Design of a Web-based Teaching Environment for Engineering Education of Undergraduates

Weiming Cai and *Lingong Li*[*]

School of Information Science and Engineering, Ningbo Institute of Technology, Zhejiang University, Ningbo 315100, China

[*]Corresponding author: Lingong Li, Associate professor, nitllg@qq.com

Abstract

The increasing use of internet in people's daily life and its continuous development lead to the inevitable use of web-based applications because of their easy access in any place at any time. In this study, a new Web-based teaching environment is developed and presented for the engineering education of undergraduates. The web-based teaching environment model consists of bulletins on major information, materials of major courses, interacting between teachers and students, simulating design, and practicing application (BMISP). The process of engineering education can easily realize the interaction between teachers and students, the interaction between theory and practice, and the interaction between process and result by using the web-based teaching environment. A case based on the web-based teaching environment model for the majority of electronic information engineering in Ningbo Institute of Technology, Zhejiang University (NIT) is introduced as a successful example. Both teachers and students can realize great advantages of the web-based Teaching Environment.

Key words: *teaching mode; teaching environment; engineering teaching; educational tool*

1 Introduction

The Massive Open Online Courses (MOOCs) are a recent popular trend in the online learning landscape. [1-3] Flipped classroom teaching methodology as a type of blended learning in which the traditional class setting is inverted, lecture is shifted outside of class, while the classroom time is used to solve problems or do practical works through the discussion collaboration of students and instructors. [4] Those novel teaching ways and instructional methodology were proved to flip the classroom engages more effectively students with the learning process, and achieving better teaching results in many cases. [5-7] As the extension and application of these new teaching ideas, the traditional teaching mode and teaching environment which learning fixed contents in a fixed time and fixed location is getting changed, autonomous learning mode which studying any content at any time in any place has become more and more popular amount undergraduates.

China is the largest producer of engineering graduates in the world now. As "Post-90s" university students in the Chinese mainland begin to enter the university, walk out of campus and start to practice in the society since 2008, Post-90s have gradually become the main body of the college students. They were born in 1990s, accompanying high-speed economy in China. They called "post-90s university students" are mostly the only child in their families who have strong self-consciousness and good material condition. This special situation makes the post-90s undergraduates different from their elder generations. [8-9] They have distinctive characteristics, special behaviour styles, and learning habits. Besides, most post-90s

undergraduates tend to choose to give up when encounter a problem in their study if it is not timely solved.

Based on these problems, this research aimed to design a novel web-based teaching environment for post-90s engineering undergraduates.

2 Teaching Environment design

As shown in Fig.1, the teaching environment model consists of Bulletin on major information, Materials of major courses, interacting between teachers and students, Simulating design, and Practicing application (BMISP). Through the five teaching platform, the process of engineering education can easily realize the interaction between teachers and students, the interaction between theory and practice, and the interaction between process and result.
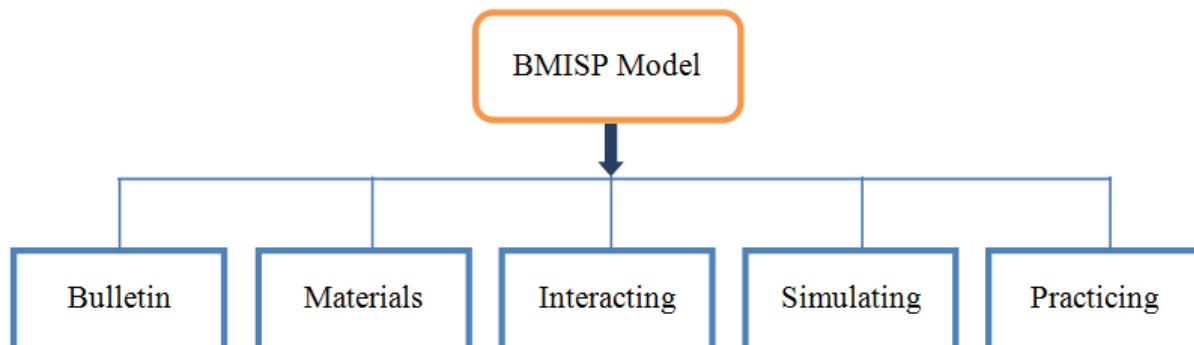

Fig. 1 – Structure diagram of the teaching environment model

2.1Bulletin on major information

A website was designed to storage major construction materials, training plan, faculty introduction, professional laboratory introduction, discipline competition information, students' scientific research project, faculties' scientific research project requirements etc. Students can conveniently find teaching related information and data in the website.

2.2Materials of major courses

All the teacher materials of major courses were placed in a course website. The course website is convenient for students to preview before class, review after class. According to students' needs, teaching materials of each course can be updated and refreshed timely, and guide the students to improve their learning effect by course instructors.

2.3Interacting between teachers and students

The QQ group was built for each major course. Instructors and students can make discussion through the instant messaging tool. Course materials, teaching requirements and other information can be published in the QQ group. Students can release the problem encountered in the process of the course study. Both instructors and students within the QQ group can express their views, discuss together, learn together, and resolve the questions encountered timely. All the students can get help timely when encountering a problem in the learning process. Spontaneously, students' learning interest and self-confidence can be increased. As a result, the teaching effect can be improved.

2.4Simulating design

For engineering students, theoretical courses such as Signals and Systems, and Digital Signal Processing are usually hard to learn. The simulating platform-MATLAB was constructed

forthose courses. Besides, the simulating platform-Proteus was used to Practical courses such as Microcontroller Principle and Applications, and Analogic Electronic Technology. Different courses can take different simulation software as a supplement, which enable student conduct simulating design in any place with internet at any time.

2.5Practicing application

A three-dimensional and open practice platform was design for practicing application. The platform was consisting of six levels, which are major associations, practice courses, faculties' scientific research, students' scientific research, academic competition, enterprise practice. All the students are able to choose an appropriate mode of practice and practice content according to their actual needs.

3 Results and Discussion

According to the teaching environment model described above, the majority of electronic information engineering in Ningbo Institute of Technology, Zhejiang University (NIT) was taken as a successful case.

3.1 The website of the Bulletin on major information

The webpage designed for bulletining major of the electronic information engineering can not only enable enrolled students find major materials (Major introduction, faculty introduction, professional laboratory introduction, and so on) conveniently, but also offer the public a way to understand the major in NIT and make their best choice before enter NIT.

3.2 The website of main courses

The main course learning service was available online such as the course website of Monolithic Machine Principle and Application showed in Fig.2. According to the students' evaluation and demand, teaching materials in the website were updating and enriching. Instructors can guide the student to study much more relevant course knowledge through the course website. A QQ link was placed in the website. As showed in Fig.3, one of the instructors was chatting with a student about programming issues of the course through the
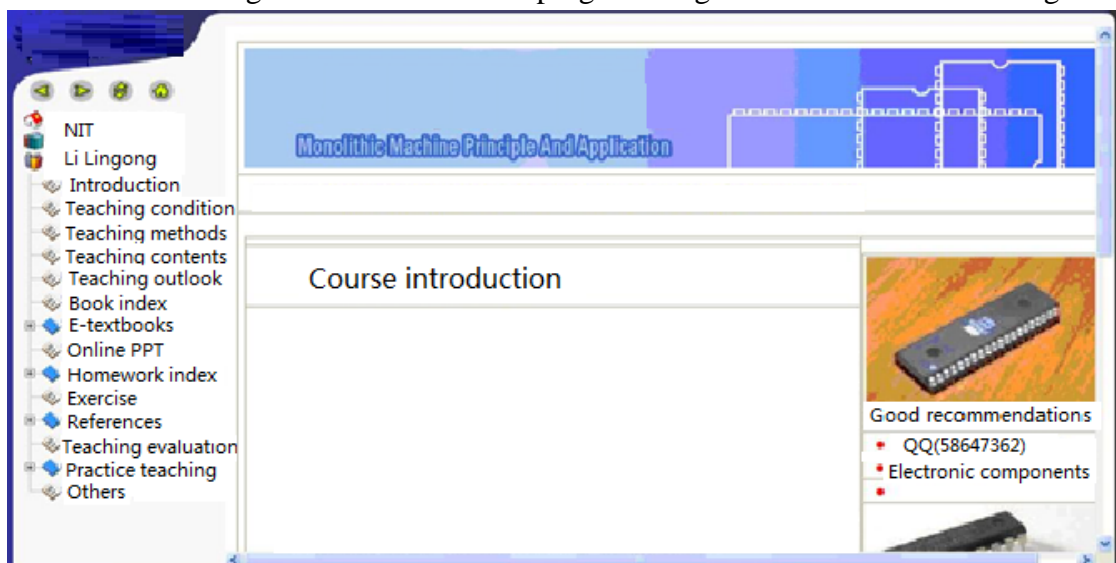

Fig. 2 – Webpage outline in the course website of Monolithic Machine Principle and Application

QQ tool. The active level of the QQ group was high indicated that the QQ tool was frequently used for the course study by the students. The QQ has been a convenient and popular on-line tool for students' course study just like other kinds of interactive teaching tools. [10-11]
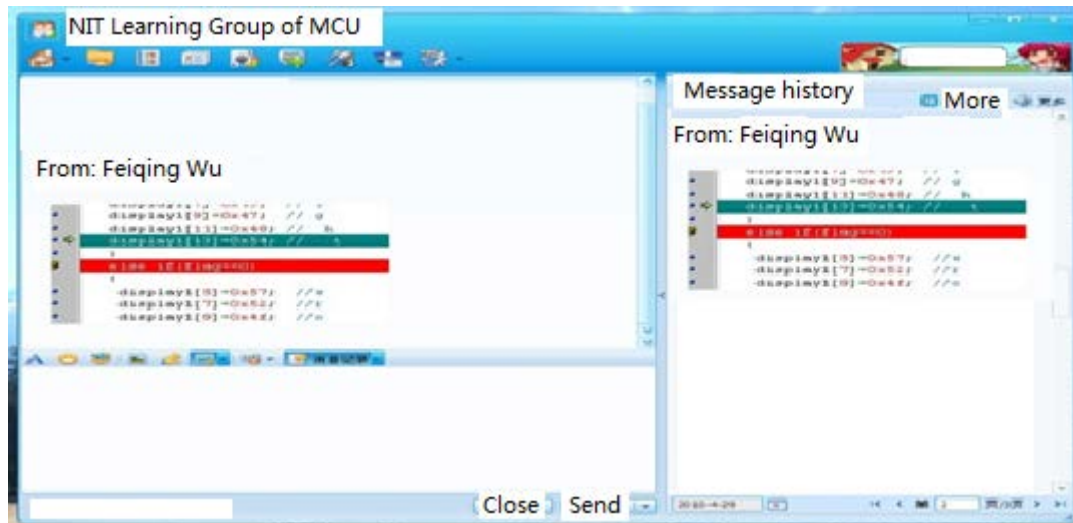

Fig. 3 – One of the QQ chat window between instructors and students

3.3 The simulating platform

Simulation software has been a main teaching tool, [12-13] for example, the microcontroller Simulation-Proteus contains everything students need to develop, test and virtually prototype their embedded system designs based around the popular series of microcontrollers. Essentially, it is a computer program that converts a computer into a fully virtual microcontroller laboratory like other virtual laboratories. [14-15]

3.4 The open practice platform

All the students are able to choose an appropriate mode of practice and practice content according to their actual needs by the three-dimensional and open practice platform. The students in Fig.4 were practicing in the academic competition.

Practice teaching is the key content for engineering education. The three-dimensional and open practice platform offered every freshman a chance to join professional associations to train their professional interest and skills, and improve team spirit. The curriculum practice was divided into four levels which are basic, design, comprehensive, and innovative. To encourage the development of students' personality, different students can choose different content according to their needs. Teachers guide students to participate in scientific research activities, and provide scientific practice opportunities for all students. All the students were able to do the project, learn knowledge, and improve professional ability under the guidance of teachers. To guide students to apply for research and innovation project at all levels of college students, guide students to participate in various activities in science and technology. Organize students to participate in various academic competitions, learning in the competition, competing in learning. Organize students to participate in enterprise practice which helps students understanding the real enterprise production system, and understand the needs of enterprises. To ensure the continuity and effectiveness of the activities, major tutors are responsible for the publicity, organization, guidance and management of the practice activities.

Practice in curriculum was included in the teaching evaluation, and it has become a part of the curriculum teaching content. Schools selected for the scholarships adopted a new policy, students' scientific research, academic competitions records, and students take part in teachers' research activities can get extra points.
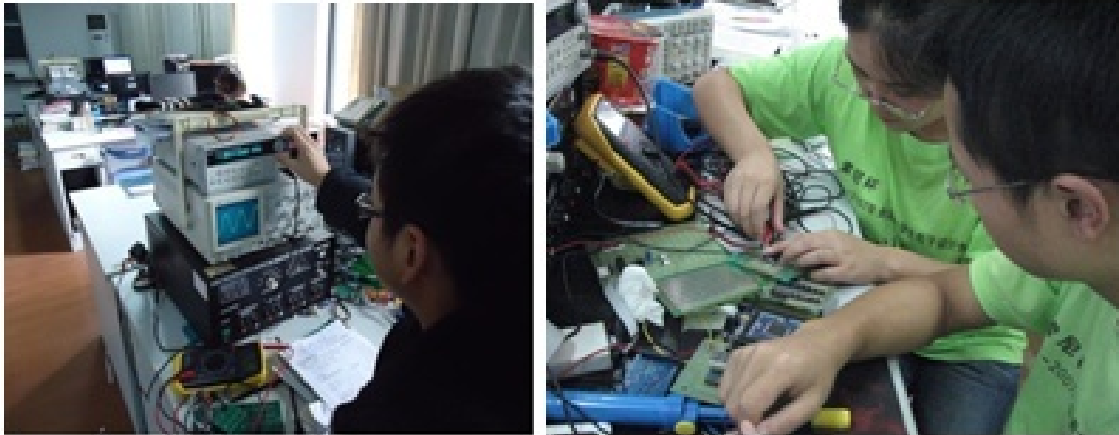
Fig. 4 –Students in the practicing

As a result, over 40% students were involved in teachers' research activities, over 25% student can apply student research project, and about 50% students participated in various academic competitions. Almost all the students participated in the enterprise practice before graduation.

4 Conclusions

Through the implementation of BMISP teaching environment construction, the NIT case has achieved good results. Tutors' information and course information are getting more open and complete, and satisfied the practical needs of engineering education of undergraduates. It offers students a convenient way to choose teachers, select courses. Teachers pay more attention to the construction of on-line teaching resources, more and more courses included design content, simulation practice, and some courses included the competition test, which effectively improve the teaching effect.

Students pay more attention to the use of web-based environment for learning activities. QQ and Wechat groups are used more popular than ever in the study process. Teachers and students communicate more and more in-depth by using the QQ group or Wechat group. Problems encountered in the process of learning can mostly be solved timely, which effectively improve the students' enthusiasm for learning.

As a result, the graduated students are getting more and more welcomed by employers and over 98% of them can find their job in one attempt. The novel web-based teaching environment is a useful way for post-90s engineering undergraduates' study. The next step of our work is to create more chance for undergraduates in NIT to involve in the web-based teaching environment.

Acknowledgements

References

1. *J.Wulf, I.Blohm,J. M.Leimeister, and W.Brenner,* Massive Open Online Courses. Business & Information Systems Engineering, 6(2014)111-114.

2. *T. Phan,S.G. McNeil, and B.R. Robin*, Students' patterns of engagement and course performance in a Massive Open Online Course.Computers & Education 95 (2016)36-44.

3. D. Gamage,S.Fernando, I.Perera, Factors leading to an effective MOOC from participants perspective. 8th international conference on Ubi-media computing, (2015) 230-235.

4. *C.Nwosisi,A.Ferreira,W. Rosenberg, K.Walsh,* A Study of the Flipped Classroom and Its Effectiveness in Flipping ThirtyPercent of the Course Content.International Journal of Information and Education Technology 6(2016), 348.

5. *G.G David, J.S.Jeong, and D.A.Rodríguez*, Performance and Perception in the Flipped Learning Model: An Initial Approach to Evaluate the Effectiveness of a New Teaching Methodology in a General Science Classroom. Journal of Science Education and Technology (2016)1-10.

6. *K. Gary*, A new wave of innovation using mobile learning analytics for flipped classroom//Mobile Learning Design, Springer Singapore(2016) 189-218.

7. *R.M. Felder，R.Brent*, To flip or not to flip. Chemical Engineering Education, 4(2015)191-192.

8. *H.C. Liu,*Chinese" Post-90s" Social Practice Analysis. Canadian Social Science 11(2015)131.

9. *X.J. Luo*,The Analysis of The Post-90s College Students' Self-management ability and Its Training Mode.Sichuan University of Arts and Science Journal 6 (2012)32.

10. *J. L.Guzman, R. Costa-Castello, S.Dormido,* M.*Berenguel*, An Interactivity-Based Methodology to Support Control Education: How to Teach and Learn Using Simple Interactive Tools [Lecture Notes]. Control Systems, IEEE 1(2016)63-76.

11. *C. A.Bodnar, D.Anastasio, J. A.Enszer*, Engineers at Play: Games as Teaching Tools for Undergraduate Engineering Students. Journal of Engineering Education1(2016) 147-200.

12. *F.Grasso, A.Luchetta, S.Manetti, M. C.Piccirilli, A.Reatti,* SapWin 4.0–a new simulation program for electrical engineering education using symbolic analysis. Computer Applications in Engineering Education 1(2016)44-57.

13. *S.Fragoso,M. L.Ruz, J.Garrido, F.Vázquez, F.Morilla,* Educational software tool for decoupling control in wind turbines applied to a lab‑scale system. Computer Applications in Engineering Education 3(2016)400-411.

14. *V.Potkonjak, M.Gardner, V.Callaghan, P.Mattila, C.Guetl, V. M.Petrović, K.Jovanović,* Virtual Laboratories for Education in Science, Technology, and Engineering: a Review.Computers & Education 95 (2016)309-327.

15. *A. T.Navaraja, N.Jain,D.Sengupta, C. S.Kumar,* Web Based Simulation and Remote Triggered Laboratory for Robots. In CAD/CAM,Robotics and Factories of the Future,Springer India (2016) 665-677.