Optimization of Instructional Resources for University Physics through Industry-Academic Integration Oriented towards Engineering Application Ability Development

Xiao Ma[1], Hongmei Gong[1], Xinshuang Liu[2,*]

[1]School of Optics and Electronic Information, Suzhou City University, Suzhou, 215104, Jiangsu, China

[2]School of Mathematics and Physics, Anqing Normal University, Anqing, 246011, Anhui, China

[*]Corresponding author

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Abstract: With the improvement of the application ability of talents in engineering field, the optimization of university physics instructional resources has become the key to cultivate high-quality engineering talents. This article focuses on the optimization of instructional resources of industry-academic integration of university physics for the cultivation of engineering application ability. At present, the instructional resources of university physics do not match the needs of engineering application ability training in terms of course content, teaching staff and practical teaching. Based on the concept of industry-academic integration, and adhering to the principle of cultivating students' engineering application ability, optimization strategies can be put forward from many aspects. In terms of course content, we should integrate engineering cases and build a modular teaching system. In the construction of teachers, it is needed to improve teachers' engineering practice ability and introduce enterprise experts to participate in teaching. In practical teaching, we should promote the co-construction and sharing of practical instructional resources inside and outside the school. It is expected that students' engineering application ability will be significantly improved and the teaching quality will be improved in an all-round way. The research shows that optimizing university physics instructional resources based on industry-academic integration can effectively solve the problem of disconnection between teaching and engineering practice, and provide strong support for the training of engineering application talents.

1. Introduction

In today's era of rapid development of science and technology and engineering, engineering application ability has become the key goal of talent training in universities [1]. University physics, as an essential basic course for engineering students, its teaching effect directly affects students' subsequent professional course study and the cultivation of engineering practice ability [2]. However, there is an obvious disconnect between university physics teaching and engineering application ability training [3]. Traditional teaching mode focuses on imparting theoretical knowledge, and instructional resources fail to effectively meet the actual needs of engineering, resulting in students mastering physical knowledge, but it is difficult to flexibly apply it to engineering practice scenarios [4].

In this context, industry-academic integration, as an innovative educational concept and model, provides a new opportunity for the optimization of university physics instructional resources [5]. Industry-academic integration emphasizes the deep cooperation between industry and education, aiming at making the teaching process closely meet the needs of industry, thus improving students' practical ability and innovative spirit [6]. Optimizing university physics instructional resources through industry-academic integration can make the teaching content more practical, the teaching staff more experienced in engineering practice, and the practical instructional resources more abundant, laying a solid foundation for the cultivation of students' engineering application ability.

The purpose of this study is to explore the optimization strategy of instructional resources for

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industry-academic integration of university physics for the cultivation of engineering application ability. By analyzing the present situation of instructional resources, excavating the existing problems, and combining the ideas and principles of industry-academic integration, this article puts forward targeted optimization strategies in order to improve the quality of university physics teaching.

2. Present situation of university physics instructional resources

University physics is an important basic course for science and engineering majors, and its instructional resources cover many key aspects such as course content, teaching staff, practical teaching and so on [7]. However, the current situation of university physics instructional resources is difficult to meet the needs of engineering application ability training, and there are many problems to be solved urgently.

Course content resources are the core of university physics teaching. At present, the curriculum content is mostly arranged in the framework of classical physics theory system. Although this arrangement is helpful to build a systematic physical knowledge system, it is not closely related to engineering practice. Many knowledge points only stay at the theoretical level and fail to fully show their specific application scenarios in the engineering field [8]. For example, when explaining the related knowledge of electromagnetism, we simply deduced the formula and expounded the principle, but did not analyze the electromagnetic equipment and electromagnetic interference in practical engineering in depth. This makes it difficult for students to understand the correlation between physical knowledge and their future careers, reduces their enthusiasm and initiative in learning, and is not conducive to cultivating their ability to solve practical engineering problems by using physical knowledge.

In terms of teaching staff resources, most teachers have solid knowledge of physics theory, but their engineering practice experience is generally insufficient. In the teaching process, they often focus on theoretical explanation, and are used to teaching step by step according to the content of the textbook, so it is difficult to integrate engineering cases into teaching vividly and concretely [9]. Due to the lack of the support of practical engineering background, the teaching content is empty and abstract, and it is difficult for students to have intuitive feelings and profound understanding. This not only affects the teaching effect, but also is not conducive to the cultivation of students' engineering thinking, which makes students lack the ability to analyze and solve practical engineering problems.

Practical instructional resources are also facing many difficulties. Part of the laboratory equipment in the school is outdated and cannot meet the needs of modern engineering practice [10]. Moreover, most of the experimental projects are confirmatory experiments, and students only need to follow the established steps to verify the known physical laws, lacking comprehensive and designed experiments. This experimental mode is difficult to stimulate students' innovative thinking and practical ability, and to cultivate their ability to design experiments and solve practical problems independently. The number of off-campus practice bases is limited, and the enthusiasm of enterprises to participate in college practice teaching is not high. Enterprises are often concerned about their own interests, fearing that students' internship will affect the production progress and reveal business secrets, and are unwilling to provide students with enough internship positions and practice opportunities [11]. This leads to fewer opportunities for students to actually participate in engineering practice, and the effect of practical teaching is not good, so they can't apply the physical knowledge they have learned to practical engineering.

To sum up, there are obvious problems in the course content, teaching staff and practical teaching of university physics instructional resources. In order to meet the needs of cultivating engineering application ability, it is needed to comprehensively optimize the instructional resources of university physics, strengthen the connection between course content and engineering practice, improve teachers' engineering practice ability and improve practical teaching conditions.

3. The path of optimizing instructional resources by industry-academic integration

3.1 Optimization principle

1) The guiding principle is to cultivate students' engineering application ability: It is always the core goal to improve students' ability to use physical knowledge to solve problems in practical engineering scenarios. The selection and design of instructional resources should focus on this goal, so that students can effectively associate physics principles with engineering practice through learning.

2) Principle of combining science with practicality: Educators should not only ensure the science and rigor of physics knowledge in instructional resources, but also pay attention to its practicality in engineering field. Practical training should avoid theoretical teaching content and ensure that the knowledge and skills students have acquired can be applied in practical engineering scenarios.

3) Principle of collaborative innovation: Universities and enterprises should break down barriers and cooperate with each other. Universities give full play to their advantages in scientific research and teaching, while enterprises provide practical engineering cases, practice sites and cutting-edge information in the industry to jointly innovate instructional resources and create a more innovative and practical learning environment for students.

3.2 Optimized path

Teachers can deeply investigate the needs of different engineering fields for physical knowledge, analyze the physical principles required by typical engineering cases, and reorganize and integrate the contents of university physics courses based on this. For example, in the field of mechanical engineering, mechanical knowledge in physics is needed to analyze the mechanical properties of materials, and the focus of teaching content in relevant chapters can be adjusted accordingly. Figure 1 shows the key physical knowledge points in various fields.

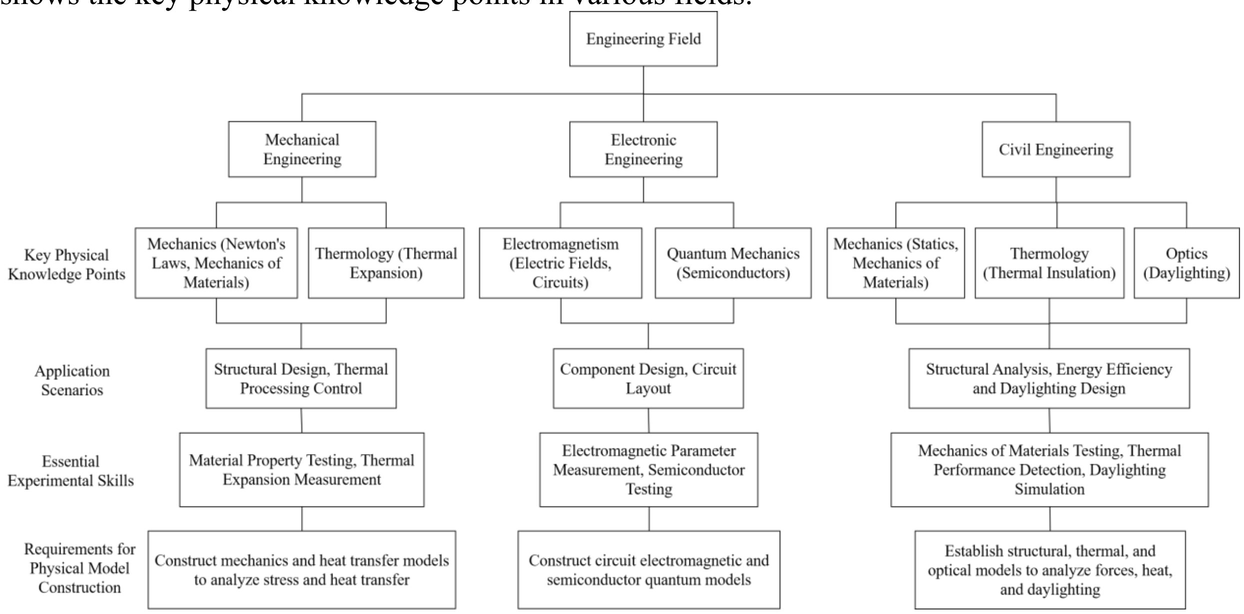

Figure 1 Physics Knowledge Requirements in Different Engineering Fields

On the one hand, universities regularly send teachers to enterprises for attachment training, participate in actual engineering projects, and accumulate engineering practical experience, so as to better integrate practical cases into teaching. On the other hand, enterprises send senior engineers to universities as part-time teachers to directly teach students the skills and experience of physics application in engineering practice. In addition, universities and enterprises can also cooperate to develop practical instructional resources, such as building laboratories and jointly designing and developing comprehensive and designed experimental projects, so that students can exercise their engineering application ability in real engineering environment.

4. Optimization strategy of instructional resources

1) Optimization of course content resources

Combined with the needs of the industry, the actual engineering cases are deeply integrated into the teaching content. For example, when explaining electromagnetic induction, the working principles of generators and transformers in power system are introduced, so that students can understand the application of physical principles in practical power engineering. At the same time, a modular curriculum system is constructed to meet the needs of different engineering majors. According to the emphasis on physical knowledge in different engineering fields, it is divided into modules such as mechanics, electromagnetism and optics. Guided by Figure 2, the content of the course module is adjusted and optimized.

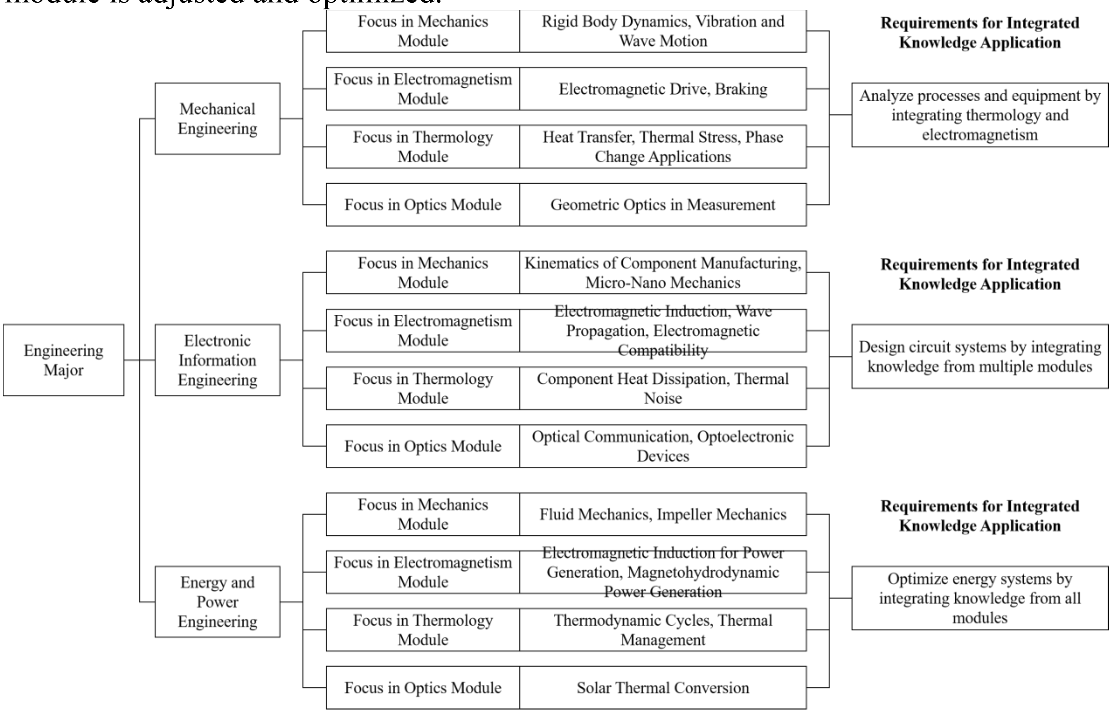

Figure 2 Key Focus of Physics Course Modules in Different Engineering Majors

2) Optimization of teaching staff resources

Teachers' engineering practice ability should be improved, and universities and enterprises should establish a joint training mechanism. Teachers regularly go to enterprises to participate in project research and development, and enterprises provide practical platforms and instructors for teachers. For example, physics teachers can be arranged to participate in the collision safety test projects of automobile manufacturing enterprises to deepen their understanding of the application of mechanics knowledge. At the same time, a mechanism for enterprise experts to participate in teaching should be established, inviting senior engineers from enterprises to serve as visiting professors, hold lectures regularly, and participate in curriculum design. Taking mechanical engineering as an example, enterprise experts can explain the application of physical principles in mechanical design in combination with actual production, and broaden students' horizons.

3) Optimization of practical instructional resources

It is needed to strengthen the co-construction of laboratories in schools and enterprise practice bases. Schools should cooperate with enterprises to update experimental equipment and develop experimental projects that are closely integrated with engineering practice. For example, schools can collaborate with electronic enterprises to establish an electronic physics laboratory and carry out circuit board design and electromagnetic compatibility experiments. In terms of enterprise practice base, enterprises provide more opportunities for students to participate in practical projects. Enterprises and universities jointly formulate internship plans and define internship objectives and tasks. During the internship, students participate in projects with enterprise tutors, apply theoretical knowledge to practical work, and improve their engineering practice ability. Through these optimization strategies, we can build a perfect instructional resource system and effectively improve students' engineering application ability.

5. The expected effect and guarantee means of optimizing instructional resources

5.1 Expected results

1) Significant improvement of students' engineering application ability: Through the close combination of course content and engineering practice and rich practical teaching links, students can better apply physics knowledge to engineering scenes. It is expected that students' ability to analyze and deal with practical engineering problems will be greatly improved, and they can independently design solutions and implement them effectively.

2) Overall improvement of teaching quality: The optimized instructional resources will make the teaching process more vivid and practical, and stimulate students' interest and enthusiasm in learning. By participating in enterprise practice, teachers have more depth and breadth of teaching content, and the quality of classroom teaching has been improved. The needs of different engineering majors for physics knowledge have been accurately met, the connection between professional courses and university physics has been smoother, and the overall teaching quality has been comprehensively improved.

5.2 Safeguard means

1) Policy support and management system guarantee: The school should formulate policies to encourage industry-academic integration, and give support to teachers who participate in enterprise practice in terms of time, funds and professional title assessment. Special funds should be set up to support instructional resources optimization projects, such as cooperating with enterprises to develop courses and build laboratories. A strict instructional resources optimization management system should be established to clarify the responsibilities of various departments and personnel and ensure that all optimization work is carried out in an orderly manner.

2) Construction of teaching quality monitoring and assessment system: The school has established diversified teaching quality monitoring mechanism, including regular teaching inspection, students' assessment of teaching, peer assessment and enterprise feedback. To formulate scientific and reasonable teaching assessment indicators, we should not only pay attention to students' mastery of theoretical knowledge, but also pay attention to the assessment of their engineering application ability. According to the assessment results, the teaching strategies and resource allocation are adjusted in time to ensure that the optimization of instructional resources advances towards the expected goal. For example, a questionnaire survey on the practicality of teaching content is conducted every semester, and enterprise experts are invited to evaluate students' engineering practice ability every semester, which is an important basis for improving teaching. Through perfect guarantee means, it provides solid support for optimizing instructional resources and achieving expected results.

6. Conclusions

This article focuses on the optimization of instructional resources for industry-academic integration of university physics for the cultivation of engineering application ability. At present, there are many shortcomings in the cultivation of docking engineering application ability of university physics instructional resources, such as the disconnection between course content and engineering practice, the lack of engineering practice experience of teachers and the lack of practical instructional resources.

Based on the concept of industry-academic integration, the optimization strategy is targeted and feasible from three aspects: course content, teaching staff and practical instructional resources. By integrating the course contents into engineering cases and building a modular system, the teaching can better meet the needs of different engineering majors. Teachers enhance the engineering practicality of teaching by improving teachers' practical ability and introducing enterprise experts;

Practical instructional resources provide more practical opportunities for students by building bases inside and outside the school.

Through these optimization strategies, it is expected that students' engineering application ability can be significantly improved, the teaching quality can be improved in an all-round way, and a guarantee system can be built from the aspects of policy support and quality monitoring to ensure the smooth progress of optimization work. However, this study has some limitations in tracking the long-term implementation effect of the optimization strategy and the influence of different disciplines on the strategy. Future research can further strengthen the long-term assessment of the implementation effect of the optimization strategy, and explore the uniqueness of the optimization of instructional resources in different disciplines, so as to continuously improve the optimization scheme of university physics instructional resources.

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