

Research on Reform of Graphic Techniques for Civil Engineering Courses Based on Outcome Based Education

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Abstract—With China accession to the “Washington agreement”, the engineering education in our country must set up a new standard equal to the quality of the world, the Outcome Based Education (OBE) is the main concept of engineering education reform in developed countries. In this paper the core basic course of civil engineering “Graphic Techniques for Civil Engineering” was taken as a example, to investigate the reform method from the normal teaching mode to the mode of improving student’s ability. By determining the course teaching object according the specialty education objective, using the course teaching object to design teaching materials, and optimizing the assessment methods aimed by expected teaching results, the method of teaching mode reform and improving the ability of students was explored.

Keywords—Outcome Based Education(OBE); Graphic Techniques for Civil Engineering; Expected Learning Outcomes

I. INTRODUCTION

In June 2016, China became the 18th official member of the Washington agreement. After becoming a full member, our country will fully participate in the formulation of the rules of the Washington agreement, the engineering education certification in our country and the graduate degree will be recognized internationally. This means that China's engineering education must set up a new international equivalent standard on engineering education quality. To do this, we must change the traditional education concept at first. Outcome -based education, referred to as “OBE”, also called ability oriented education, goal oriented education or demand oriented education was proposed by Spady Et al since 1981, this concept put emphasis on “student centered”, “goal-directed” and “continuous improvement”. It quickly gained people's attention and recognition, and has become the mainstream concept of education reform in the developed countries of the world [1]. The American engineering education certification association (A-BET) has accepted the concept of OBE, and has carried it through the whole engineering education certification standard. It is also clear that the training objectives of civil engineering specialty should reflect the expected achievements of students in social and professional fields within 5 years after graduation in our professional certification standards for civil engineering. In order to achieve this goal, graduates majoring in civil engineering should have the following graduation requirements: ability to use engineering knowledge and problem analysis method to solve complex engineering problems; ability to

design and research solutions to complex engineering problems, and also focuses on factors such as engineering and society, health, safety, law, culture and environment and sustainable development. At the same time, have the ability to abide the professional standards, have the ability of project management and teamwork communication, and have the awareness of self-learning and lifelong learning, and have the ability to constantly learn and adapt to development [2]. However, it is difficult to meet the above requirements for most college graduates majoring in civil engineering in China. The main reason is that our country's most senior majoring in civil engineering still uses the knowledge oriented education mode, the traditional course system and teaching methods in which teachers as the main body, students are still in passively accepting the teacher's knowledge, and passing the examination as the main evaluation of training quality. This all results in the ability of the civil engineers to solve practical engineering problems is weak, and the students' creative thinking and comprehensive skills are poor too [3,4].

In this paper, Graphic Techniques for Civil Engineering courses was taken as an example, aiming at the main problems of classroom teaching mode in most universities in China, surrounding the topic about OBE's core idea, the reform thought on turning the traditional classroom teaching mode into enhancing the students' ability as the core target of classroom teaching mode was proposed, and the method about the reform of college classroom teaching mode and the basic way to improve college students comprehensive quality and ability were explored too.

II. COMMON PROBLEMS IN CURRICULUM TEACHING

The course of "Graphic Techniques for Civil Engineering" is a compulsory course for civil engineering, the students need to use projection theory to solve space problems in this class, after completing this course, students should master the ability to read and draw engineering drawings. In the traditional teaching system, the cultivation of drawing ability is emphasized more. In the course teaching, the students will be trained by means of a large number of manual drawings, computer aided drawing exercises, etc. However, there is relatively little training in the reading drawings. As a result, the students can not understand a set of drawings, do not know the meaning of the technical specification and standards, can not read the various standard schematic handbooks, and can not be able to guide the construction directly.

Graphic Techniques for Civil Engineering course has 64 class hours in our school, it is the integration of descriptive geometry, civil engineering drawings and CAD these three courses. But the class hour was less than half of what it used to be, this requires teachers to carry out teaching efficiently with the aid of multimedia teaching methods. However, the course has the characteristics of difficult theory and difficult exercise, and the limited teaching time in class can hardly guarantee the students' learning effect. In addition, due to the freshman lack of professional basic knowledge on construction and other aspects, cause the student don't understand its graphics expression of civil construction, so it's hard to use the theoretical knowledge to solve practical engineering problems after learning. In addition, with the continuous development of society, civil engineering professionals should not only have skilled manual drawing and computer drawing ability, but also have innovative consciousness and innovative ability. Also only pay attention to develop the students' ability of space imagination and graphic techniques already can't satisfy the demand of contemporary society of civil engineers, the contemporary civil engineer should also have the team cooperation ability, communication and coordination ability and writing ability of the technical documentation, how to cultivate these abilities bringing a grand challenge to the traditional teaching mode [5]. Therefore, it is very important to explore and practice the teaching reform in order to improve students' comprehensive quality ability.

III. CURRICULUM REFORM AND PRACTICE

A. Clearing the Teaching Objectives with the Goal of Professional Training

The course syllabus based on OBE should determine the teaching objectives of the course and the students' learning outcomes in combination with the graduation requirements of the major. The teaching objective of Graphic Techniques for Civil Engineering is to cultivate the freshman's ability on drawing and reading professional drawings. After completing the course learning, students should have the professional knowledge level, abilities and qualities to support the goal of cultivating. This must be expressed in clear text, and shall have the corresponding teaching activities to achieve these goals. As shown in Table I.

B. Designing Teaching Content Based on the Curriculum Objectives

In the OBE education mode, we emphasize on the curriculum objectives precedes its content. The course design and development, teaching process organization, teaching activity design and so on all revolve the teaching goal to carry on. To provide students with knowledge and skills, and to train students' abilities and quality, so as to ensure that students can achieve the expected learning outcomes. For this purpose, the expected learning outcomes of this course in the syllabus are shown in Table II. Because the descriptive geometry part is very

abstractly, we need often ask questions and inspire thinking, encourage students to actively ask questions on these problems in time, and also inspire student in giving advice or opinion to the teaching schedule and teaching methods. In the content of teaching, it is not limited to the content of teaching materials, but the content of other excellent teaching materials, engineering examples, etc. In the teaching mode, the selected part needs students complete through self-study, class discussion, group tasks or presentation form, create more innovative thinking and expression opportunity to the students. In the group task, we divided all the students into a group of 3 to 4 students, and gave each group the corresponding tasks and each group presentation the learning outcomes in class. Teachers and other students ask questions, and finally, teachers and students jointly evaluate. With this kind of teaching model, teachers and students can fully integrate into the classroom. In the process of "self-study - complete tasks - class presentation - discussion", students need to think and study independently, which can fully develop and improve students' thinking and creativity. In addition, teamwork and communication skills are improved, and students' self-confidence is improved so that students can not only master the knowledge of books, but also make achievements in practical work.

C. Optimizing the Assessment Method Based on Expected Learning Outcomes

Under the OBE education mode, besides to design the teaching contents according to the teaching goals, and develop the relevant teaching activities, also we must build a diversified evaluation system to test the reaching degree of the curriculum objectives [6]. Without a strict and effective evaluation system, it is difficult to achieve the expected learning outcomes. Assessment should cover all the learning outcomes of this course, the results should be able to fully reflect the students in the teaching process of personal growth and diversification development, thus must adopt diversified evaluation method to measure the students' learning outcomes, such as: homework, quizzes, model drawing, physical mapping, group task, etc. Through these procedures, we can grasp the students' level of knowledge and the level of their ability. Also through the feedback of test results, the teaching design is improved in real time. The specific assessment system is shown in Fig. 1.

In view of the above assessment indicators, as shown in Table III, design different evaluation methods to assess the students' learning attitude, analysis and problem-solving ability, engineering practice ability, team cooperation ability, oral expression ability, etc. The main body of the evaluation includes all the teachers and students. Moreover, the achievement of the corresponding learning outcomes is verified by the evaluation results, and the teaching process and corresponding assessment methods and evaluation system are improved according to the achievement analysis to achieve the goal of continuous improvement.

TABLE I. CURRICULUM OBJECTIVES AND LEARNING OUTCOMES

Type of Objectives	Expected Learning Outcomes	Teaching Activities				
		Teaching	discussion	self-study	Group tasks	Computer experiments
Knowledge Objectives	a. Master the basic theory and drawing method of various projection methods	✓	✓	✓	✓	✓
	b. Familiar with current drawing standards	✓				✓
Ability Objectives	c. Use drawing tools and instruments properly	✓				
	d. Be able to write standard HZCF	✓		✓		
	e. Be able to draw drawings that conform to national cartographic standards and read general engineering drawings correctly.	✓	✓	✓	✓	
	f. Master AutoCAD commands, able to draw basic shapes using commands	✓				✓
	g. Have certain communication and teamwork skills		✓		✓	
	h. Have a positive attitude to study and have a responsible working attitude and rigorous and meticulous work style.	✓		✓	✓	

TABLE II. COURSE CONTENT DESIGN

Items	Course content	Class Hour	Teaching Activities	Expected Learning Outcomes
1	Basic Knowledge of Drafting	4	Teaching	b,c,d
2	Basic Knowledge of Projections	4	Teaching+Discussion	a,e,g
3	Projections of Points, Lines and Planes	8	Teaching + Discussion +Group Task	a,e,g,h
4	Relationship of Lines to Planes, Planes to Planes	4	Teaching + Self-Study	a,e
5	Curves and Curved Surfaces	2	Teaching	a,e
6	Cutting Lines and Intersection Lines	6	Teaching + Discussion +Group Task	a,e,g,h
7	Representation of Architectural Solids	3	Teaching + Self	a,e
8	Axonometric Projection	3	Teaching + Self	a,e
9	Architectural Working Drawing	10	Teaching + Discussion +Group Task	a,b,c,d,e,g,h
10	Reforced Concrete Structure Drawing	8	Teaching + Discussion +Group Task	a,b,c,d,e,g,h
11	Water Supply and Drainage Engineering Drawing	2	Teaching	a,b,c,d,e
12	Road and Bridge Engineering Drawing	2	Teaching	a,b,c,d,e
13	Computer Drawing	8	Teaching + Computer experiments	a,b,f

TABLE III. COURSE EVALUATION METHOD

Items	Assessment Types	Assessment Contents	Evaluation Method	Subject of Evaluation	Expected Learning Outcomes
1	Learning Attitude	Attendance, Performance, Participation & Discussion	Observation	Teacher	g
2	Analysis and Problem-Solving Ability	Theoretical knowledge, Applying knowledge, Discussion	Paper-pencil test, Homework evaluation	Teacher & students	a,b,c,d,e,f
3	Engineering Practice Ability	Physical mapping, Group task	Performance Assessment	Teacher & students	c,d,e,f,g,h
4	Team Cooperation Ability	Group task	Performance Assessment	Teacher & students	g,h
5	Oral Expression Ability	Discussion, Presentation	Oral assessment	Teacher & students	g,h

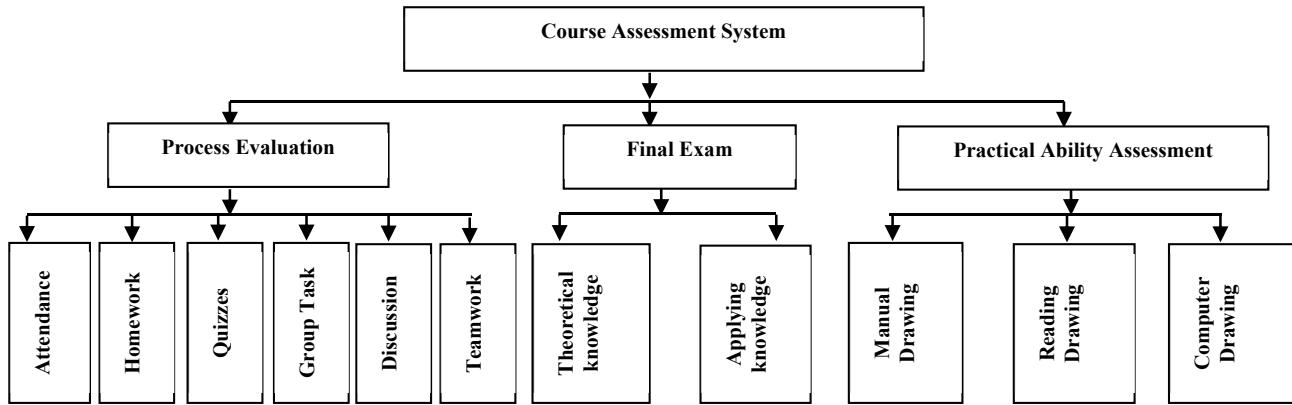


Fig. 1. Course assessment system

IV. CONCLUSIONS

Based on the OBE education mode, the method and practice approach of the curriculum reform of Graphic Techniques for Civil Engineering is established in this paper. According to the professional training target in our school, the corresponding expected learning outcomes are worked out through the knowledge, ability and quality objectives, and the corresponding teaching content are designed, and the different teaching activities such as the lectures, class discussion, group tasks, self-study and computer experiments are performed. At the same time, the assessment methods are optimized and a diversified evaluation system is constructed to test the achievement of teaching objectives. Finally, the teaching process and the corresponding assessment system and evaluation system are improved according to the achievement analysis to achieve the goal of continuous improvement.

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