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Optimization Design and Practice of Interdisciplinary Specialty Elective Course "Foundation of Engineering Technology" under the Background of New Business

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Abstract: *Foundation of Engineering Technology is an interdisciplinary elective course for students majoring in finance and economics in our university under the background of New business, which mainly cultivates students' engineering literacy and labor skills. Aiming at the deficiency of current teaching, this course has been optimized design and practice. The research method of comparative experiment analysis is adopted to analyze the effect of reform. The practice shows that the optimized course improves the effectiveness of classroom teaching and promotes the practical ability and engineering quality of business students.*

Keywords: *New business, Foundation of engineering technology, Optimization design, Effect of reform*

1. Introduction

In May 2019, 12 ministries and commissions including the Ministry of Education launched the "Six Excellence and one Excellence" Plan 2.0 project and began to comprehensively promote the construction of "New engineering", "New medical science", "New agricultural science" and "New liberal arts". "New Business" is a new concept to carry out economic management education under the concept of "New liberal arts". It reorganizes and intersects traditional business disciplines, integrates new technologies into business courses, and provides comprehensive interdisciplinary education for students with new ideas, new models and new methods.

The concept of "New business" has been put forward since 2019. The curriculum system, teaching mode and teaching method of new business are also rising in China, and domestic scholars have carried out certain theoretical and practical exploration in this aspect. In terms of the introduction of the theory and model of the New business science, Guo Chen, Likun Wei, Zhaohui Lu, Tuo Wang, Weiwei Ren (2021) and others have made corresponding discussions on the origin, definition, characteristics and development conditions of the new business science [1-3]. Ying He, Jia Guo, Suxin Rong, etc., based on the perspective of business studies, conducted research on interdisciplinary integration and new liberal arts talent training paths [4]. Jiao Peng, Liyan Feng, Shiwen Wang, Shu Duan (2021) and others carried out specific research on the reform of professional courses under the background of New business [5-6]. All the above studies believe that new technologies should be integrated into business courses and comprehensive interdisciplinary education should be provided to students with new ideas, new models and new methods.

2. Course features and significance

Foundation of Engineering Technology is an interdisciplinary elective course for finance and economics majors in our school, which integrates engineering technology education and engineering quality. It aims to cultivate students' engineering knowledge and labor skills, enrich students' knowledge structure, enhance students' interdisciplinary thinking and improve their career competitiveness. And this course supports the teaching of subsequent interdisciplinary professional courses. The course is based on the basic knowledge of machinery and electronics, so that business students can understand the four

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industrial revolutions in the world and the status and role of China in the four industrial revolutions, and promote the spirit of power by explaining made in China; Always pay attention to students' engineering knowledge, so that students can understand the relevant content of intelligent manufacturing, obtain the special knowledge of contemporary science and technology frontier, and cultivate students' engineering knowledge; Highlight the cultivation of students' interdisciplinary thinking ability; Focus on the latest development of intelligent manufacturing and highlight the update of course content.

With the global new scientific and technological revolution and the development of new economy, non-engineering majors such as finance and economics and humanities and social sciences have shown a new development trend, breaking through the traditional thinking mode of liberal arts and business, and promoting cross-disciplinary and deep integration by taking inheritance and innovation, crossover and integration, collaboration and sharing as the main approaches. New requirements are put forward for talents in these majors in terms of hierarchy, knowledge structure and quality structure, so as to be able to keep pace with new engineering, new medicine and new agriculture, especially the combination of non-engineering majors such as finance, finance, management and humanities with engineering knowledge is becoming increasingly prominent. Engineering technical knowledge is a knowledge that applies scientific principles and follows the objective laws of the development of things, emphasizes seeking truth from facts and has strict logic. Carrying out engineering quality education for students is conducive to cultivating students' down-to-earth work style, hard work and teamwork spirit, and improving students' rational thinking ability and innovation consciousness.

3. Course Status

In June 2019, our school launched the construction of interdisciplinary elective courses, with the goal of integrating students' technical and business management abilities through the construction of a series of interdisciplinary elective courses, so as to cultivate good professional talents with characteristics of socialist core values. The objectives of the course are as follows:

Knowledge objective: To understand the basic knowledge of machinery, electrical and electronic engineering, intelligent manufacturing and other engineering.

Ability goal: master the use of common electromechanical tools at home, and cultivate students' labor skills.

Quality goal: stimulate students' labor consciousness and cultivate students' engineering literacy.

Ideological and political goal: to establish the values of advocating and respecting labor.

This course adopts modular teaching, which mainly includes four modules: mechanical technology foundation, electrical and electronic technology foundation, intelligent manufacturing and creative comprehensive application. Practice and theory time 1:1, a total of 32 hours. At present, three rounds of teaching have been conducted. Summarizing the three rounds of teaching, the curriculum team found the following problems in the teaching process:

(1) In terms of teaching methods, theoretical teaching basically adopts the traditional teaching method of "teaching and learning", and classroom teaching is mainly taught by teachers. Since finance and economics students generally lack basic engineering knowledge, students are easy to get tired of traditional teaching methods. In addition, the phenomenon of playing mobile phones is serious in large class teaching, and the theoretical teaching effect is not good.

(2) Some practical activities are set to be professional and not enough for life.

(3) Insufficient teaching resources. At present, the course "Foundation of Engineering Technology" is the first batch of interdisciplinary elective courses in our school, which has no teaching precedent in other universities in China, and there is no relevant teaching resources in the market. Due to the short construction period, its resources are mainly offline resources such as self-edited handouts, experimental instructions and multimedia courseware, and lack of online resources.

4. Teaching optimization design

The object-oriented course is mainly for students majoring in economics and management, involving 6 branches, 23 majors and two campuses (mainly Hangzhou Bay Campus). It is characterized by more girls, overall more outgoing, more ideas, and more lively classes. The disadvantage is the lack of

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engineering knowledge and weak practical ability.

According to the characteristics and shortcomings of students, the teaching strategies and methods adopted are as follows:

Selected teaching cases: pertinence, life, interest and timeliness;

Adopt suitable teaching methods: such as discussion method, physical demonstration method, field teaching method, flipped classroom method, etc

Pay attention to the choice of practical projects: close to life, practical projects are diversified, giving students a certain choice.

Multimedia courseware: in the form of GIFs, videos and other rich media.

It is optimized from teaching content, teaching method and teaching resources.

4.1 Teaching content optimization, increase the proportion of practical hours

In the current teaching, it is found that business students have little interest in the theoretical knowledge of this course, but have a high interest in practical courses. They can participate in and complete each experiment seriously. In order to ensure the learning effect and improve the practical ability, the ratio of theory and practice is adjusted from 1:1 to 1:2. The details are shown in Table 1.

Table 1: Class hours before and after teaching content optimization

<table>
<tr><th>Module</th><th>Theoretical teaching content</th><th>Practical teaching content</th><th>Instructions before and after optimization</th></tr>
<tr><td>Summarize</td><td>With the four industrial Revolutions as the main line, the characteristics and development of engineering technology are described through typical cases.</td><td rowspan="2">Experiment one: Cognitive experiment
The purpose of the experiment: to know the common mechanical tools, to know the common mechanism and transmission.
Experiment 2: Disassemble mechanical components
The purpose of the experiment: to select the appropriate mechanical tools for disassembly.
Experiment 3: three-dimensional modeling
The purpose of the experiment: to master the operation of 3D modeling software and lay a good foundation for the subsequent 3D printing.</td><td>The module has not changed and the theoretical class hours are 2.</td></tr>
<tr><td>Foundation of mechanical technology</td><td>Common mechanism and transmission introduction, industrial design software application. Introduction of famous companies such as Midea and Xiaomi through four global design awards.</td><td>Before the optimization of the module, the theoretical class hours are, and the practical class hours are 8. After optimization, the theoretical class hours are 2, while the practical hours remain unchanged.</td></tr>
<tr><td>Fundamentals of electrical and electronic technology</td><td>Common electronic components, household electricity knowledge and safety. Experts such as Zhaolin Zhong and YouSheng Wang will be introduced.</td><td>Experiment 4: Installation of lighting circuit
Experimental purpose: To master the common lighting circuit installation, wiring and maintenance methods.
Experiment 5: LED and digital tube display experiment
Experimental purpose: To master the display principle and wiring method of LED and digital tube.</td><td>Before the optimization of this module, the theoretical and practical class hours are 4 each. After optimization, the theoretical class hours are 2, and the practical class hours are 8.</td></tr>
<tr><td>Intelligent manufacturing</td><td>3D printing, industrial robots, smart agriculture. Discussion on famous enterprises such as China High Speed Railway, Huawei and DJI.</td><td rowspan="2">Experiment 6: Making creative products
Experimental purpose: to make creative products, such as smart fish design, creative model making, 3D printing, etc.</td><td rowspan="2">The content of these two modules intersects. Before optimization, the theoretical class hours are 6 and the practical class hours are 4. After optimization, the theoretical class hours are 2 and the practical class hours are 8.</td></tr>
<tr><td>Creative comprehensive application</td><td>Creative methods, creative works introduction.</td></tr>
</table>

In the course of teaching, the explanation is fully combined with life cases. For example, when talking about the basic module of mechanical technology, when introducing common mechanical parts and mechanisms, the abdominal turbine is selected to introduce the role of bearings, and the mechanism dog is selected to demonstrate the application of connecting rod mechanism, and the GIF is used to show. In the introduction of industrial design software, choose the software students are familiar with to introduce, such as MATLAB is the logistics management major needs to learn industrial design software, you can focus on Harbin engineering and Harbin Institute of Technology disabled events of the software for students to discuss. In the practice teaching of 3D modeling, the selected cases are targeted, life and interesting, such as the official seal familiar to economic and management majors, the table tennis bat of sports enthusiasts, and the carton dog that has recently become popular on the Internet.

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4.2 Optimization of teaching methods

In order to improve the effectiveness of classroom teaching, the curriculum team carefully designed each lesson and adopted different teaching methods according to the teaching content. Specific teaching methods are as follows:

Inquiry teaching. The teaching will focus on engineering and technology issues in enterprises, combine the characteristics of interdisciplinary students to set up teaching content, and manage the teaching process. Engineering and technical problems in enterprises can better reflect the process of finding problems → raising problems → analyzing problems → solving problems, and at present, it is also a problem of general concern to enterprises. Inquisitive teaching is adopted, and resources are mobilized to support the student-centered learning process through adequate dialogue between teachers and students.

Discussion teaching. The basic content of engineering technology is a new concept for business students, so it needs extensive participation of students, and multi-party discussion can promote the improvement of teaching effect. For this reason, more discussions on relevant topics should be carried out to encourage students to participate more, think more and act more. According to the teaching content, carefully design the discussion topics, such as financial management majors, in the cost accounting often appear "workpiece", "parts" and "outsourcing" and other professional terms, can use the "cloud class" platform to discuss these terms.

"Learning by Doing". All students are required to move, such as when talking about common institutions, can be combined with the "disassembly of mechanical components" experiment to explain. It is to combine theory and practice, intersperse theory in practice, set up some related professional problems, and let students think about classroom teaching content in a practical environment.

Flipped teaching. The content of intelligent manufacturing module is selected for flipped classroom teaching, the task is published on the cloud class platform before class, and the specific topic is discussed in class.

4.3 Optimization of teaching resources

Improve the teaching implementation plan, multimedia courseware and experimental instructions. On the basis of the existing laboratory, the corresponding experimental equipment and equipment are added according to the experimental requirements. An objective question bank is established for daily work and testing.

Multimedia courseware, in the form of GIFs, videos and other rich media.

5. Analysis of teaching practice effect

5.1 Comparative analysis of test results

The optimized teaching mode has been implemented in grade 20. Two large classes, Class 5-6 of 19 financial management (hereinafter referred to as the comparison class) and Class 1-2 of 20 Financial Engineering (hereinafter referred to as the optimization class), are selected for comparative analysis of the final test results. The number of students in the two classes is 86 and 88 respectively, which are similar in number and belong to the same branch, which is feasible for comparison. The final test results of the two classes are shown in Figure 1.

As can be seen from the figure, the test score of the optimized class was significantly better than that of the 19-grade comparison class before the reform and optimization. The average score of the 20-grade optimization class was 78.81, while that of the 19-grade comparison class was 66.91, with an average difference of nearly 12 points.

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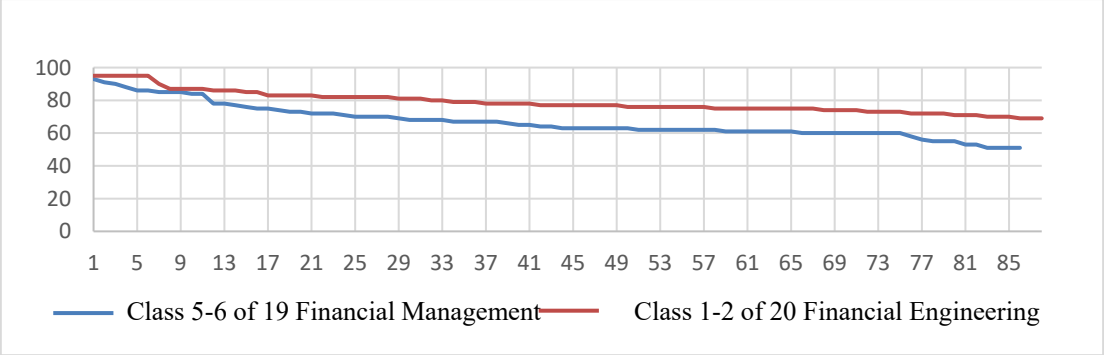

Figure 1: Ranking chart of students' test scores

Then, the scores of the students in the two classes are analyzed by bar chart, and the statistical chart of the scores distribution is shown in Figure 2.

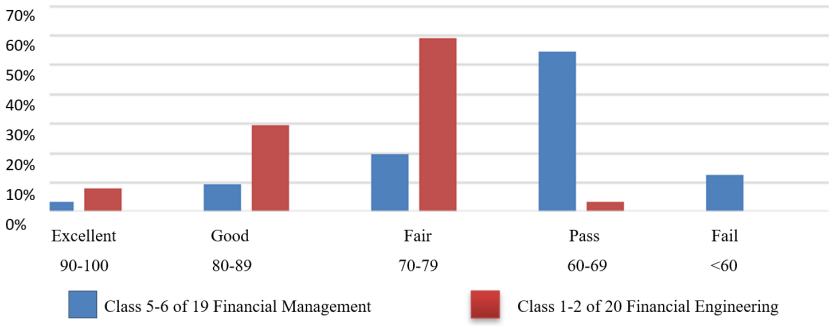

Figure 2: Statistical chart of students' test results

As can be seen from the figure, the distribution ratio of students in the comparison class in these five grades is 3%, 9%, 20%, 55% and 13%, respectively. The distribution ratio of students in the optimized class in these four grades was 8%, 30%, 59%, 13% and 0%, respectively. The excellent and good rate of the optimized class was 16% higher than that of the contrast class, which fully demonstrated that the effectiveness of the optimized class had been improved.

5.2 Teaching effect feedback analysis

The teaching effect survey will be carried out in the last lesson of this course every school year to continuously find and solve problems. Figure 3 is the teaching effect feedback graphs of grade 19 and grade 20 respectively.

It is evident from the graph that optimized students have significantly improved their learning outcomes in the course.

Figure 3: Feedback diagram of teaching effect of Grade 19 and Grade 20

6. Summary

Fundamentals of Engineering Technology is an interdisciplinary elective course. Business students

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can cultivate their engineering literacy and practical ability through learning simple theoretical knowledge of engineering technology and rich practical operation, combined with daily life and labor needs. Practice has proved that through the optimized design of this course, students' interest in the course has been greatly improved, and the effectiveness of classroom teaching has also been improved.

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