Research of Project-Based Engineering Teaching Method

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Abstract. Guided by CDIO educational philosophy, we explored project based teaching mode reform on the core courses of e-commerce majors, in order to cultivate students' innovative consciousness and ability to solve practical problems. On the basis of in-depth analysis of the existing curriculum plans and syllabuses, this reform covers all aspects of course contents, teaching methods, practice teaching and teacher ability training, we transformed the traditional teaching methods into an active project-driven learning mode through the development of simulation of practical projects and the design of undergraduate open experiment project. In the meantime, we founded Teaching Development Promotion Association to promote CDIO teaching ability of the teaching team.

Keywords: The CDIO educational philosophy · e-commerce · project based teaching

1 Introduction

E-commerce involves computer technology, management, economy, modern logistics and many other aspects. E-commerce courses have the characteristics of strong practicality. Through practical teaching, the content of classroom teaching can be deepened and the effectiveness of classroom teaching can be improved. E-commerce talent training not only requires students to master basic e-commerce theoretical knowledge, but also requires students to have strong scientific literacy, innovative awareness, independent work ability and hands-on ability. The cultivation of these abilities must be achieved through a sound practical teaching system. However, the traditional teaching method of e-commerce core courses emphasizes the teaching of theoretical knowledge. This kind of reception learning is teacher-centered, and students mainly rely on teachers and handouts without self-learning. The teaching focuses on the theoretical nature of the course and the systematism of knowledge, and pays much attention on theoretical analysis but little practices. Some courses are out dated and out of touch with the application and development of e-commerce. The existing teaching schemes, teaching methods, teaching resources and teaching staff construction of the core courses have been unable to keep up with the development of e-commerce. Deepening practical teaching by reforming the practical teaching system, cultivating students' ability to solve practical problems

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and innovation, and improving their comprehensive quality are the top priorities in the teaching reform of e-commerce majors.

The CDIO is an innovative educational framework providing students with an education stressing engineering fundamentals set in the context of Conceiving - Designing - Implementing - Operating (CDIO) real-world systems and products. It was founded by four universities including MIT and three Swedish universities in 2000 to reform engineering education by introducing the concept of "Learning by doing" and "Project based education and learning" [4]. The concept of talent training and teaching mode of CDIO is very significant to guide the reform of the teaching mode of the core courses of e-commerce major. The project-driven teaching method of e-commerce major is based on the CDIO education concept to reform the traditional classroom-teaching mode. Based on the talent training objectives of e-commerce majors, a suitable practical teaching project curriculum system is developed and designed around the teaching content of the core courses of e-commerce majors.

The practice teaching is organized in a project-driven, teacher-guided, and student-centered manner, to stimulate students' interest in learning through projects and improve students' comprehensive ability and quality. This paper introduces the reform and development of project-driven teaching method for e-commerce majors from three aspects: active project-driven learning of core courses for e-commerce majors, design of open experimental projects for undergraduates based on core course groups, and teacher ability training based on teaching promotion associations.

2 Active Project-Based Learning

Based on the characteristics of the core courses of e-commerce majors, combined with the professional training plan and goals, the project based teaching reform of the core courses of e-commerce majors is carried out guided by the CDIO education concept. Through the combination of classroom teaching and practice teaching, the CDIO concept is integrated into all aspects of teaching. We reconstructed the content of the course, selected and designed the practice teaching projects, carried out active project based teaching, and explained the knowledge points used in the progress of the project. Students can master knowledge and skills by solving practical problems [2].

Taking the core course "logistics management" of e-commerce major as an example, this paper introduces the reform and exploration of the active project based teaching method. "Logistics management" requires students to possess both advanced e-commerce logistics concept and practical operation ability of logistics operation management and planning. However, the existing teaching method has always adopted the traditional teaching mode of "theory + case", emphasizing theory rather than practice.

In the teaching mode of active project based learning, the design of teaching projects is the key, which directly affects the teaching effectiveness. Inventory Management, Transportation Management and Warehouse Management are the key contents of logistics management. We developed the simulation of a practical project on the logistics simulation experiment platform developed by a logistics enterprise. This practical project is the real international logistics project of a computer production base. The basic knowledge and theories links to CDIO ability training goals through the simulated project form

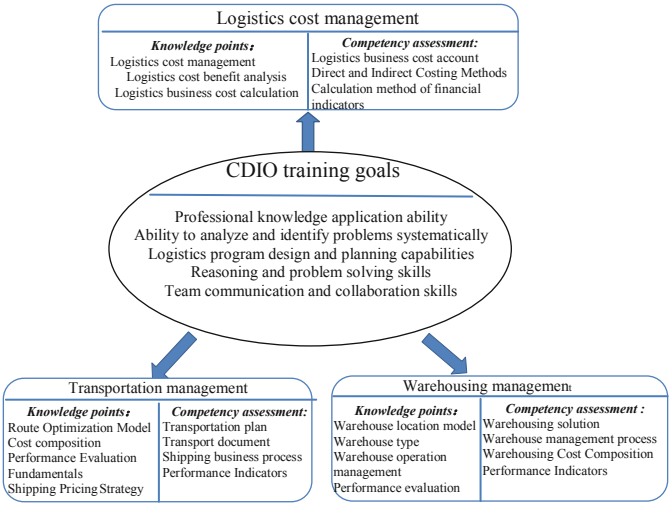

Fig. 1. Logistics management simulation training

an organic integration of knowledge structure and ability training [3]. Through careful design of project-driven learning scenarios, students can complete the training of each step of project-driven teaching. The logistics management simulation training project includes three sub-projects: warehouse management, transportation management and logistics cost management, as shown in Fig. 1.

In this new teaching process, the teacher is the leader and completes the design and planning of the project; the student is the main body, and the teacher guides the students to experience the whole process of the project. The classroom is a learning community that fully demonstrates the subjectivity and initiative of students [5]. The project based teaching mode of logistics management simulation training provides students with a platform for creatively applying the theoretical knowledge of logistics management, effectively cultivates students' autonomous learning habits, and deepens students' understanding of the course content. Students' abilities in problem-finding, problem-analysing, problem-solving, and e-commerce creative thinking have been improved…

3 Design of Undergraduate Open Experiment Project Based on Course Modules

The curriculum of e-commerce major adopts a modular curriculum system. The curriculum modules are connected with each other, and the theoretical knowledge is related to each other, forming a structured curriculum system. Many practical problems of e-commerce operation are comprehensive problems involving multi-disciplinary theory and multi-professional curriculum knowledge. Based on the actual problems of e-commerce operation, an undergraduate open experimental project is designed and developed to realize the interconnection of relevant professional courses in the course module. Through this project based teaching process, the theoretical knowledge, professional ability and quality training objectives of each professional course are organically

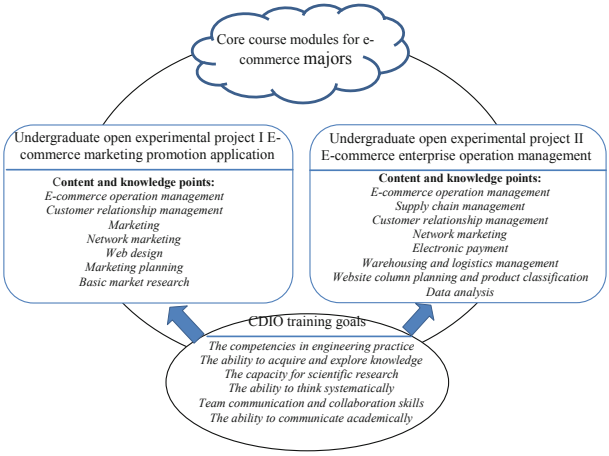

Fig. 2. Undergraduates open experimental project

integrated. During the research process of the undergraduate open experimental project, the students further clarified the correlation and role of the professional core courses in solving specific e-commerce problems, and learned to comprehensively use the theoretical knowledge of multiple courses to complete the project, so that a positive interaction between the learning of the theoretical knowledge and the practical application can be realized.

Taking the design and implementation of two open experimental projects for undergraduates majoring in e-commerce as an example, this paper introduces the open experimental project based teaching mode based on course modules. According to the requirements of the core courses such as "Internet Marketing", "E-commerce Operation Management", "Supply Chain Management", "Customer Relationship Management" and "Web Design", the experimental course content and system are designed. Based on the position needs of online marketing, customer service, e-commerce platform application, logistics informatization construction, operation, and management practice, two projects, i.e., "E-commerce Marketing Promotion Practice Application" and "E-commerce Enterprise Operation Management", have been developed as shown in Fig. 2.

Based on the actual situation of e-commerce marketing and promotion, the project of "practical application of e-commerce marketing promotion" comprehensively uses the theoretical knowledge of marketing, network marketing and e-commerce operation management to understand the functions of e-commerce business marketing in enterprise operation. Through market positioning, marketing strategy, information collection and other workflows, it helps students build a knowledge system of e-commerce network marketing. At the same time, the process of corporate marketing lets students fully understand the responsibilities of each position and the teamwork between each other. Students plan and design the corporate positioning and marketing plans of e-commerce companies based on the theoretical knowledge of the courses they have learned, and adjust the various resources of e-commerce enterprises to complete the implementation

of specific functions such as hot marketing, WeChat promotion, WeChat store promotion, and advertisement placement. The "E-commerce Enterprise Operation Management" project simulates the work of e-commerce enterprises in network marketing, customer communication, and enterprise operation management. Students complete the entire process of e-commerce enterprise operation through preliminary market research and planning. It helps students build a knowledge system of e-commerce operation management, understand the essence of enterprise operation and the form of e-commerce enterprise operation, and be familiar with the basic process of supply chain management. It also asks students to learn the operation of specific procurement business and specific sales business and financial processing of the month. Through the practical training of the undergraduate open experimental project, the comprehensive practical ability of the students has been cultivated. Specifically, it includes platform design and development capabilities, offline and online combined network marketing and promotion capabilities, mobile commerce marketing and operation capabilities, network operation management capabilities, and cost control capabilities [1].

The development of a project based teaching model based on the undergraduate open experimental project, is a supplement to the entire modular teaching system. It mainly cultivates students' ability to apply comprehensively relevant course knowledge, and pays attention to students' ability to analyse and solve problems and innovative thinking and the lifelong learning.

4 Development of Practice Micro-lectures Based on Research Projects

In the traditional teaching mode of knowledge passing-on, teaching and learning are knowledge-oriented. Students passively accept basic knowledge, lack the time and space to think, and lack the ability to learn independently. The knowledge-oriented teaching process is difficult to arouse students' motivation and interest in inquiry-based learning, and it is even more difficult to cultivate students' innovative awareness of analysing and solving problems. The curriculum setting of e-commerce major lacks problem orientation and attaches great importance to the teaching of theoretical knowledge. The new concepts, new contents, new methods and new technologies of the frontier of the discipline are not reflected, let alone the integration of science and education, the integration of production and education, and the integration of interdisciplinary. The teaching mode uses less practical application cases.

In order to overcome the weakness of the traditional teaching mode, our reform of e-commerce courses re-constructs the courses based on scientific research projects, focusing on students' independent learning and ability improvement. The new courses achieve the integration of scientific research and teaching by combining basic theory with professional application. Through the integration of the problems to be solved in scientific research or engineering projects into the course contents, we designed practice course units, optimized and integrated the teaching content of e-commerce majors with the route of "proposing problems - analysing problems - solving problems." This paper takes the core course "operations research" of e-commerce major as an example, and

introduces the reform and exploration of developing modular practice courses based on scientific research results [6].

Operations research uses mathematical theory to explain how to use quantitative analysis methods to improve or optimize the efficiency of existing systems. It aims to cultivate students to master the optimization decision-making ideas contained in various mathematical models. It aims to solve complex engineering problems in the fields of modern engineering technology, operation management and economic management, and provide scientific basis for management decision-making. In 2019, the Institute for Operations Research and the Management Sciences (Institute for Operations Research and the Management Sciences), a leading society in the field of operations research, updated the definition of operations research as "the scientific process of mining information from data to make better decisions" to emphasize the repositioning of operations research courses in the context of the era of big data. Operations research mainly cultivates students' spirit of exploration and improves their ability to solve practical problems.

The e-commerce operations research courses have three goals: knowledge, ability and value goal. The knowledge goal is to master the modelling and solving algorithms of simplex method, transportation problems, integer programming, graph and network analysis, network planning technology, decision analysis, etc. The ability goal is to model and solve complex problems in engineering, and achieve decision management. The value goal is to cultivate students' systematic thinking, dialectical thinking and innovative thinking ability. Based on these goals, we designed practice micro-lecture units by integrating the problems in scientific research projects into the course contents. The micro-lecture units adopt the thinking mode from simple to complex, from learning and imitation to improvement and innovation, and relate each knowledge point. These

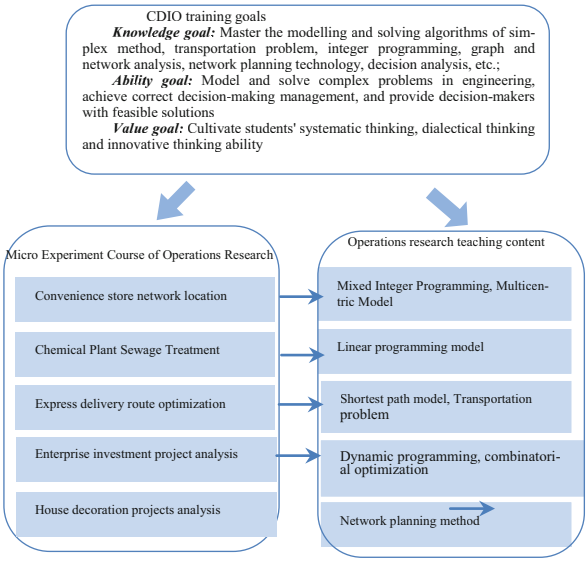

Fig. 3. Micro Experiment Course of Operations Research

micro-lectures make use of research projects as cases to foster students' ability of solving practical problems. Five micro experiment courses of operations research have been developed as shown in Fig. 3.

5 Teacher Ability Training Based on Teaching Development Promotion Association

In project based teaching, teachers need to design and develop the curriculum system of teaching projects, and to grasp the rhythm and content of project implementation to guide students in real time. Teachers' teaching concepts, teaching methods, and their own theoretical and practical levels all affect the implementation effectiveness. The project based teaching model puts forward higher requirements for teachers' innovative practical ability and comprehensive quality.

The Department of Electronic Commerce has established the "Undergraduate Teaching Core Team" Practical Education Innovation Research and Development Promotion Association. The teachers and practical tutors conduct multi-dimensional interactive project based teaching practice to promote the application of the project based teaching model, and cultivate teachers' CDIO teaching ability.

The Teaching Development Promotion Association regularly conducts multi-dimensional interactive teaching activities for the project-based teaching process, discusses the problems encountered in the implementation, and sorts out the effective means through reflection on the teaching results and sharing of successful experience. Teachers improve project based teaching capability in the process of continuous redesign and revision of the CDIO teaching program.

Most of the teachers of e-commerce majors have taken up educational positions directly after graduation from colleges and universities. They lack practical experience in the operation and management of e-commerce enterprises and related engineering background. Some teachers have little scientific research ability training, and lack innovation and practice ability. The Teaching Promotion Association actively carries out in-depth cooperation with the e-commerce practice bases, and forms a full-time and part-time teaching team by introducing the part-time teachers from the practice base. Real cases from enterprises were introduced into the construction and development of practice teaching projects. Through the promotion of teaching staff, the successful implementation of project based teaching mode has been ensured.

6 Conclusions

Based on the advanced CDIO engineering education concept, the project based teaching model is introduced into the design and content reform of the core courses of e-commerce majors. The design and development of standardized professional core course training projects and open experimental projects based on course modules effectively ensure the quality and optimization of the project based teaching model. The introduction of the practice micro-lectures based on research projects better integrates the forefront new concepts, new content, new methods and new technologies into the teaching content,

realizes the integration of scientific research and teaching, and enhances students' higher-order thinking and innovative awareness of analysing and solving problems.

Learning from easy to difficult, the CDIO project-based teaching approach improves the comprehensive ability and quality of students, which facilities the realization of the goal of training applied talents. The establishment of the Practical Education Innovation Research and Development Promotion Association has greatly promoted the application of the project-based teaching model and the cultivation of the CDIO teaching ability of the teaching team.

With the development and application of modern information technologies such as cloud computing, big data, mobile Internet, and artificial intelligence, the integration and penetration of information technology to education have been deepening, and information education has also continued to develop in terms of connotation, depth and quality. The structure and form of the education and teaching system are undergoing changes and transformations, smart education, a new educational concept and model are gradually formed.

In the future research of teaching mode reform research, modern information technology such as big data technology will be effectively used to achieve situational teaching. A wise learning environment will be created for the project-based engineering teaching method, and provide more intelligent and efficient educational services for this teaching mode.

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