Practical Teaching System Based on Innovation and Entrepreneurship Education

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Abstract. Practical teaching has a decisive position in computer science and technology major. Nevertheless, traditional education way usually focus on knowledge imparting while overlooking the training of practical skills, as well as the capabilities of innovation and entrepreneurship. Aiming at these problems, practical teaching reform was carried out in this paper. The concept of innovation and entrepreneurship was embedded in all aspects of practical teaching system. Holistic design was conducted including experiments, integrative curriculum designs, internship, extracurricular scientific and technological activities. It provides significant reference value for teaching reform of computer professional education.

Introduction

Practical teaching plays an important role in computer professional education. However, some problems are always there under the influence of traditional idea. For example, it is ubiquitous focusing on theory teaching while overlooking training in reality, focusing on knowledge imparting while overlooking the cultivation of innovative concept [1, 2]. As a result, the practice capabilities of quite a few students are not professional enough to accommodate the requirements of businesses. They are not competent for the task of entrepreneurship and innovation. As Farrell pointed out the fact that traditional Chinese education system places too much emphasis on theoretical knowledge teaching. Many students have little practical training by the project and team work [3].

The education of entrepreneurship and innovation, originated in the United States, has gone through more than 50 years. It was less than 20 years in China from the early year of the century when Tsinghua university, Renmin University, and other 9 universities took the lead on innovative education. In 2010, Chinese ministry of education enacted the Policies on Promoting the Innovation and Entrepreneurship Education in Colleges and Universities [4, 5]. Since then, Southeast university[6], Jilin university [7], and many other universities and colleges have carried out a lot of useful attempts, and have made remarkable achievements [8]. Above researches showed that innovation education must be integrated with professional teaching activities. Innovation and entrepreneurship concept should be combined with current teaching resources, instead of starting something entirely new.

Computer science department of Huazhong agricultural university has been carrying out innovation education reform and achieved positive results. The concept of innovation and entrepreneurship was embedded in all aspects of practical teaching system [9]. Holistic design was conducted including experiments, integrative curriculum designs, internship, extracurricular scientific and technological activities. It provides significant reference value for other colleges and universities to make their own scheme of teaching reform.
The Scheme of Practical Teaching System

According to the definition of Computer Teaching Guidance Committee for Chinese Ministry of Education, practical teaching includes the following four categories: experiments, course project, internship and graduation project.

We made efforts to reform the traditional teaching content, ideas and methods, introduced the concept of innovation and entrepreneurship education, constructed the practical teaching system for computer science and technology major. The practical teaching system is educational objectives-oriented, includes the development of experimental curriculum system, the reform of teaching methodology, the deployment of facilities and other conditions. The teaching reform framework is shown in Fig. 1. The detailed measures are as follows.

Figure 1. Practical Teaching System Infused Innovation and Entrepreneurship concept.

The Development of Experimental Curriculum

We have been trying progressive teaching model in the development of experimental curriculum in last few years. We lay stress on the interest cultivation for junior students and put emphasis on capability improvement for senior students. The demonstration experiments and the comprehensive experiments are carried out in different levels. The concept of innovation and entrepreneurship education was implemented in the above process. Basic experimental curriculum and core experimental curriculum are shown in Fig. 2. We have made efforts on the following two issues.

(1) We enriched the experimental curriculum with teaching resources related to innovation, infused innovation and entrepreneurship concept into specific course and teaching activities, which solve the "implementation" problem of innovation and entrepreneurship in practice.

(2) Although some previous courses penetrate the concept of innovation and entrepreneurship, they are discrete and fragmented between each other. We gave the previous fragmented materials systemic integration, complement, modification, and choosing to build a complete system of innovation education.
Comprehensive Curriculum Project

After learning basic courses and required courses, students mastered basic knowledge and skills and established innovation and entrepreneurship concept, which lay a solid foundation for the improvement of their comprehensive design capability and innovative capability. We took the following two measures.

The Build-up of Comprehensive Curriculum Project Platform

Innovation and entrepreneurship education needs systematic curriculum to establish relations between courses. As a result, multiple courses can work together to support the same education goals. Comprehensive course project platform consists of the following three parts according to the educational objectives of computer science and technology major. They are hardware capability training platform, software capability training platform, and integrated capability training platform. The build-up of the platforms involves the courses, venue, equipment, regulations, assessment of the projects, and much other content. Each part covers a number of professional courses. They are shown in Fig. 3.

In traditional way, course-design usually aims at the corresponding course to utilise its theoretical knowledge in practice. However, computer professionals require a combination of hardware design capabilities, software design capabilities, as well as comprehensive research and development capabilities. Considering the above reasons, we established and improved hardware and software development integrated capability training platform. The platform provides students with an education stressing on innovative fundamentals which are set in conceiving, designing, implementing of real-world systems and products. They can master complex hardware circuit design method, large software design ideas and specifications, as well as hardware & software joint design and debugging. System design is an effective way of cultivating the capability of innovation and entrepreneurship.

Projects with the School Characteristics

Our school is dominated by agriculture and life sciences major university, and the discipline of computer science undertakes the mission of supporting traditional agriculture with modern information technology. Experimental projects with school characteristics are helpful for the capability promotion of hardware and software development, and for the capability promotion of innovation and entrepreneurship. Traditional computer teaching system centers on “knowledge point” organizes theoretical and experimental teaching materials, so it is lack of systematicness and innovativeness. We introduced scientific research and enterprise projects into teaching practice in accordance with the concept of innovation and entrepreneurship. Some examples of comprehensive projects are listed in table 1.
### Table 1. Some Examples of Comprehensive Projects.

<table>
<thead>
<tr>
<th>Category</th>
<th>Projects</th>
<th>Courses and knowledge be covered</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hardware capability training platform.</strong></td>
<td>Development of condition monitoring and control system for greenhouse environment</td>
<td>Principles of Computer Organization, Embedded System Design, Computer Interface Technology</td>
</tr>
<tr>
<td></td>
<td>Scheduling and data acquisition system for refrigerated food transport vehicles</td>
<td>Electronic Design Automation, Embedded System Design, Computer Interface Technology</td>
</tr>
<tr>
<td></td>
<td>Embedded CPU design based on FPGA</td>
<td>Computer Systems Architecture, Electronic Design Automation, Embedded System Design</td>
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<tr>
<td><strong>Software capability training platform.</strong></td>
<td>Linux kernel cutting for agricultural weather station</td>
<td>Operating System, Software Test, Algorithm Design and Analysis</td>
</tr>
<tr>
<td></td>
<td>Construction of food quality tracking and tracing system</td>
<td>Database Principles, Web Design and Development, Computer Network</td>
</tr>
<tr>
<td></td>
<td>Construction of crop growth model and the visual displaying</td>
<td>Mathematical Modeling, Computer Graphics, Algorithm Design and Analysis</td>
</tr>
<tr>
<td><strong>Integrated capability training platform.</strong></td>
<td>Field data compression method and realization for wireless sensor networks</td>
<td>Computer Network, Algorithm Design and Analysis, Embedded System Design</td>
</tr>
<tr>
<td></td>
<td>Design of agricultural products classification system</td>
<td>Computer Interface Technology, Digital Image Processing, Algorithm Design and Analysis</td>
</tr>
<tr>
<td></td>
<td>Construction of crop pests forecasting and classification expert system</td>
<td>Computer Interface Technology, Digital Image Processing, Database Principles, Computer Network</td>
</tr>
</tbody>
</table>
School-enterprise Cooperation

Enterprises play important roles in education of innovation and entrepreneurship, which coincides with the policies of Chinese government. The document *Outline of National Medium and Long Term Educational Reform and Development Plan (2010-2020)* is the guidance of education. It pointed out the cooperation should be strengthened between schools and enterprises, between universities and research institutions.

We enhanced the construction of various forms of practical teaching base and laboratories, built strategic alliances between university and enterprises, explored resources sharing mechanism. In recent years, we have developed a solid partnership with Chinasoft International Limited, Neusoft Group, Altera Corporation, and other well-known enterprises. Our cooperations are briefed as follows.

**Teacher Training**

Innovation and entrepreneurship education has higher requirements on the teachers’ capability, including innovation capability, engineering capacity and engineering education capability. We took the following measures to solve the problem: inviting experts from enterprises to give lectures; encouraging teachers receiving training in related corporations; researching the projects from enterprises to meet their significant needs.

**Curriculum and Teaching Resources**

We study the development of hardware and software industry to master the requirements of the job market, revised personnel training program. According to the requirements of industry, we schemed system design and development with practical projects as a link, set high-level, medium-level and low-level projects. High-level projects are proposed consecutively entire undergraduate teaching stage to provide students the systematic training of conceiving, implementation and design. As a high-level project support, medium-level projects integrated related courses to strengthen the study and application of core courses. Low-level projects are for one single course to enhance the comprehension for them.

**Extracurricular Science and Technology Activities**

The extracurricular science and technology activities such as scientific research and competition are another forms of practical teaching. Students participate in teachers' research projects, as well as a variety of program design competition, mathematical contest in modeling, electronic designing competition, etc. As a result, they can get promotion of the capabilities of innovation and entrepreneurship through diversified teaching methods. We have been constructing better teaching conditions to make above measures a reality in practice, providing with fundings, venues, and equipments.

**Conclusion**

Based on the teaching practices of Huazhong Agricultural University in China, in this paper we tried to resolve the long-standing problems in practical teaching in the major of computer science and technology. We built up practical teaching system infused innovation and entrepreneurship concept. It covered experiments, integrative curriculum designs, internship, extracurricular scientific and technological activities. The teaching system has testified the effectiveness in cultivating the students’ hardware and software integrated development capability. It also provides a valuable example for other colleges and universities to scheme their own practical teaching system.
References


