offline blended course, the teaching reform scheme of college physics under the department of IPE is explored. The teaching effect shows that the college physics course which is integrated with IPE elements has improved students' learning ability and comprehensive quality.

Keywords: college physics · ideological and political education (IPE) · blended teaching · course assessment

1 Introduction

General Secretary Xi Jinping pointed out at the 2016 National Conference on ideological and political education (IPE) Work in universities: “Each course should keep a good section of the canal and plant a good field with responsibility, so that all kinds of courses can go in the same direction and form a synergy effect as the IPE theory courses”. Physics is the natural science that studies the basic structure of matter, the fundamental forms of motion and interactions. In the process of human's pursuit of truth and exploration for unknown world, physics has demonstrated a series of scientific worldviews and methodologies [1]. The college physics course, which is based on the fundamentals of physics, has an undervalued role in developing students' thinking skills and scientific literacy, correctly understanding objective things and forming a materialistic world view [2]. Physics encompasses the large and the small, the old and the new. From the atom to galaxies, from electrical circuitry to aerodynamics, physics is very much a part of the world around us. Therefore, it is a challenge for every teacher to explore the IPE elements which can make the college physics course lively and interesting [3]. Also, it's important for every teacher to integrate curriculum IPE into the college physics classroom, so that physics knowledge can be taught and values can be guided. As a basic course for science

and technology majors in universities, college physics courses should also respond to the needs of the times and carry out IPE in the courses to achieve collaborative education for students. Research articles on ideological and political issues in college physics have been emerging in recent years [4–9]. Currently, traditional teaching methods are still employed in college physics education, and the teaching tools are quite basic, which makes it difficult to stimulate students' interest [10]. However, incorporating a blended teaching approach into college physics course can emphasize students' central roles and enhance their capacity for both learning and application [11, 12].

Based on the students' cognitive characteristics and quality requirements, this paper builds the curriculum system according to the overall positioning requirements of the major. The idea of IPE is elevated to a new level in terms of educational goals and standards. The online and offline blended teaching method is adopted to integrate the IPE elements into the college physics, so as to give full play to the IPE function of this course. From the analysis report of students' course scores and teaching feedback, it can be seen that integrating IPE elements into college physics teaching can significantly improve students' interest in learning, and students prefer this teaching method.

2 The Importance of IPE in College Physics

College Physics is a basic course for science and engineering majors. The three-dimensional teaching objectives of college physics are shown as follows:

- Knowledge objectives: To enable students to acquire a comprehensive and systematic understanding of the basic concepts, principles and laws of physics.
- Capability objectives: To enhance students' capacity for logical thinking, abstract thinking, and problem-solving.
- Quality objectives: To cultivate students' scientific literacy, correctly understand objective things, form a materialistic world outlook, and strengthen their patriotism.

This subject covers the theory of forces, heat, light, electricity, magnetism, and other physical phenomena [13]. It provides a good physical basis for students to learn in subsequent professional courses and engage in independent scientific research. In addition, it can help students develop accurate knowledge, the capacity to approach problems scientifically, and strong scientific literacy. Therefore, teachers must possess the proper value guidance skills in order to develop the nation's future brilliance. In the course of college physics, IPE should be integrated to achieve the basic teaching goal of establishing morality and cultivating people. At the same time, it is more significant to implement IPE in college physics courses [14]. First, it's simpler to explore the IPE elements found in college physics. Second, college physics has a wide coverage because it is a public basic course, which benefits students more. Finally, college is a crucial period for students to form a correct outlook on life, and a good beginning is half the success. Therefore, it is urgent to implement IPE in college physics curriculum.

3 The Classical Cases of IPE in College Physics

Physics is an all-embracing science that connects the ancient and modern worlds and blends the East and the West. The scientific genes of traditional Chinese culture can be explored in the course delivery. Students will be guided to establish the correct scientific thinking and the remarkable contributions in the development of modern and contemporary physics. Also, students will be lead to learn the lessons of history, to build national confidence, to promote the excellent Chinese traditions and to strive for national rejuvenation and for the establishment of a community of human destiny. In the course of college physics lectures, students are able to understand and deepen their knowledge of the theoretical points through typical teaching examples, which makes the abstruse theoretical knowledge straightforward to visualize.

For example, materialist worldview education can be reinforced during the teaching of particle dynamics. That is, the world is material, all substances are in motion, the forms of material movement are diverse, and the development of materials are regular.

During the teaching of Bernoulli's equation in fluid mechanics, the elements of traditional Chinese culture are introduced [15]. The course can be started through a Tang poem: "The spring tide comes in the evening with rain, and no one is in the boat at the wilderness", which leads student to analyse the physical phenomena discovered by the poet and discover the genes of physics in traditional Chinese culture.

The second law of thermodynamics teaches that the natural tendency of isolated systems is to proceed in the direction of increasing disorder. The systems must be consumed by the outside world if they want to maintain a stable and orderly state. An analogy can be drawn here to introduce a reflection on the scientific basis of the idea about a community of human destiny. Only when all mankind forms a unified system, builds a community of human destiny and forms a game between human systems and the natural world, can mankind achieve common development and move towards a further future.

The teaching of Coulomb's law in electrostatic fields will often reveal that students make some incorrect applications. That is, when r tends to 0, consider F as infinity. The reason for the error here is that q cannot be regarded as a point charge when r tends to 0, so the original theory must be corrected. Here students can be taught to avoid dogma and be realistic, that any theoretical experience has a scope of application and cannot be directly copied and used, it must be modified to suit the specific situation, and the modification itself can become new ideas and great theories.

It's a fascinating topic to discuss the nature of light in wave optics. The conflict between Newton's particle theory and Huygens' wave theory in the 17th century marked the beginning of the discussion on the nature of light. However, by the 18th century, the one-sided pursuit of Newton's authority had stalled the discussion. Until the 19th century, people emancipated their minds and established wave optics, which contributed to the formation of the wave-particle duality theory in the 20th century. This example can teach students how to think critically, liberate their brains, and seek the truth in the facts, so that they can overcome partiality as well as authority-following and possess the bravery to shatter free of the ideological restraints, and cultivate an innovative spirit.

Some significant historical findings can be introduced to students as they study electromagnetic interaction. The quantitative study of electricity was initiated by the publication of Coulomb's law in 1785, which was a systematic study of electrostatic

interactions. The transition from electrostatic research to dynamic electricity began with the invention of the electric stack by Volta in 1800, and made it possible to obtain a steady current. Then in 1820, Oster discovered the magnetic effect of current, which made a breakthrough in the isolation of electricity and magnetism. In the same year, Ampere made a thorough study of the electromagnetic interaction and proposed Ampere's Law. In 1831, Faraday's contribution was particularly notable. He discovered the electromagnetic induction phenomenon, which further revealed the internal relationship of electromagnetic phenomena. In 1865, based on the achievements of predecessors, Maxwell summarized all electromagnetic theories into a set of equations, namely Maxwell's equations, and established a complete set of electromagnetic theories. By introducing the research history of electromagnetic interaction, students can realize that in the process of learning and exploring new things, they should develop a sense of national confidence and learn to summarize on the basis of predecessors. This example can encourage pupils to think scientifically, to be curious, and to solve physical difficulties.

When talking about the Compton effect, it is natural to talk about Wu Youxun, one of the great masters of Chinese physics. The scattering curve of 15 kinds of substances he made is one of the most powerful experimental evidences of Compton effect and plays a key role. Students can be impressed by his scientific outlook and rigorous scientific approach through the introduction of this example, as well as by his patriotism in twice declining Compton's invitation to return to his nation, which teaches them about family and patriotism. There are numerous instances of eminent academics who choose to return to their native nations despite enjoying favorable circumstances overseas.

The college physics teaching material must be integrated into the teaching process under the IPE teaching objectives of the course, and gradually the educational role of IPE courses in the process of restructuring the knowledge and optimizing the content must be highlighted. To provide students a proper perspective on life and values, socialist core principles will be promoted and content that complies with contemporary needs will be incorporated into classroom teaching.

4 Reform and Practice of IPE in College Physics

4.1 Exploring College Physics' IPE Elements

Deeply promote the "three integrity education" with the high-quality development of curriculum ideology and politics. By incorporating IPE elements into the original curriculum, students can develop the scientific spirit of rigorous learning and establish a proper outlook on life and values; they can also develop the spirit of patriotism and inspire students' patriotism; they can develop the noble sentiments, dedication, innovation, and craftsmanship; they can develop the "four self-confidences;" and they can develop their creative thinking and innovative, entrepreneurial, and creative thinking. The primary instructional content and how the IPE elements were incorporated are shown as follows:

In the Sect. 1-1 Description of Particle Motion, the IPE element is about "Success-relating factors". The teaching expansion can be displayed like: Initial conditions, motivation and perseverance all affect the final result and whether a thing can be done successfully.

In the Sect. 1–2 Motion in a Circle, the IPE element is about “Core socialist values, legal system”. The teaching expansion can be displayed like: “No rules, no square”. Every citizen has a duty to uphold the law and order out of moral and social responsibility.

In the Sect. 2–1 Work and Kinetic energy, the IPE element is about “Quantitative and qualitative change”. The teaching expansion can be displayed like: Life is full of examples of quantitative and qualitative change. The proverbs “ten years sharpen a blade,” “a thousand mile dike is ruined in an ant nest,” “a minute on the stage and a decade off the stage,” etc. All convey the same truth: the key to success is persistence.

In the Sect. 2–2 Potential Energy and Energy Conservation, the IPE element is about “Outlook on life and values”. The teaching expansion can be displayed like: People will confront numerous forms of resistance along the way to achievement. Only by overcoming these resistance can people accumulate more “energy” and make themselves fly higher and further from success.

In the Sect. 3–1 Rotation of Rigid Bodies, the IPE element is about “Development perspective”. The teaching expansion can be displayed like: The progression from particle dynamics to rigid body mechanics corresponds to the change in the research object from “point” to “body”, which follows the way that people generally understand things from simple to complex. So that students’ opinions on the professional training plan’s ineffectiveness of particular courses can be accurate.

In the Sect. 3–1 Dynamics of Rotational Motion, the IPE element is about “Universally views”. The teaching expansion can be displayed like: Teachers must always adhere to the idea of connection and reject the idea of isolation. In the course of their personal development, pupils learn to see not only who they are but also how they fit into society. They are self-enclosed and self-satisfied.

In the Sect. 4–1 Gauss’s Law, the IPE element is about “Scientific method and dialectical materialist worldview”. The teaching expansion can be displayed like: Learn the scientific mindset of people who are not scared of challenges and dangers, who seek the truth, who dare to invent, who pursue their studies with rigor. So that students can be guided toward developing the right outlook on life and morals.

In the Sect. 4–2 Electric Potential, the IPE element is about “Analogy”. The teaching expansion can be displayed like: Students will be taught to select familiar items and study objects from the aspects of research methodologies, functional characteristics, causality, etc. to draw scientific laws and build their capacity for scientific logic through the use of the analogy between electromotive force and water pump.

In the Sect. 5–1 Faraday Law of Electromagnetic Induction, the IPE element is about “Creative thinking, entrepreneurship, and innovative thinking”. The teaching expansion can be displayed like: The generator was created by the practical application of electromagnetic induction theory, which also gave birth to commercial electric power companies and ushered in the electrical era. It doesn’t matter if it’s Faraday’s experiment’s success, Clayton’s experiment’s failure, or Maxwell’s theory of the electromagnetic field from a symmetry perspective, these are good resources for innovation, entrepreneurship, and creative education.

In the Sect. 5–2 Motional Electromotive Force and Induced Electric Field, the IPE element is about “Socialist Core Values, harmony”. The teaching expansion can be

displayed like: Terrorism in Xinjiang, Tibetan independence in Tibet, and Western anti-China movements have all negatively impacted social stability and a peaceful, civilized life.

In the Sect. 6–1 The First Law of Thermodynamics, the IPE element is about “Core socialist values, dedication”. The teaching expansion can be displayed like: Continuous work is not possible without providing energy. If students want to make contributions to society, they should study hard and increase knowledge.

In the Sect. 6–2 The Second Law of Thermodynamics, the IPE element is about “Life attitude”. The teaching expansion can be displayed like: The efficiency of a heat engine cannot be 100%. There are no short cuts to success in education or in life. Nothing can be obtained without effort.

4.2 Adopting Online and Offline Blended Teaching Mode

Students’ engagement in class is insufficient in the standard college physics learning process, they frequently get distracted, and there is only one form of assessment, which cannot accurately reflect the students’ actual understanding. On the other hand, online learning lacks teacher guidance and is unable to overcome its own inertia.

Therefore, in order to improve the learning of college physics courses, this research combines online teaching platforms such as ChaoXing and Zhihuishu with traditional teaching methods, where using select classes from Wuhan Technology and Business University as objects. Blended teaching mode sets higher expectations for teachers’ teaching ability. In a blended teaching environment, teachers need possess not only the fundamental theoretical knowledge but also the ability to apply information technology. However, students can create a strong foundation for future professional course learning and practice by developing the habit of independent preview and independent thinking through this blended curriculum resources. To achieve the learning effect of being “task driven and problem oriented,” online and offline blended teaching is adopted, and the learning task list is utilized to develop the entire process independent learning framework for students before, during, and after class.

The first stage learning evaluation results are formed through independent learning before class. First, students accept the task, define the learning task, and learn the knowledge of this lesson by watching the video and courseware. Then, completing the objective test online through the learning test to evaluate their own learning. Finally, comparing to the task list, finish the learning task of relevant knowledge through practical operation.

The second stage learning evaluation results are formed through offline classroom collaborative research. First, teacher analyzes the learning results of the first stage and explains the key knowledge in class. Then, students finish the assignments in groups, submit their work, and teachers provide personalized guidance. Finally, the groups communicate with each other and complete the group mutual evaluation. The teacher discusses common issues in the learning process and gives the evaluation results of each group.

The final stage learning evaluation results are formed through consolidations after online and offline classes. First, based on the learning impact, students may individually decide to continue their education after class. After finishing their studies, the students have the option of expanding their knowledge and taking a self-test. Finally, once the

students complete the assigned task, the teacher gives evaluation according to the learning results.

4.3 Perfecting the Assessment System of College Physics

Many college physics courses are assessed by usual scores and final exam scores. Although this traditional assessment method is quite straightforward, it is challenging to assess students' comprehension. Therefore, it is necessary to integrate IPE into the examination of college physics courses. An open assessment system is developed in accordance with the course characteristics of college physics in order to fully integrate the IPE elements into the knowledge, ability, and quality covered by the process assessment and result assessment. So that students' enthusiasm and motivation for learning can be stimulated, and the teaching quality can be enhanced. In order to consciously incorporate the IPE elements into the college physics knowledge for students to learn and test independently, the IPE teacher and the college physics teacher jointly prepare a question bank based on the actual situation of students and the teaching content. In the question bank, select the questions covering the IPE elements in a certain proportion for the final examination, and effectively carry out the IPE examination of college physics in the form of discussion, quick answers, questionnaires, grouped tasks, practical operations, so as to diversify the examination forms and play a role in educating students silently. The quality of IPE needs to be evaluated with appropriate methods. Since the IPE is a gradual process to improve the students' ideological quality, it should not just focus on results, but should pay more attention to the cultivation of students and give them more opportunities for growth.

5 The Teaching Effect of IPE in College Physics

This research selects 405 students from Wuhan Technology and Business University in the academic year 2019–2022, including Microelectronics Science and Technology, Electronic Information Engineering, Internet of Things Engineering, and Communication Engineering.

The statistical chart of college physics final exam is shown in Fig. 1. With the promotion of IPE as well as the online and offline blended teaching, the pass rate has reached 93%, and the outstanding students account for 43%, which is a great improvement over previous data.

In Fig. 2, it is evident from the feedback of students' questionnaire that students enjoy the college physics curriculum with IPE elements. This also demonstrates that through the IPE, students can establish a correct view of the country, nationality, history, and culture, and strive to become talents with all-round development of moral, intellectual, physical, artistic, and labor skills, which has certain radiation and promotion value. Consequently, the primary goal of developing morality and raising students has been accomplished.

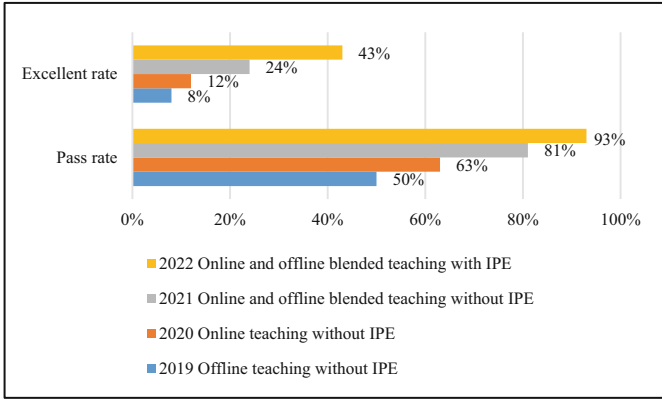


Fig. 1. Statistics of college physics final exam

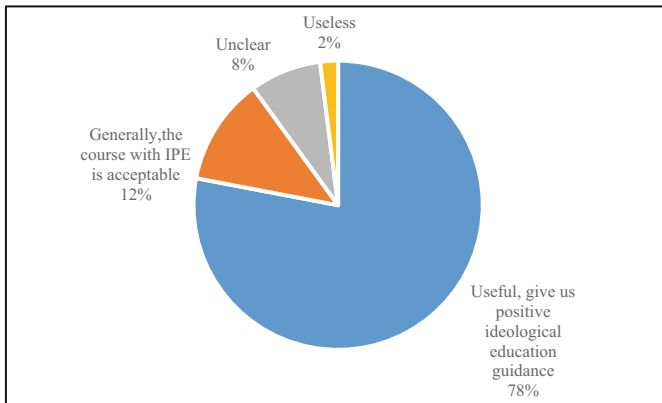


Fig. 2. Statistics of the usefulness of teaching ideological and political content in college physics

6 Conclusions

In this paper, the IPE is integrated into the college physics course, and a number of well-known teaching cases are presented. Through mining the IPE elements, the online and offline blended teaching mode is used, and the curriculum assessment is reformed. College physics teaching materials, teaching modes, and procedures have undergone some exploration and reform after years of study and practice. To attain the same attitude in teaching and educating students, the physics education together with IPE are organically integrated. Through further teaching reform, the better ideological and political courses will be implemented in college physics teaching.

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