Study on Teaching Reform for Bridge Engineering Major
Based on "U–learning +CDIO" Education Concept

Yu-min ZHANG

Mechanical Engineering College, Xi’an ShiYou University, Shaanxi Province, Xi’an, 710061, P.R. China
*Corresponding author

Keywords: Bridge engineering, CDIO education concept, U-learning model, Teaching reform.

Abstract. As the latest research achievements on combining theory with practice, CDIO education mode has been widely applied in engineering colleges for professional personnel training. Depend on rapid development information technology, learning model has experienced from E-Learning to M-Learning to U-learning, which have reached a consensus. In order to improve the practical ability and independent learning ability of bridge engineering professionals, the education concept of "U–learning +CDIO" have been applied in bridge engineering courses. It is found that "U–learning +CDIO" education concept is the most convenient way to cultivate engineering talents for students with innovative and practical ability, and is worthy of being widely used in the teaching reform in universities.

Introduction

With the rapid development of engineering construction technology and the smooth implementation of "One Belt And One Road" strategy deployment, colleges and universities, as the training base of high-quality and top-notch talents, face more challenges in practical and innovative talent training [1].

The "CDIO engineering education model" proposed by the multinational research group consisting of four universities, including the Massachusetts institute of technology and the royal Swedish institute of technology, is the result of exploring the educational quality problems of engineering students. "CDIO engineering education model", which involves four links including conception, Design, implementation and operation, is a centralized summary and abstract expression of "education and learning based on project" [2]. CDIO engineering education pays attention to cultivate students to combine the basic theory and professional knowledge to practical engineering, mix the actual project and innovative practice in the whole process of engineering talent training. So that the students will become a new generation of high level engineer with solid professional foundation and practical ability in the learning environment of interaction theory and practice [3].

With the development of science and technology, the information technology is wide application in education; college students are no longer satisfied with classroom teaching. Under this opportunity, the mobile learning mode with the characteristic of 4A (Anyone, Anytime, Anywhere, Any device) have realized by taking advantage of utilizing debris time [4]. In recent years, mobile learning has formed a consensus of development from E-learning to M-learning to U-learning, and accumulated research results from theories to resources, terminals to platforms, activities to practice, which has become the most advocated learning mode of modern education.

Combination of "U-learning +CDIO" Education Mode

U–learning refers to the learning and communication conducted by learners at anytime, anywhere and anything with the help of information resources on the Internet through mobile terminals.

This model, which abandons the monotonous form of face-to-face courses, integrates offline and online teaching techniques such as classroom teaching, skill practice, online discussion group. It
covering all modules of knowledge transfer, exploring interaction, information-based learning and team communication, is an effective learning method that integrates specific industries to achieve learning goals. In recent years, MIT of Harvard University in the United States has carried out collaborative research on the education mode of CDIO engineering and the U–learning mode [5], and some universities in China have also carried out an attempt and research on the combination of the two education modes [6].

Bridge engineering is a major that emphasizes the combination of theory and practice and the usage of innovative thinking to solve engineering problems. The effective combination of CDIO engineering education concept and convenient U–learning is a feasible direction for bridge engineering teaching reform.

Guided by the CDIO education concept, the practical problems were introduced into classroom teaching through combining practical engineering and scientific research projects in class. At the same time, by virtue of the professional content in the recommendation network platform, the classroom, pre-class and after-class are integrated with practical teaching, so that U–learning can be realized by students. With the help of "flipped classroom" and "blended teaching" based on professional software, the thinking and practice of "U–learning +CDIO" are strengthened.

CDIO Engineering Education Mode Design for Bridge Engineering Major Based on U-learning

The "U–learning +CDIO" education mode have the characteristics of ubiquitous learning and based on engineering time. So that the U–learning teaching reform with CDIO characteristics was proposed for the bridge engineering direction course and related teaching links. The research programme of "U–learning +CDIO" education mode has been shown in Fig.1.

Figure 1. The research programme of “U-learning+CDIO” education mode.

The following reform content was designed for the specific education mode.

Build Professional Knowledge Learning Based on U-learning

According to the teaching content of “bridge engineering”, “bridge construction and organization management” and other professional teaching links, the ability of students to use U–learning based on mobile terminal is cultivated. Teachers recommend network learning resources related to teaching content. Students learn professional knowledge points by means of U–learning, including
professional theoretical knowledge, normative articles, advanced design methods and construction techniques. Students have been suggested to preview in advance, review after class, and take the initiative to practice with the help of flipped classroom, so as to cultivate the ability of combining theory with practice, expanding academic knowledge and teamwork, and form the lifelong learning habit of U–learning.

U–learning of Important and Difficult Points Based on "Micro Class" and "Flipped Class"

For the key and difficult parts in the course learning, students can conduct offline teaching by means of "micro class" or consult professional literature, so that students can repeatedly study the parts that are difficult to master in the course.

At the same time, students are encouraged to share the results of U–learning, and it is planned to make PPT by organizing learning groups, form discussion groups to discuss different views and analyze practical engineering, so that students can become the subject of learning in the process of search, learning, discussion, reflection and construction.

The Comprehensive Application of "U–learning +CDIO" in Practice

The structural design competition and graduation design are practical teaching links for college students of Bridge engineering major, the practice parts are from scratch with the comprehensive application of multiple professional knowledge.

With the help of the bridge design standard drawing, general design specifications, professional training video and other materials in internet platforms such as "engineering network" and "civil engineering network", the professional knowledge and skills can be mastered through self-learning and interactive communication with teachers by U–learning.

On this basis, the whole learning process of CDIO "conception, design, realization and operation" could be completed combined with professional software such as Midas and Doctor Bridge. Finally, the teaching effect of "U–learning +CDIO" will verified by means of subject development overview, analysis model, and design drawing and calculation book.

The Curriculum Reform Effect of Bridge Engineering Direction Course under "U–learning +CDIO" Education Mode

Through teaching reform based on “CDIO engineering education concept” and " leaning + CDIO " of bridge engineering several years, the study found CDIO engineering education concept is very beneficial to cultivate interdisciplinary ability, theory combined with practice experience and forward-looking perspective of a new generation of engineering talent. The “U–learning” education mode has improved the autonomous learning ability and subjective initiative of students, as well as stimulated the creative thinking and comprehensive ability of them.

Based on curriculum reform, in view of cultivate creative consciousness, creative ability and the team spirit of students, our school organized two terms of “civil engineering structure design competition” in our majoring. The students use 10 pieces of A3 drawings design and modeling paper bridges from scratch to conception, in the process of primary design, mechanical analysis, making model, and load experiment, the whole process combined with the CDIO education concept perfectly.

More than 50 bridge models in the competition both experience the test of theory and practice. And ridge design information on network platform have been used in the design of bridges, which trained the ability of U–learning, stimulate the innovation consciousness, cultivate the practice ability and cooperation spirit, improve the comprehensive quality of students, enrich the campus academic atmosphere.

In the course of bridge engineering, students are actively guided to adopt the learning mode of U–learning. In the “bridge engineering” course and graduation design teaching process the offline test of autonomous learning have been adopted, by providing professional information for students in the network platform, guiding the student to find professional materials, the students can have more time to study the bridge engineering professional knowledge. At the same time, professional question have
been solved by groups and "Flipped classroom" have been adopted in class during teaching process, which greatly mobilized the team collaboration and ubiquitous learning ability of students.

**Summary**

At present, the network carrier has become a new education platform popular in colleges and universities. The comprehensiveness and readiness of online information provide a strong support for education in colleges and universities, which is more in line with the "learning appetite" of contemporary college students. The introduction of “U–learning” teaching mode combines the learning mode anytime and anywhere into all links of colleges and universities education. The organic combination of CDIO engineering education concept and “U–learning” teaching mode enables teachers to transform from skilled to reflective practitioner and make full use of technical resources to consciously improve the teaching process. The teaching reform based on the concept of "U–learning +CDIO" education concept will certainly promote the transformation theoretical ability to practical ability, knowledge to skills, and individual skills to comprehensive quality of students, and will become a newly emerging engineering teaching philosophy in universities.

**Acknowledgement**

This research was financially supported by The 2017 Advanced Education Scientific Research Project of the Advanced Education Society in Shaanxi Province Government (Project NO.XGH17088) and 2015 Shaanxi Higher Education Teaching Reform Research Project (Project NO.15BY55).

**References**


