Construction of Innovation and Business running Course for Computer Major Based on CDIO Concept

Chen Huie, Hu Anming

Tianhe College of Guang Dong Polytechnic Normal University Guangzhou, Guangdong 510540

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Abstract: To deepen the reform of mode and curriculum of Internet innovation and business running talents training requires an organic combination of top-level design and pract l exploration relying on effective curriculum carriers. CDIO engineering education concept can realize the organic combination of IT professional courses and innovative business running practice. Based on CDIO model and combined with the concept of innovation and business running, this research reconstructs four aspects including computer professional orientation, curriculum design, curriculum implementation and curriculum evaluation, in order to improve the quality of professional innovation and practice personnel training.

1. Introduction

Internet, big data, artificial intelligence, block chains and other technologies have profoundly changed human thinking and working methods. One study points out that MBA students in a Canadian university take more than three business running-related courses, and their business running rate increases [1]. Another study indicates that business running courses can help alumni make better decisions in the process of starting business [2]. *The Outline of National Medium and Long Term Education Reform and Development Plan (2010-2020)* [3] points out that "The international financial crisis further highlights the importance and urgency of improving national quality and cultivating innovative talents." At the same time, as a typical area of open innovation, Guangdong is committed to building its own brand, positively laying out the "IAB" plan, developing the new generation of inCreation technology (IT/IOT), artificial intelligence and other emerging industries in the process of transCreation of customer-centered and efficiency-driven innovation development [4], forming an important industrial cluster area of big data and artificial intelligence. Besides, it is supposed to pay attention to embedding innovation network and innovative elements around the world and merge overseas high-quality manufacturing industry. Media Group acquired KuKa, German robotic giant. And it is necessary to develop internationalized local enterprises. The innovation development of digital enterprises such as Huawei, Tencent and OPPO urgently need international innovative engineering talents of computer specialty.

After graduation, engineering students in China lack practical training in project development and team cooperation, thus being inferior to European and American students who solve practical problems through team cooperation. In view of this, training engineers in line with international standards has become extremely necessary for domestic higher engineering education. As a successful model and the latest achievement of international engineering education reform, CDIO engineering education model won tremendous popularity among enterprises and society.

At the same time, it is supposed to cultivate high-level computer application-oriented talents who can systematically grasp the concepts, design, research, development and comprehensive application methods of computer software and hardware systems, and have pioneering and innovative consciousness and strong practical ability regarding in Creationization, Internet of Things, software development and big data analysis. Through systematic learning, students should master engineering development technology, such as APP development, small program development, software system development, general website development and so on. In addition, the ability of teamwork should also be improved, which is exactly the necessary ability for problem-

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solving while starting an Internet business. There is outstanding technical strengths of staring IT business in APP development, small program development, trading platform, Wechat payment, logistics and other aspects. Therefore, it is of practical significance to explore the creative education by drawing on the ideas and models of international engineering education. It is feasible and necessary to promote the combination of international engineering education and innovation and business running education in computer specialty.

2. Conceive Stage: Orientation of Computer in CDIO Innovation and Business Running Education

CDIO engineering education is aimed at cultivating engineering knowledge, personal ability, team cooperation ability and engineering system ability. It guides students to learn engineering in the way of linking practice, involving stages of conception, design, implementation and operation and the whole product cycle. At present, China is in an important strategic period of innovation-driven development. Innovative technology enterprises represented by Ali, Tencent, Baidu, Jingdong and Netease have become industry leaders.

Innovation and business running education, as a practical education, is used to cultivate students' entrepreneurial consciousness, innovative spirit, innovation ability and business running ability. In order to promote the deep integration of professionalism into innovation education, it is necessary to define the consciousness and ability of innovation and business running as the goal of professional training, and to ensure the cultivation of ability through the reform of teaching links such as creative courses.

Based on the analysis of CDIO engineering education and the actual situation of innovation and business running, Computer is a combination of hardware and software focused on practical engineering application. The education of this discipline is aimed at cultivating practical personnel with computational thinking and professional programming skills who can contribute to economic and social development. They should also have the abilities of industry recognition, innovation, communication and cooperation needed by MIS.

To sum up, the innovation and business running ability necessary for students majoring in Computer specialty includes needs conscious cultural innovation, flexible industry cognition and scientific exploration and practice ability. According to the above analysis of the characteristics of computer specialty, the computer specialty in CDIO innovation and professionalism education is positioned as follows: involved in the curriculum system of computer specialty, students are trained into practical personnel of this specialty harboring culture awareness in IT innovation and business running, IT innovation and business running literacy and quality, IT innovation and business running methods and practical ability, being able to meet the needs of IT technological progress and industrial change and being dare to create, innovate and start a business.

3. Design: Curriculum Design of Computer Specialty in CDIO Innovation and Business Running Education

To achieve the goal of computer professional innovation and business running personnel training with DIO innovation and business running course as a carrier cannot be separated from curriculum design. Through investigating the relevant innovative participants (universities and scientific research institutions, intermediary service institutions, financial institutions, government, etc.), basing on an analysis of the practical links of computer courses and the training objectives and modes of innovation and business running courses, taking reference of Timmons’ ideas of "business running model" design, selecting IT innovation and business running projects and commercial projects as teaching content, organizing curriculum structure according to learners' needs of "activity-experience" and interests, taking problem solving in innovation and business running as the core, the author proposes to construct a four-dimensional integrated innovation and business running education curriculum system for IT majors, that is, to construct an educational system containing "IT innovation and business running general courses, IT innovation and business running

professional courses, IT innovation and business running practice courses and IT innovation and business running development courses", as shown in Figure 1. Through the four dimensional training of consciousness, ability, environmental awareness and practice simulation, students will be able to meet the basic requirements of process and method, knowledge and skills, emotional attitude and values in IT innovation and business running.

Evaluation of CDIO IT professional and innovation course Innovation Creation Creation Entrepreneurial
Major Orientation of CDIO IT professional and innovation course
IT professional and innovation general courses IT professional and innovation specialized courses
IT professional and innovation practice courses IT professional and innovation development courses
social value and service industry cognition
Software Engineering Course Design business project
web project scenario SSH project scenario
SSI Joyjt Project Internet architecture project
big data E-commerce project implementation of CDIO IT innovation and profession course

Figure 1 Course system of computer in CDIO innovation and business running education

For IT innovation and business running general course, educators should think about how to make students better sublimate "human significance" [5] in the combination of innovation activities and "life world". Thus, it is supposed to pay attention to cultivating students' cultural innovation consciousness and thus encouraging them paying more attention to the major issues of human society and Internet industry and relating their self-value realization closely to social service in the process of innovation, In innovation and business running courses of computer software specialty in our college, the compulsory courses such as Foundation of Business Running, Practical Writing and Computer Foundation, elective courses regarding innovation and business running such as Frontier of Discipline, Scientific Research Method, Critical Thinking, Project Analysis and Business Planning Letter, basic professional courses like Java Language Foundation and object-oriented Java programming, and core professional courses including Java EE project, Zebra, Hadoop, Spark, Hive_Basic, Flume_Basic. These courses not only effectively integrate and optimize the contents related to innovative business running contents but also innovate the cultural perspective of computer engineering. More importantly, in the development and operation of EasyMall and Joyjt projects, these courses greatly stimulate students' initiative to innovate and start business and cultivate students' innovative consciousness and enthusiasm.

It is supposed to fully tap the resources and elements relevant with innovation and business running in IT professional courses, and internalize the essential qualities of innovators, like innovative thinking, technological knowledge, internal and external driving forces, into the project courses involving computer. In addition, it is necessary to combine the current research hotspots of innovation and Business running with the popular products in the market, use the professional knowledge and skills in the curriculum system of computer specialty to couple innovation methods (TRIZ theory and innovation methods) to project resources, so as to design the professional courses of IT innovation and business running. For example, the curriculum design of software engineering specialty is a project-based design of five project learning scenarios, from simple to complex, including the website-egou.com (the project involving the whole earning stage of Java Web). Knowledge points derived from project requirements should be used for teaching. Needs lead ideas and application stimulates learning. It is favorable to improve the students' programming thinking, coding ability, mastery of Java background knowledge, thus laying foundation for the follow-up

course learning. SSH project Baitong Logistics introduces the core business logic and complex functions of the project, and realizes proficient application of all kinds of mainstream core technologies, such as workflow, Web Service, security framework, large database applications, etc. In SSI project Jingtao, the items analyzed include the development of e-commerce industry and technology input points, e-commerce business, distributed system architecture of Nginx, CMS and HttpClient, Rdeis cache, single sign-on, order system, Quartz timing tasks; full-text retrieval, commodity search Lucence, MQ message queue, etc. The Internet Architecture Project Telecom realizes the selection of architecture, the monitoring of system performance, the optimization of system performance and so on. Data analysis projects, data display projects and other projects of large data e-commerce contain project situation of different level ranging from simple to complex, and they are selected to encourage students to carry on innovative thinking and stimulate creative thoughts.

IT innovation and business running practice course is the actual test of professional courses, the innovative application of professional knowledge and the exploration of the implementation process. At present, the innovation and business running practice platform based on computer software engineering experimental teaching center and studio has been built. The innovation business running practice courses with computer specialty characteristics in our college include: Science and Technology Culture Festival for University Students, Intellectual Property Promotion Week, Software Design Competition, “Challenge Cup” Sci-tech Works Competition, “Blue Bridge Cup” Innovative Design competition, China “Internet+” Innovation and Business running Competition, etc. The design practice course based on competition activities is designed to encourage students to use IT professional skills to participate in innovation and business running practice activities, realize the organic combination of theory knowledge system and professional practice ability, broaden the practice platform, gather and build excellent innovation team, and promote the promotion of innovation and business running ability.

As an important supplement to innovation and business running practice course, innovation and business running development course is mainly used to enhance students' creativity and business running ability. Creativity, as a life skill and business skill, needs to be constantly trained in life. In view of the actual situation of this major, it is supposed to expand the curriculum relying on enterprise and company projects, college students' innovation and business running training program projects, innovation and business running research projects, actively guide students to make real creations in the true life [6], and encourage students to solve complex problems in practice from different perspectives, which is favorable to elevating students' enthusiasm and initiative in various aspects, such as thinking, planning, procedure, operation and practice.

4. Implementation: Promoting the Implementation of Courses of Computer Specialty in CDIO Innovation and Business Running Education

For the implementation of IT innovation and business running courses with high efficiency, high quality and assurance, a special innovation and business running college was established in our college. In order to promote the implementation of innovation and business running education, efforts have been devoted to designing from the top level, creating innovation and business running culture, improving innovation and business running education mechanism, strengthening the team building and curriculum building of innovation and business running, vigorously promoting discipline competitions, starting large-scale school-based innovation projects, establishing business incubation bases, and building social resources platform. Combining with the characteristics of Computer, it is supposed to implement it in an innovative and interdisciplinary way.

4.1 Implementing IT innovation and business running general course under the drive of activities and stimulating students' inner drive of innovation and business running

In the implementation of IT Innovation General Course, the school invited well-known entrepreneurs and outstanding alumni to participate in the Forum on innovation and business running, and set up an innovation resource bank such as Original Creativity Training Camp.

Through knowledge processing and skills training, students are encouraged to transform imagination, association and inspiration into creativity [7], and they are actively guided to participate in market research, so as to help them develop entrepreneurial awareness. In order to improve students' innovative ability, it is supposed to show students thinking pattern of innovation, and let students participate in the implementation of intellectual property rights application and protection activities. In business promotion and technology docking, traditional trial-and-error method, brainstorming method and Hotan twelve methods were used to provide all-round support of general knowledge of innovation and business running for the landing of Internet business running projects in computer industry, enlighten students' cultural consciousness of professional innovation, and stimulate the motive force of innovation [8].

4.2 Implementing IT innovation and business running course with the drive of situational projects and strengthening students' professional ability of innovation and business running

Peter F. Drucker, “the father of modern management”, believes that "smart idea" is original but imitative. In the four project phases of conception, design, implementation and operation, the innovation and business running course of situational projects (WEB stage-SSH stage-SSI stage-architecture project-data project) is implemented progressively from simple to complex by adopting 5W2H method, gonging-stopping method, lateral thinking methods, etc.

The classroom teaching mode is reversed through five steps of innovation (pre-thinking, bottom-up, drilling, expansion, reflection), which runs through the implementation process of each of the five curriculum projects. In the pre-thinking stage, the professor motivates students by introducing the project theme; in the bottom-up stage, the professor chooses materials, synthesizes them into videos and sends them to study in advance before class; then, the professor demonstrates to let the students complete the training, and the students make plans, implement them and conduct final evaluation; In expansion stage, the professor encourages students to make groups to achieve more complex project tasks. Finally, in reflection stage, students are guided to clarify ideas and steps around the project objectives, and they are encouraged to grasp the innovative points of the object, to think about problems in multi-dimensions, multi-perspective and multi-way, to apply in a different environment and strive to overcome the influence of thinking inertia. Students understand the project system through six steps of inCreation, planning, decision-making, implementation, inspection and evaluation. They apply their professional knowledge to solve specific problems, analyze existing problems and explore solutions to problems.

4.3 Implementing IT innovation and business running practice course under the drive of science and technology projects to train students' innovation and business running practice ability

To create is to think of or do something unprecedented. Creativity is ability to solve problems. It is supposed to taking scientific and technological projects as the carrier and conduct the training on creative thinking techniques including holistic thinking, TRIZ multi-screen method, resource analysis method, etc., so as to eliminate students' conformity, stereotype thinking and mindset, train their divergent and convergent thinking, horizontal and positive thinking, vertical and reverse thinking, similarity-seeking thinking and difference-seeking thinking and other innovative ways of thinking and techniques.

There are quite a few examples of starting a business with patents. For example, Li Yanhong, the CEO of Baidu, conducted innovative research in search engine technology, obtaining the "super chain analysis" technology patent and setting up Baidu Inc [9]. In order to integrate the innovation and business running resources of computer specialty in schools, enterprises, businesses and academia, and promote the combination of innovation and business running projects and industrial resources, the school organized and carried out science and technology projects including Campus Science and Technology Cultural Festival and Intellectual Property Publicity Week. Through Intellectual Property Publicity Week, the school actively guided students to innovative thinking and instructed cross-disciplinary student teams (computer software engineering + construction cost) to write inventive patent technology submissions and draw CAD drawings, which were successfully

submit to the Patent Office for acceptance.

Li Guanyao invented “electronic pen" (No. 201910239462.1). Innovation inside this invention originates from the finding that the existing electronic pen is inferior in single function and user experience. These shortcomings cause users to hold microphone in one hand and electronic pen in the other hand during delivering speeches. He also found that the U disk, as a small common office supplies, was often placed arbitrarily and then got lost. Then, he thought of designing "an electronic pen integrating U disk and wireless Bluetooth microphone"; Huang Haocheng invented "a double screen display screen based on WIFI"; Huang Yuekang invented "wireless mobile charger" and so on; Guo Yuexin invented "intelligent lifting and folding multi-functional computer table", whose uniqueness lies in lifting. It improves the area utilization rate of modern housing and alleviates cervical and lumbar soreness caused by long-time sitting in office. It is a "computer desk with USB expansion socket and heat dissipation function". Wang Haibin invented a portable multi-functional keyboard, whose originality lies in the setting of mobile phone fixtures. The mobile phone can be fixed in different directions on the keyboard. In this way, the mobile phone on the bracket does not affect the work and bring more convenience. He also set up various functional areas on the keyboard to improve the user experience; And someone else invented "a touch mouse" (patent number 201920279821.1). There are still more inventions of other students.

4.4 Implementing IT innovation and business running development training course under the drive of business project and enhancing students' innovation and business running practical ability

In order to ensure the effective implementation of innovation and business running courses, the college formulated the "Management Measures for College Students' Business Incubation Base", selected innovative and business running projects to be stationed in the incubation base, and provided continuous guidance and assistance for business running problems encountered in the incubation projects, such as company registration, development inCreation, tax and fee relief.

For complex innovation problems in business running projects guiding, innovation practice projects will be upgraded to commercial projects mainly through TRIZ's technological evolution method, contradiction matrix solution method, physical contradiction and separation analysis method, scientific effect database and others alike. What’s more, the practical knowledge of business running (including pioneering spirit, enthusiasm and dedicating toward work, innovative spirit, et.), together with abilities required for CDIO engineering model (system knowledge skills, team development, engineering communication), will be integrated into computer-based project management courses (such as management inCreation system, project management, etc.) to train students' engineering thinking and engineering practice ability.

With "Enterprise + Studio" as the carrier, the innovative business running team is established under the guidance of the professional curriculum system, and the teaching resources are fully utilized to carry out business project cooperation within the professional curriculum. Up to now, the student teams of innovation and business running has successively developed "i Shangbu Mall" for Guangzhou Shangpei Network Technology Co., Ltd., public number “Family Education InCreation " for Guangzhou Lihu Education Technology Co., Ltd. with developing tool of Wechat web as the front-end development tool, WEchat micro-program “common craftsmen o2o”, which is a platform system providing domestic services, for Guangzhou Haojiang technology limited technology. The team also developed a platform “Hardware Home”, whose originality is that it is a hardware mall developed in the form of Wechat micro-program, which enables consumers to easily and quickly preview or purchase hardware products. The business running team led by Peng Qiduo of our university established Guangzhou Alisons Internet Technology Co., Ltd., realized the integrated management mode of E-station driving learning and achieve good returns. Efforts to promote the implementation of IT innovation and profession courses and improve the integration of “teaching, learning and doing” should be reflected in the process of IT innovation and business running and the close connection between the training process and production practice. And it is necessary to give full play to the advantages of computer specialty, actively combine with market demand,

master the key technology of computer specialty, and realize the innovation and high-quality development of computer specialty.

5. Operation: Perfecting the evaluation of Computer course in CDIO innovation and business running education

The evaluation of Computer courses in innovation and business running education refers to checking whether major orientation, curriculum design and curriculum implementation have achieved the goal of professional innovative talents training, and to what extent, so as to judge the effect of curriculum design and make the decision on curriculum optimization and improvement accordingly.

Maturity Model (CMM) is a benchmark for software contracting capability and maturity evaluation launched by Software Research Institute of Carnegie Mellon University in 1987. It has become the most authoritative evaluation and certification system in the software industry. According to the actual situation of innovation and business running training in computer specialty and the evaluation index of course object achievement, reference maturity model and evaluation model of Chinese talent innovation and business running index system [10], the evaluation index matrix suitable to evaluating professional innovation and business running ability of students majoring in Computer. The first-level indicators are divided into 4 innovation and business running level (Innovation Originality Creation Entrepreneurial), and the second-level indicators is evaluation system for course achievement degree regarding first-level indicators, which mainly includes general knowledge of innovation and business running, professional skills, attitudes, emotions, process and methods, business perception (required in activity project, stage project, science and technology project, business project); advancement of project conception, design, implementation, operation innovation; project platform, applications, intelligent creation; business running contest, patent transformation and business running, as shown in Table 1.

It can be deduced from this table that the state and level of innovation and business running of students majoring equals to A*FA+B*FB+C*FC+D*FD; similarly, the calculation method of secondary indicators A to D is the same, and the results of calculation can reflect the needs of students at different levels and stages of development, serving as reference data for evaluation on optimization of curriculum system, practice design, and students' professional ability of innovation and business running.

In addition, the college combined the characteristics of engineering disciplines, formulated the "Selection Method of Student Innovation and Business Running Award", and incorporated subject competition awards, innovation research results, invention patents, technology development program, and published papers into the evaluation criteria. By setting Innovation and Business Running Award, students' innovation and business running achievements are converted into credits, and the last mile of innovation and business running talents training was opened.

6. Conclusion

In the wave of innovation-driven professional development, combined with the reality of Internet business running in IT industry, based on CDIO model and innovative business running concept, this paper reconstructs the curriculum system of computer specialty, and adds the training objectives of engineering and innovative business running to the orientation of computer specialty. In the reform and practice of curriculum design, curriculum implementation and curriculum evaluation, the four-dimensional innovation and business running curriculum system has been designed from simple to complex, which has opened up the key links between IT professional business running project and curriculum project, science and technology project and business project, and has injected more innovation vitality into the reform and practice of professional computer curriculum. The author strives to lead students to achieve the combination of life value realization and innovation and business running with the aid of innovative culture, and gradually cultivate students' innovative and creative thinking and ability.

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Table 1 Matrix of evaluation index of professional innovation and business running ability of Computer

first-level indicators	**Innovation A**						**Originality B**				**Creation C**			**Entrepreneurial D**		
weight(Fi)	**0.20**						**0.25**				**0.25**			**0.3**		
GCR Seriel No.	5.01	5.02	5.03	5.04	5.05	5.06	2.01	2.02	2.03	2.04	13.01	13.02	12.07	6.01	6.02	6.03
Second-level indicators	General Knowledge of Project Innovation	Project Innovation Professional Skills	Project Innovation Attitude and Emotion	Project Innovation Process Methodology	Project Innovation Industry Cognition	Business Cognition of Project Innovation	project conceptual process upgrading	Promotion of project design process	Promotion of project implementation process	Improvement of project operation process	Creation of Project Development Platform	Industrial Application Creation	Project Intelligent Application Creation	Provincial and National Business running Competition	Intellectual Property Patent Authorization	Incubation and transformation of project results
weight(Ri)	0.10	0.20	0.30	0.10	0.10	0.20	0.20	0.30	0.30	0.20	0.30	0.30	0.40	0.20	0.30	0.50