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Experimental Teaching Reform and Practice of Visual Basic programming based on the Concept of CDIO Education

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Abstract: This paper proposed an innovation experimental teaching reform mode based on the CDIO engineering education idea, with the aim of solving the existing problems in the teaching process of visual basic programming (VB) in agricultural colleges, such as low learning interest and weak application ability, which is a common phenomenon for non-computer major students in colleges. The teaching reforms contains teaching method reform of case demonstrating and project driven, multi-level experiment projects constructing, adopting multiple assessment mechanism through the whole learning process, and constructing teaching platform by integrating modern information technology. The reform will provide a useful reference for improving the teaching quality of computer public basic courses in colleges.

Keywords: Experimental teaching reform, visual basic programming, CDIO.

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1. INTRODUCTION

VB programming is the introductory computer language course for the non-computer major students of in many colleges and universities. It is also a public compulsory computer course for the undergraduates in Northwest A&F University. Based on the visual interface design and structured programming, the course focuses on the common principles and methods of programming, by means of problem analyzing and expressing, algorithm designing and applications, coding and debugging and so on. The course has a strong practicality, among which the practical teaching module is an important way to train the students' programming skills and promote their ability of integration of theory with practice, it is also the key point to cultivate the students' innovative consciousness.

At present, there are some problems in the experimental teaching of the course, which are embodied in the following three aspects. Firstly, the experiments during the course are boring, which are mainly based on the verification of theoretical knowledge and algorithms. For having little association with practical application, the experimental contents results in the students' lack of leaning interest and motivation. Secondly, the organization of the experiments is too scattered and fragmented to learn. Most of the experiments are single examples or exercises in the book. The knowledge appears to be too fragmented, lacking of comprehensive

and coherent experiment content, and thus leading to the negative examination-oriented phenomena such as rote learning. Thirdly, the present teaching methods, which are mainly based on the passive verification of the theoretical knowledge and have no training on solving the practical application problems, cannot effectively mobilize the enthusiasm of learning. On the whole, the effect of experimental teaching is not ideal, with the outstanding manifestation of that the students' programming skill is too poor to solve specific application.

CDIO represents the ability of conceiving, designing, implementing and operating, which is a new achievement in the reform of international engineering education in recent years. Its core idea is to promote the comprehensive quality of students' basic knowledge, practical ability, team cooperation and vocational skills through the implementation of a complete project. Due to the emphasis on the learning process and the training of practical innovation ability, the CDIO concept has been widely concerned in the reform of engineering education and teaching [1]. It is an important direction for the reform of computer, software engineering and other major courses [2].

The existing researches have made beneficial explorations on the CDIO education concept from different aspects, such as reconstructing and optimizing the cultivation scheme [3], perfecting the curriculum system [4], implementing the project teaching and case teaching method [5], the innovative teaching evaluation model [6], improving the teaching process [7] and so on, all of which have made some achievements. However, due to the fact that the large teaching class, the differences of students' basic knowledge and professional background, and the lack of project experience for the lower grade students, colleges and universities still need to consider the objective factors such as the nature of the course, teaching objects and teaching platforms and other factors, so as to construct a suitable CDIO teaching model.

In order to solve the problems and improve the present teaching situation of VB in Northwest A&F University, an experimental teaching reform mode instructed by the CDIO concept has been put forward. The model is based on systematic research and long-term practice on the reform of teaching methods, the construction of teaching resources, the practicing of the examination and evaluation mechanism, and the building of new teaching platform. It aims to improve the quality of experimental teaching in multiple ways.

2. GENERAL IDEA OF THE EXPERIMENTAL TEACHING REFORM

With the guidance of CDIO engineering education concept and the specialty characteristics of higher agricultural and forestry universities, the "four in one" practice teaching innovation model is constructed by reforming the teaching methods, optimizing the experiment content of the course, improving the evaluation mechanism and building the practical teaching platform. The teaching reform aims to improve the students' practical and applied abilities through multiple channels. The main reform measures are as follows: taking case-demonstration and project-driven teaching method reform as the main line, taking the experimental projects and cases as the support to optimize the teaching content, focusing on the diversified assessment and evaluation across the whole learning process, and using modern information technology to build a practical teaching platform in a comprehensive way.

3. SPECIFIC STRATEGIES FOR THE TEACHING REFORM

3.1 Building Teaching Resource Library Characterized by Multilevel Experiment Projects

In order to solve the problem that the present teaching content is scattered and not closely related to practical application, the new teaching content which is close to life and oriented to application is designed and developed. At the same time, the comprehensive experimental

project is adopted to optimize the organization of teaching content and also improve the application and systematization of the experiment content.

First of all, multi-level experimental project library design is designed. Considering the knowledge base of the junior students and synthesizing the difference of students' professional background and individual ability, the experimental projects of three levels and 5 different types are designed according to the principle of simple to complex. The first level are the general-purpose projects, which include confirmatory, interesting and design projects, focusing on training students' programming thinking and basic skills, and also developing their learning interest. While the second level are the comprehensive applied experiment projects, which include database, network, multimedia related or other application problems with a certain degree of comprehensiveness and technical difficulty, focusing on opening up programming ideas and studying horizons. The third level are the specialty characteristic projects. Combining with the specialty characteristics of agricultural colleges, the personality cases with different professional characteristics are designed, focusing on enlightening the student to achieve mastery through a comprehensive study of the subject.

Second, the micro-projects are then made to simulate the real software developing situation, by breaking the routine grammar training and combining students' interests, typical applications and professional knowledge with the teaching content. The special experimental project resources are finally formed based on the general projects, promoted by the comprehensive applied or the professional characteristic projects .Because the experimental content is more interesting, comprehensive, applicable and challenging, it can effectively mobilize students' enthusiasm to integrate existing knowledge to solve specific problems, and promote the cultivation of programming thinking and the improvement of practical ability.

Third, other teaching resources related to the experimental projects are also constructed for strengthening the guidance of the practice process. The detailed experimental instruction is provided by writing the task book of the project, and the targeted micro videos are recorded to provide guidance for students' autonomous learning. The outstanding achievements of previous students are collected and organized to encourage the students to achieve excellent works.

3.2 Teaching Method Reform Focusing on the Cultivation of Applied Ability

Many studies show that project-driven teaching method is conducive to the cultivation of practical ability [1]. But for the low grade students of non computer major, the single form of project-driven teaching method is faced with many challenges, such as the weak foundation, little experience, capacity variance and so on. Therefore, the demonstration role of case teaching and the application role of project teaching are organically combined in this paper. The specific processes are as follows.

The first stage is the typical case demonstration teaching. Based on the construction of multi level experimental projects, targeted projects are selected according to teaching objectives and professional characteristics. Centralized case teaching is then carried out according to the process of "case background problem analysis group discussion problem solving summing up and expanding". In the specific application background, with the help of concrete cases, the students can understand the basic principles of program design, master the programming methods and skills, understand the relationship between theoretical knowledge and practical skills, and finally expand the open thinking of the problems.

The second stage is the project-driven teaching. Taking individual or group as a unit, with reference to the CDIO concept of "conception, design, implementation, operation" process, the specific project teaching is organized according to the 5 steps of "project selection function design project implementation results defense improvement and summary". First of all, students are encouraged to conceive topics according to their daily life experience, professional knowledge, scientific and technological innovation projects and so on. They can also choose

their own topics in the designated project library. Secondly, the software interface, function, implementing process and so on are designed in detail, and the implementation plan and experimental steps are made around the project goal. Then the software is completed by using the basic knowledge and programming skill in a comprehensive way, and the various functions of the software are gradually improved through operating, testing and optimizing. The technical difficulties in project implementation can be solved by watching relevant micro videos, consulting teachers and reading materials. Finally, the software is displayed through the open reply and jointly evaluated by teachers and students. After the open reply, students modify and improve the existing problems, write and submit summary reports.

Case demonstration and project practice alternately run through the whole teaching process. The case demonstration focuses on demonstration, guidance and imitation, which inspires students to conceive and design from the case to the other and guide students to combine theory with practice. Project practice focuses on practice, application and innovation. With the help of individual project, group collaboration project, innovation practice project and many other forms, the practice ability and comprehensive quality of the students are improved through the whole training process of conception, design, realization, test and defense. The two teaching methods support and cooperate with each other, forming a virtuous teaching cycle of first telling and then practicing while learning and using, thus promotes the transfer of students' theoretical knowledge to practical skills.

In addition, case demonstration and project-driven teaching reform can led to a significant change in the roles of teachers and students. It can give full play to the guiding role of teachers and the main role of students, and urge students to participate fully in experimental teaching.

3.3 Multiple Assessment and Evaluation Mechanism accross the Whole Learning Process

At present, the experimental teaching assessment focuses on single form of the paper report, which can not truly reflect students' practical ability. In order to evaluate the learning effect accurately and comprehensively, various assessment measures are taken, such as encouraging classroom participation, individual and group works, computer tests and exemption by developing a software. The new multi-element assessment mechanism covering the whole teaching process is formed by increasing the strength of process assessment and paying attention to the practical ability.

First of all, students learning enthusiasm is enhanced by encouraging classroom participation. The students' attendance, teacher and student communication, question answer and classroom participation are all included in the normal assessment basis. The students are encouraged to actively participate in the classroom by taking incentive measures. In addition, the "program show" is carried out among the students to improve their sense of achievement and self-confidence, by sharing the students' excellent works, interesting programs and novel designing ideas.

Secondly, the project practice process is paid special attention in the assessment. At each stage of the project practice, the progress are regularly checked and the qualitative evaluation in the stage is conducted by the teacher. After the project is completed, a quantitative evaluation of the project is jointly made by the teacher and the student. The students are fully encouraged to participate in the whole practice process through the combination of process assessment and result assessment, and also the combination of qualitative evaluation and quantitative evaluation.

Thirdly, the single form of assessment method is perfected. Over the years, the course examination has been been the final computer test. Since 2015, the exemption from test by software designing has been gradually carried out, that is, to guide students to design a practical or creative software and reply in public. The software is evaluated according to the quality, technical difficulty, functional characteristics and innovation by more than 5 teachers, and the evaluated results of the software are taken as the test results of the course. This reform has

received a positive response from students and greatly inspire the enthusiasm of the students with strong practical ability. Every year, there are many students choose to design software and get an excellent work.

3.4 Building Interactive Platform for Experimental Teaching

In view of the disadvantages of lack of time in teaching, the teaching resources such as project task book, experimental guidance and micro video are gradually perfected. In order to promote the integration of teaching resources and promote interaction and communication between teachers and students, it is necessary to build an interactive teaching platform relying on the modern information technology.

After the early construction, the course group have developed and designed a series of network teaching platform, including homework management system, experiment management system, computer examination and marking system. These online systems can realize the network distribution and sharing of teaching resources, experimental results online submission and correction, computer examination and network marking function.

On the basis of such systems, by giving full play to the advantages of modern information technology, such as the creation of "blue cloud class" and tencent QQ learning group, learning resources are further pushed to the mobile end for accessing whenever and wherever possible. Based on the mobile platform, teaching activities such as questionnaire, mobile phone check-in, online answering questions, classroom test, learning progress tracking, work sharing and mutual evaluation and so on are carried out, which can promote the positive complementarity between online teaching and offline teaching, broaden the channels of communication and feedback between teachers and students, and improve the efficiency of large class teaching.

4. ACHIEVEMENTS OF THE TEACHING REFORM

The teaching reform has been funded by the school level teaching reform project during 2015 to 2017. The teaching practice has been carried out in several majors in the university. The following achievements have been made.

(1) More than 20 different typical experimental projects have been designed and completed, and the systematic experimental project library has been built up, providing a strong support for the follow-up teaching reform.

(2) Students' ability to solve practical application problems is obviously enhanced. Each student can complete 4~6 experimental projects during the course study period. Some students also obtain course credits by making practical or professional application software, and their interest in learning increased significantly.

(3)The teaching reform has been widely accepted by the students. A survey of 235 students in 2016 showed that 91% of the students were interested in the content of the project, 99% of the students believed that the course learning is helpful to improve their computer application ability and to solve the professional problems, and 93% of the students agreed with the measure of the test-free examination reform.

5. SUMMARY

In order to improve the programming ability of non-computer major students, this paper, guided by the CDIO education concept, presents an innovative reform method for practice teaching of the programming-based courses, which integrates the reform of teaching methods, the construction of characteristic teaching resources, the examination and encouragement mechanism and the interactive platform for experiments. On the basis of fully arousing learning interest and enthusiasm, the reform can train the students' theoretical knowledge and

practical skills, cooperation and innovation consciousness through the whole process of experimental teaching, thus can improve the students computer application ability effectively. There are also be some challenges in implementing the teaching reform. For teachers, it is necessary to improve their own project practice ability, to master professional knowledge of other disciplines and also to mine high-quality experimental projects constantly. For students, it is necessary for them to improve self-learning ability to finish the complicated project. Therefore, teachers should take appropriate and incentive measures to adjust teaching strategies and improve teaching quality in combination with specific situations.

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