Educational Innovation and Practice of the Theory of Geographic Information System Based on CDIO

Jinling Yang
School of Surveying and Mapping Engineering
Heilongjiang Institute of Technology
Harbin, China
yangjinlingkm@126.com

Xiange Cao
School of Surveying and Mapping Engineering
Heilongjiang Institute of Technology
Harbin, China
caoxiange@126.com

Mingshuang Wang
School of Surveying and Mapping Engineering
Heilongjiang Institute of Technology
Harbin, China

Xin Liang
School of Surveying and Mapping Engineering
Heilongjiang Institute of Technology
Harbin, China

Yan Liu
School of Surveying and Mapping Engineering
Heilongjiang Institute of Technology
Harbin, China

Dan Li
School of Surveying and Mapping Engineering
Heilongjiang Institute of Technology
Harbin, China

***Abstract*—CDIO is a new model in current engineering education. This paper introduces the course design and implementation process of The Theory of Geographic Information System course based on CDIO concept, the curriculum reform ideas presented based on CDIO concept, analyzes the "Teaching-Learning-Working integration" teaching procedures and teaching mode, introduces the implementation process of CDIO teaching mode, illustrates the application of this teaching mode in the teaching of The Theory of Geographic Information System.**

Keywords-CDIO; Teaching-Learning-Working integration; teaching mode; engineering project

I. INTRODUCTION

To solve the contradictions of higher engineering education and the social demand, some European and American universities launched a higher engineering education reform—"return to the project", CDIO teaching mode is one of the representative accomplishments. This engineering education mode founded by international research institutions composed by Massachusetts institute of technology and the Swedish royal institute of technology and other two frontier universities[1]. CDIO represents Conceiving, Designing, Implementing and Operating the four real-world systems and products, they are components of industrial products whole life cycle of the project, CDIO engineering education concept is the carrier of cultivating engineering students engineering ability. CDIO is a new type of teaching mode which advocated "learning by doing" and "project-based education and learning", it takes the project's life cycle from development to run as the carrier, lets the students to learn engineering by the active, practice, course organic connection way, cultivates the students' engineering ability, professional ethics, academic knowledge, ability to use knowledge to solve problems, lifelong learning ability, team cooperation ability, communication ability and control ability of big system[2], so as to cultivate the internationalization of engineer with excellent professional skills and good professional ethics[3].

As the latest achievements of international higher engineering education reform, the curriculum of CDIO engineering education mode meets the professional engineer organization requirements to engineering education in United States, Canada and other Washington agreement countries, the teaching framework embodies the innovation of education thought[4]. This paper takes the Theory of Geographic Information System course as an example, introduces the situation of introducing CDIO concept to curriculum design and implementation link.

II. MAIN IDEAS OF TEACHING MODE REFORM

Based on the comprehensive understanding of CDIO education concept and combining with our own conditions, this paper takes "Theory of Geographic Information System" course reform project as the breach to reform the teaching mode.

We take 2010 students of Geographic Information System major to pilot, the students were divided into 10 project working group, each group with 6 students, team leader were recommended by every team who will responsible for the work progress and team member task arrangement and work of leadership. Five learning work projects of The Theory of Geographic Information System course were designed, the theory knowledge which each project involves will be guided by teachers to make the necessary theoretical preparation.

Students will under teacher's inspiring to complete the project's basic and extended demands gradually, the implementation of the project adhere to the principle of from simple to complex, and through the gradual learning gradually improve and perfect the students' knowledge.

The Theory of Geographic Information System course has the characteristics of practical, in order to improve the students' quality and cultivate students' ability, on the basis of improving the quality of classroom teaching, we take various reforms to the content of the original curriculum and practice, the main idea is: take the cooperation between colleges and work-integrated learning as the breakthrough point, combine the CDIO engineering education concept, highlight the openness and professional of teaching process, using the CDIO concept, keep up with the pace of the information development, reduce the conventional classroom teaching content, strengthen practice teaching; Take the knowledge and skills of Geographic Information which will be required when career in the Geographic Information System designing and developing activities as the guide, organize teaching content, make good use of the existing internal and external training base, explore an effective mode of CDIO teaching, so that students ability in practical, independent innovation and teamwork has been increased, explore out a train of thought to other engineering professional course's engineering education reform, play the role of point[4]. Taking practical engineering project as the carrier of the students' ability training, we designed the teaching project, combined with the development of The Theory of Geographic Information System for the requirement of knowledge, ability and quality to design the teaching task, and took task leading the teaching, according to the "task, project, Teaching-learning-working integration" training mode, finally complete project on student's ability training.

III. Characteristics Of Teaching Procedures And Teaching Mode

The Theory of Geographic Information System is the core curriculum of Geographic Information System major, it is also an indispensable professional ability of students majoring in Geographic Information System, this course has a strong engineering application background, therefore, and in the teaching process we must pay attention to the practicality, openness and professional courses. The Theory of Geographic Information System course's all teaching contents can be designed into five projects, a number of work units can be developed according to the projects, in the teaching base, the teaching activities can be implemented according to the actual working process. During teaching we implemented "Teaching-Learning-Working Integration" teaching methods such as project orientation, task driven, class and practice experiment base integration[5,6].

A. "Teaching-Learning-Working Integration" Operating Procedures of CDIO Teaching Mode

In the CDIO teaching mode, each teaching project (work unit) uses the four stages of conception, design, implementation and operation. During task conception stage teachers need to design students work unit and arrange it to all students, clear to students the project requirements and methods, to let the students know what they need to do and to consider how to do it. During design phase, the project implementation plan will be designed, students are required to design project implementation plan themselves, in this phase the teachers provide the request, tour guide and put forward suggestions for improvement. During implementation stage, students are required to complete the project by themselves, in this phase the teachers should answer students' questions, correct mistakes, maintain order in time. Operation stage is evaluation of the project, in accordance with the requirements of the task assigned by the teacher, the self-evaluation and mutual evaluation between team members and team should be implemented, teachers organize project rejoin and audit the project implementation report and evaluate the completion and feedback to students.

B. The Characteristics of "Teaching-Learning-Working Integration" CDIO Teaching Mode

1) Fully mobilize students' learning enthusiasm and initiative. CDIO teaching mode takes students as the center, carries out in the form of theory with practice, fully mobilizes students' enthusiasm and initiative in the project learning, the target of students' study is to apply.

2) Training the ability of cooperation and communication. Curriculum construction project will be proceed with group cooperation way, in the process of cooperation projects students through completing the project to cultivate team spirit and communication ability.

3) Mutual integration of project with the knowledge, ability and quality. In the training curriculum system the integrated courses are introduced to skills and training project, which organize the implementation of curriculum aiming at training skills, promote the professional knowledge of learning, realize the professional knowledge, project and ability.

4) Strengthens the employment competitive power, improves students' employment rate and employment quality. CDIO teaching mode through "learning by doing" enhances the students' professional skill, and the employment rate and employment quality are significantly improved.

IV. CDIO Teaching Mode Analysis Of The Implementation Process

Here taking the learning task "GIS basic skill training—Map Registration with Georeferencing tools" as an example, illustrates the implementation of the process of CDIO teaching mode.

A. Conception (1 hour)

Physical teaching method: according to the registration of the People's Republic of China's map without actual coordinate system, the teacher explains the registration principle through multimedia courseware, selects control points, and raises the main task teaching goal — Map Registration with Georeferencing tools. In this phase, teacher provides learning materials and lists the learning resources which can be used, answers students' questions, finally the teacher distributes task

list, provides relevant project information for students' inquiry learning.

Independent inquiry teaching method: the classmates through teaching materials, network resources, laboratory physical research methods and other methods by themselves to further familiar with the work tasks.

Multimedia means: By means of using multimedia network, through the multimedia courseware, students autonomous learning, teachers give some guidance, develop the students' ability of methods, improve the learning interest[1].

B. Design (1 hour)

Teaching methods: Students are divided into different study groups, each group discussions and writes the plan of Map Registration with Georeferencing tools chaired by the leader of the group, carries out the task description and explains mission objectives. Teacher reviews the student's plan and conducts review and discusses the feasibility of the implementation plan, provides guidance and timely feedback to students to modify, so repeatedly and ultimately determines the completion of the project planning and implementation.

C. Implementation (2 hours)

Live demonstration: teacher on-site scans a map of our college campus, then scanned electronic versions of maps will be distributed to students, allow students to observe the characteristics of this map; Teacher uses ArcGIS Georeferencing tool for map matching operation, and then asks students to observe the change of the map, helps them to understand the principle of map matching; Lets the student feel the atmosphere of the scene work, deepen impression of learning.

Site operation: teacher lets every student manipulates the operation of select control points through computer to understand the principle of map matching and use ArcGIS Georeferencing tools for map registration, observe the change of the map before and after registration, and master the map matching skills with ArcGIS Georeferencing tool, in order to lay a good foundation for improving students to find, analysis, solve the space data acquisition and the organization's ability, so as to improve the students' practical skills.

D. Operation(1 hour)

Each group members should reports the task according to requirements of learning task and processes the corresponding actual operation, teachers and team members will evaluate the overall completion of tasks, and also self-evaluation, mutual between groups and teachers, students' comprehensive performance are given according to the evaluation criteria[7].

V. Guarantee condition on the implementation of teaching mode

A. Teaching Methods

In the teaching process, teachers should fully mobilize students' initiative, enthusiasm and creativity, open ideas under the guidance of teachers, and through group discussion, team work and other activities to solve the problem and master the knowledge.

This course through using of multimedia courseware, course website, course video, online answering questions and other modern teaching means to optimize the teaching process, improve the teaching quality and efficiency.

B. Laboratory Construction

Spatial geographic information laboratory of our college is Geographic Information System's professional laboratory. Laboratory has the software such as ArcGIS, Supermap, which provides the safeguard to the combination of theory with practice for "The Theory of geographic information system" course.

C. Teacher Staff

The teacher staffs of this course are composed by full-time and part-time teachers, full-time teachers are mainly responsible for the teaching organization and teaching, part-time teachers are mainly responsible for guiding students training. Part-time teachers are mainly made up by enterprise and industry experts; they are mainly responsible for the revision of "The Theory of Geographic Information System" course content and the teaching of the new technology.

VI. Conclusion

Through "Teaching-Learning-Working Integration" CDIO teaching mode, the theory of practical integration teaching can be fully completed in production field practice and experimental base, through the task list issued of students to decorate the project to students, takes the project as oriented, guides the student to complete task list, completes the process of comprehensive evaluation. "Teaching-Learning-Working Integration" CDIO teaching mode helps make the students master the basic knowledge of the course of The Theory of Geographic Information System and instrument operating vocational skills.

CDIO teaching mode of "Teaching-Learning-Working Integration" as a kind of method resolve the tension between engineering education and engineering practice, integrated the knowledge, ability cultivation and quality promotion with the curriculum system and teaching process organically, formed a systematic engineering education reform, this reform in accordance with the current trends of engineering education reform, the pattern is being gradually applied to all kinds of professional course reform.

Acknowledgment

This work was financially supported by the Heilongjiang Province higher education teaching reform project (JG2201201232), Heilongjiang Institute of technology Educational Programs(JG1206), Heilongjiang Province higher education teaching reform project (JG2013010480), Heilongjiang Institute of Technology education teaching reform project (JG2012029), Heilongjiang Institute of Technology education teaching reform project (JG2013003), Standardization of Heilongjiang Institute of Technology

teaching and research section (department) construction project (2012).

REFERENCES

[1] Chen Xiangping. CDIO mode analysis and its revelation for the engineering specialty reform in local colleges. Journal of Yangtze University(Social Sciences) , vol.1, pp.128-131, Jua. 2011.

[2] J. Z. Cha."CDIO engineering education reform strategy" and the cooperation between production and internationalization. China University Teaching, vol.5, pp.16-19, 2008.

[3] J, P. LIU, Z, R. JIA, J. SHI, Z. F. CHEN, P. SHI. On three-dimensional teaching mode for concrete structure serial courses based on CDIO education ideas, Journal of Architectural Education in Institutions of Higher Learning, vol.20, pp.83-87, 2011.

[4] M. R Zhou., C. B.Shen, C. M. Ji. Practice of "Teaching-Learning-Working integration" CDIO teaching mode. Occupation, vol.16, pp.145-146, 2011.

[5] J. Z. Cha. CDIO mode under the strategy of "learning by doing". Research in Higher Education of Engineering, vol.3, pp.1-6, 2008.

[6] J. M. Zhong, Y. L. Li. Research and Practice of an Engineering Education Reform Based on CDIO Conception. Experiment Science & Technology, vol.6, pp.67-69, 2009.

[7] G. Wang. Study and thinking of CDIO Engineering Education mode. China Higher Education Research, vol.5, pp.86-87, 2009.