2016 International Conference on Education, Management and Applied Social Science (EMASS 2016)
ISBN: 978-1-60595-400-4

Research on a Practice-Based Teaching Style Based on CDIO Engineering Education Mode—Taking a Teaching Reform on Electronic and Information Course Groups as an Example

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Keywords: Practice-based teaching, CDIO, Teaching reform.

Abstract. Since the rapid development of science and technology has intensified global competition in the 21st century, it is an inevitable fact that the most talented and well-educated are in high demand. How to train high quality graduate student with higher application and practice abilities becomes an imminent problem which universities specialized curriculum teaching need to face currently. After investigated the current situation of teaching reform in home and abroad on, combined the selfish condition with professional training goal and summarized the effective methods and problems existing during the innovation experiment of teaching reform in recent years, the practice shows that the teaching reform using practice-based teaching style based on CDIO produces good results. Such an approach has many advantages: Firstly, it emphasizes the application and technical of the curriculum, and strengthens the training of practical and engineering ability. Secondly, it plays an important role in serving the request of The Economic Zone's Development strategy and providing reference for the experiment course system and the information management major reformation in other colleges and universities.

Background and Significance

After years of development, the course system of Chinese colleges and universities has established the course system structure [1] which adapted to the new-type personnel training mode [2] and the social economy development. However, the problem of emphasizing theory but underestimating practice and introspection has not been fundamentally solved, and becomes more difficult. This situation needs to change to get useful person such as engineering-type talents, management-type talents who can adapt to the requirements.

In recent years, after continuous adjustment, lab sessions are increasing, but the proportion is still low. The undergraduate training plan of electronic majors in Guangxi University 2010 showed, even the professional academic courses only make up 20% percentage of the lab sessions hour. In the actual teaching, experiments' time is often engaged by theory courses, which makes lesson time arrangements difficult to be guaranteed. The professional, technical knowledge that students can easily grasp from the experiments is taught in a spoon-feeding classroom. At the same time, most experiment teaching of tradition takes the lead of the authenticating experiment at a given time and place so that students have to complete it in a huge rush and resulting in the lack of thinking, understanding and imagination time which against the ability of engineering applications. For teachers, they fail to appropriate evaluation when facing dozens of students in experiment tests. The

final result is that students only get a superficial knowledge of professional theory and knowledge and difficult to understand and master practical, technical problems with extensive application. They may have a strong ability of dealing with examinations, but have a poor competence of dealing with communication because of the weak learning and innovation capacity and the lack of practice and innovation spirit.

Based on the present situation, we make an attempt by exploring a practice-based teaching model [3] at teaching reform on electronic and information courses as an example. The aim of this reform is to cultivate application-oriented and innovative talents, to emphasize the practice teaching, to put students as the main body, to merge practice and training into practical teaching system, and let them understand and master course knowledge by identifying and solving problems in practice. Meanwhile, a management pattern of open laboratory was established in which teachers, experiment instructors and students could handle general affairs together. Designed to fully mobilize the establishment and formation to play the main body of students, diversity and learning styles, in particular, to promote self-cooperation, explore mode. All these efforts were to train qualified application-oriented talents and laid the good foundation.

The Construction of Course Groups

The educational philosophy of this institute was "Value foundation, Value engineering practice, Value capacity-building, Strengthening the education of innovation, enterprising consciousness, and Contributing value to the construction of Beibu Gulf economic zone", which has been used as a guide for electronic and information course groups[4]. The teaching model applied in experiments, course design, understanding practice and other teaching stages has been discussed. It pointed out that students' capability in making a start, settling problems, innovating and cooperating with each other could be realized by using different teaching methods in different teaching modes [5]. Through electronics teaching content integration, deleting reasonably related subject content, it could form an effective whole to get ability module teaching content.

The architectures of Guangxi University electronic and information course groups including four modules: general education module, basic course module, specialized course module and practice teaching module. The specialized field of module was divided into major required courses and elective courses which contained "courses of relating circuit, signal, electromagnetic, communication, and computer application". For the training objectives, the course in specialized field module had other distinguishing characteristics in two main directions: linked experimental and teaching together to impart of knowledge not only from book learning but also learning by doing. The core idea was summarized as the following 3 parts:

1. Facing/one basic field: The knowledge of electronic and information field is covered completely;
2. Upholding/two basic points: The requirements of students to master theory and technology;
3. Developing/three technologies: Electronic circuit application technology, information processing technology and computer application technology.

In theory, the four modules contained almost knowledge, including information collection, processing, transmission and feedback. The courses of circuit analysis, electronic circuit (analog circuit and digital circuit) and high frequency circuits provided students basic theoretical principles of electronic systems. Signal and system, digital signal processing and computer network referred to the field of information system.

The Integration and Reform of Courses Group Teaching Content

The rapid development of technology requires institutes to improve with the times, in the limited four years teaching time, how to teach students to familiarize with information procession and mastering the professional skills practically, are teachers of thought. Based on establishment of the course

groups, we learned from the existing teaching achievement, deep analyzed the relationship among the information processing courses, re-assigned the class, reorganized the content, and enlarged the practice part.

Combination of Experiment Courses and Practical Training

Practical teaching is an important part to cultivate high quality electronic information engineering professionals, which focus developing students' ability to apply knowledge to solve practical problems and enhance their innovative spirit and practical ability. A interrelated and combined practice part was got by integrating the contents of training and academic competition to experimental courses and extracurricular practice activities, meanwhile, organizing students to participate in innovative projects, experimental skills projects, teachers' scientific research projects, electronic design training and competition and graduation design practice.

Adjustment of Professional Course

(1) The goal was to highlight and increase the ratio of experimental and practical part in the professional course. The study of content adjustment included the selection and confirmation of course content, in-class content, the content and class feature of experimental practice (validation, design applicability and subject form), selected concept, principle and methodological aspects.

(2) The study chose several high professional and high technical elective courses as independent course of experimental courses, incorporated into the practical teaching part. According to the requirements of experimental practice syllabus, adjusted the contents and teaching methods to technical design courses for an experimental teaching part.

Lab Management Based on the Curriculum Group Teaching Team

In order to meet the development of disciplines, we set up a pyramid-based laboratory construction and management team [6]. Led by the department head, 2 deputy head were responsible for the implementation of teaching and practice. With the other 7 teachers to reform the electronic professional courses and major elective courses, including the following fourteen courses: telecommunication circuit, communication theory, digital signal processing, electronic measurement technology, principle and application of single-chip, elements of information theory, computer network, microwave technology and antenna, digital audio technique, digital image processing, mobile communication, embedded technology, VHDL and programmable logic design, DSP technology. Under the direction of academic leaders, a plan was made for laboratories and personnel training by teaching team from the course groups to eliminate the inconsistency between the 2 factors from original source which could facilitate the integration of the 2 plans. At the same time, the implementation of open laboratory management, students were free to choose extra-curricular time for experiments, practices and researches. The main practice was self-management of students, supplemented by the management of teachers, student representatives in charge of the laboratory key, management laboratory environmental health, equipment and student daily activities management. From time to time, the laboratory held a discussion forum where students discussed the progress and problems of each topic. Besides instructing the students, the instructors also discussed with each other about scientific research and management and making continuous improvement, constantly sum up for scenarios with the operation of the laboratory Situation as well.

A Multidimensional Measurement of the Achievement

In assessment, effective and feasible assessment methods were explored according to the principles: reduce the assessment to individual; not to the accuracy of the experimental results to evaluate the experiment achievement, but focus on experimental methods, experimental process and analysis and processing method towards the problem, to give students more freedom of thinking and thinking possibility, to encourage students seeking divergence, exploration and innovation. In the practical learning method based on the CDIO engineering model education, the achievement evaluation of the

electronic information course consists of four parts: theoretical examination achievement (25%), normal achievement (20%), practical ability achievement (40%) and innovation (15%). Through these four parts of the scoring, the focus of project implementation, supplemented by theoretical examination, taking into consideration of daily behaving, the combination of subjective and objective scores, a more comprehensive assessment of student ability could be given.

The Major Achievements in Practice

Facilitate the Construction in Electronics Information Major

Through the implementation of studied and strengthened engineer practice teaching projects and training programs, it began to strengthen the teaching and training in practice part of professional courses among students of 2013. At the same time, carried out a theoretical study of curriculum system accommodated engineering application training, accessed references, invested research outside school, understood the development of the domestic and foreign universities professional curriculum reform, used the successful opening laboratory mode and management experience as reference, and summarized effective methods and existing problems in the process of teaching and laboratory reform recent years. A specific reform program was formulated and the new teaching program for specialized courses was published at the same time.

Promoting the Construction of Teaching Team

Undergraduates had won numbers of achievements in various innovation activities every year with the help of project team members, including teachers' own research projects, innovation training programs, Experiment Skill and Operation Contests, National Undergraduate Electronic Design Contest, guiding students' curriculum design and instruction in writing and publishing paper etc. In the process of guiding students, teachers also enriched their own knowledge, which came back to them in way which aided teaching development. In addition, three project team teachers had got training who introduced new teaching ideas and methods from American colleges and universities, which provided a strong support for future development.

Teaching Achievements Consolidation and Promotion

On the base of the previous research results, the scope of the pilot was expanded, the reform experimental unit sphere on specialized courses teaching and open laboratory management mode. Extended specialized courses reform to the whole course groups and improved the reform of open laboratory management mode. Took Microwave Technique and Antenna course as an example, by adding a programming experiment of Smith chart, students not only improved grades but also fully understood and mastered the key point of Smith chart and other microwave parameters computing which once difficult to teach and learn. The students' enthusiasm for studying was initiated by changing the structure of the elective professional courses module which completely theory courses in the past [7]. Scientific research credits and undertaking contest credits were factored into elective professional courses' cumulative rating, which created more space for students' practical innovation. According to the statistics, college organized more than 10 groups with about 50 students to participate in the National and Guangxi Undergraduate Electronic Design Contest every year, which had won 1 national first prize, 5 second prize, provincial 11 first prize and 15 second prize. At the same time, organizing students to be active in participating innovation training programs and experimental skill projects, which had successfully applied for 5 national innovative experiment projects and more than 20 district/colonel-level projects,13 school experimental skills projects and 5 concluding projects of them were rated as excellent, others were judged to be good. The scientific research results shows, undergraduate students of electronic information had magazine publications in various professional papers, participated 44 researches of teachers', and the teaching team conducted 9 projects and published 29 related papers. This work directly promoted 14 projects for the

laboratory construction and experimental teaching reform. Practice indicated that the learning energy to be stimulated by the practice-based teaching style was beyond our forecast. From the survey results, students' study time multiplied than ever before, eighty-seven percent of the students paid more than 10 hours in extra-curricular learning through information research, book reading, discussion and analyzing, and over 65% of those studied at least 12 hours or more; About 90% students devoted more than 8 hours in extra-curricular learning time to do the summary of writing report and demonstrate the research result, sixty-nine percent of which spent 10 hours or more.

Conclusion

Through the original teaching mode, it was difficult to achieve the goal of "detailed explanation, more practice which required teacher to bring the point across clearly in class and student practice more after school". However, it could be done easily in the process of practice-based teaching and benefited both sides. It showed that the total amount of time in teaching and learning had increased significantly, students got knowledge in-depth, and the quality of study could be improved, also the effect was better than the conventional method.

This paper summed up personal experiences in the practice of the teaching reform and rethinking the process. The practice-based teaching style based on CDIO engineering education mode was a kind of teaching mode, which regarded the professional course module as course groups, and strengthened the practice work as the key point. Adopting new teaching form and method, students became team players and expanded autonomous learning space by combining individual learning with group learning also theoretical knowledge with innovative practice activities. Integrating the practical problems in engineering practice into practical learning through the forefront, basic and cross-disciplinary problems could propitiously cultivated students' innovative consciousness and laid a solid foundation for training high-quality engineers and technicians. For teachers, one significant demand was to improve their teaching methods appropriately. In recent years, Electronic Information School of Guangxi University changed the present condition, provided ways to teaching reform using a practice-based teaching method and putted forward reform measures. The reform has achieved expected effect, while need further improvement and enhancement in future.

Acknowledgement

This work was financially supported in part by the Higher Education Undergraduate Teaching Reform Project of Guangxi (Nos. 2015JGB123&2015JGA126), and by the National Natural Science Foundation of China (Nos. 61262027& 45627390)

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