

CDIO-BASED TEACHING CONTENT AND METHOD REFORM OF ENVIRONMENTAL IMPACT ASSESSMENT COURSE

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ABSTRACT

Environmental Impact Assessment(EIA) has the characteristics of comprehensiveness, timeliness, practicality and applicability, etc., the current EIA courses mainly focus on the teaching of relevant theories and methods, but lack practical teaching, especially the cultivation of students' engineering practice ability. Based on CDIO engineering education idea, we try to reform the teaching content and method, and provide a real engineering environment which associates with theoretical study and engineering practice for students, improve their professional skills, team cooperation ability, critical thinking ability, comprehensive ability to solve engineering problems, and cultivation of innovation ability along with learning professional basic knowledge. The teaching reform includes some highlights, such as optimization and adjustment of course content and method, writing specialized teaching textbook and establishing teaching website, exercising and cultivating student's engineering practice ability, self-study and presentation skill, construction of curriculum evaluation system. And the reforms are applied to the EIA teaching process in two grades. Accordingly, the evaluation index system and evaluation method are explored and constructed. During 2 years of teaching reform practice in two grades, the reform effect is significant, students can master the requirements and skills of compiling EIA report, and the engineering practice ability is improved obviously.

KEYWORDS

environmental impact assessment, CDIO, engineering education, engineering practice ability, evaluation index, CDIO Standards: 3, 6, 8, 11

INTRODUCTION

Due to the active exploration and development in the past 30 years, the Environmental Impact Assessment (EIA) system was constantly improved in China, the "Environmental Impact Assessment Law of the People's Republic of China" was issued in 2002, which showed a new stage of EIA development in China. At the end of 2015, the number of EIA technical guidelines issued by Chinese Ministry of Environmental Protection was more than 20, which involved general principle, each environmental factor, planning environmental impact assessment, ecological environment, environmental risk assessment, major industries, etc. EIA plays an important role in decision-making of environmental protection, there is a great demand for technical professional in EIA market, meanwhile, students need to obtain more professional skills and knowledge in university.

Excellence engineer's education program of China has been put into practice in 2010, deep participation of industrial enterprises in the training process, cultivating students according to the general standard and industrial standard, strengthening cultivation of students' engineering ability and innovation ability are the basic characteristics. (Li Shu-wei et al., 2011). Based on "Excellence Initiative" (Han Yao-xia et al., 2014), (Han Xiang-yun et al., 2014) and "CDIO Engineering Educational Idea" (Wang Shuai-jie et al., 2015), Chinese scholars introduced guidance-case teaching method, and made a preliminary probe in the EIA course reform from teaching philosophy, content and method, which aimed to improve students' ability to analyse and solve practical problems. However, influenced by traditional teaching mode, there are many constraints or problems along with curriculum reform, for example, most of existing EIA books are lack of case analysis, and the contents are lagging far behind the EIA development, therefore, it's urgent to make reform and innovation on the existing teaching system in order to cultivate professional students who can quickly adapt themselves to the requirement of EIA market.

EIA course is a core curriculum for the environmental engineering and science majors in college of resources and environment, Chengdu University of Information Technology (CUIT), the basic goal of this curriculum is to cultivate student who can master the basic knowledge of EIA, analyse and solve practical problems, meanwhile, apply the relative knowledge to compile EIA report, and get continuous improvement in many aspects, such as self-learning ability, thinking ability and life value. In order to meet the demand of new development, we make reforms on the teaching content and method of EIA course, and apply to the environmental science majors in 2014 and 2015. From the final results, we can see that students' professional skills have been improved greatly, and the effect is significant.

MAJOR PROBLEMS OF THE COURSE

According to the retrospective analysis, major problems of EIA course before the reform are included as follows.

1. EIA textbook can't catch up with the EIA development in China, and it's difficult to find a suitable textbook at present.

Due to rapid development of EIA in recent years, the new policy, standards, technical guidelines and other normative documents have been issued or updated, so the course content need to be updated timely. In addition, most textbooks don't focus on the key point of EIA practice. Therefore, it's urgent to write a textbook which has timeliness and practicality.

2. Teaching method is too simple, and it's not enough to cultivate students' engineering practice ability.

The teaching process is dominated by classroom teaching, lecture-oriented teaching time accounts for about 90% of the total course hours, course teaching is still bound in spoon-feeding teaching and students' passive learning. In addition, it is difficult to carry out practice teaching in that there is lack of practice base. Consequently, it's so hard to effectively connect course contents with engineering practice in the teaching process, and students can't make good use of knowledge to practice. Hence, it's important to improve students' engineering practice ability by strengthening engineering practice training.

3. Students have only a flimsy grasp of EIA knowledge.

Most students' learning goal is to cope with examination, rather than take active learning to master professional knowledge. During their spare time, students are busy with student organization's work or online games, rather than learn and improve their professional knowledge or skill, consequently, they are not familiar with basic specialized knowledge and common soft wares. Therefore, it's urgent to reform the examination method, cultivate and improve students' self-learning ability.

FRAMEWORK OF THE COURSE REFORM

Framework of EIA Course Reform Based on CDIO Idea

Through teaching process of "basic content + EIA case analysis + discussion + project practice", basic knowledge, reasoning, problem-solving ability and systems thinking required by CDIO are implemented to the course teaching, theoretical knowledge and techniques of EIA, engineering practice ability, teamwork skill, report presentation and communication skill are embodied in the teaching process. Framework of curriculum reform is showed in figure 1, major reforms of course teaching and practice teaching are included as following.

1. Adjustment and optimization of teaching content and method.

Writing special teaching textbook according to the latest EIA laws and regulations, technical guidelines, which highlights EIA case analysis and report compiling. Seriously preparing the teaching plan, adjusting and optimizing the teaching content and method, difficulty and key points are stressed, such as EIA technical methods, case analysis, engineering practice ability training, etc., then striving to achieve the goal of "new, less and essence". In addition, we build teaching website which contains the latest news about EIA development, courseware, assignments, and various EIA reports, etc., and online interaction is available.

2. Cultivation of student's engineering practice ability.

EIA case analysis is strengthened in classroom teaching, and the basic professional knowledge should be mastered by each student. Then students can get to know real engineering project through practice base on campus or off-campus, and design the EIA report plan according to the knowledge in classroom, meanwhile, EIA report can be compiled and finished through team collaboration. In this way, students are trained to achieve mastery, meet practical requirement, and their engineering practice ability can be improved greatly.

3. Training of student's self-learning ability, presentation skill.

Extracurricular projects or tasks are arranged in the classroom at first, such as introduction of one aspect in EIA development, or application of one method or model, which are additional assignments of this course. Then students prepare the report by reading relevant materials in their spare time, finally students will be selected randomly to introduce the report, and everyone in the class is expected to participate in discussion. Additionally, we simulate real EIA report review, students will introduce their EIA reports when the EIA reports are finished, and teachers will review the reports and put forward existing problems and suggestions. Finally, the review comments will be provided after teacher's discussion.

4. Construction of course evaluation system.

After finishing the course, the evaluation index and method are established to evaluate the effect of course teaching, timely finding problems and continuously making improvements.



Figure 1. Framework of EIA course reform

Design of Course Teaching Mode

Refer to CDIO teaching mode, the teaching mode of EIA course includes four process, which is conceive, design, implement and operate.

1. Conceive process (clear course task and task preparation, namely let students know what should they do, and how to do).

Main task of this course is to let students master relevant knowledge and basic skills, and own the ability of compiling EIA report independently on the basis of EIA case study and project engineering practice.

2. Design process (design of project implementation plan, that is, students design project implementation plan by themselves).

Reducing teaching hours and increasing practice hours accordingly. Students try to know the real project through practice base on campus or off-campus, then learn and master the detailed implementation process or plan of on-site survey, project contract, monitoring program, outline of EIA report, EIA report compiling, report review, etc.

3. Implement process (project implementation, that is, let students complete the project by themselves).

According to preliminary study of EIA basic knowledge, and project implementation plan and related basic data, students are divided into several groups to compile EIA report by teamwork, and they can ask teachers once problems or difficulties are emerged in this process. Additionally, EIA report must be finished within the given time.

4. Operate process (project evaluation, that is, according to task requirement, obtain the evaluation and feedback of project completion).

After the reports are compiled and finished, we organize teachers to review the EIA reports which are compiled by different groups, and randomly select one student to make presentation, then teachers or students ask questions, and team members can make an answer in time. Teachers will give each student a grade according to the quality of EIA report and answer. In addition, the proportion of regular grade will be increased in the final grade.

We make a comparison between before and after the curriculum reform, the results are showed in table 1.

Table 1. Comparing with key factors of EIA course before and after the curriculum reform

Key Factor	Before Reform	After Reform
Teaching material	<ul style="list-style-type: none"> • EIA handout • courseware 	<ul style="list-style-type: none"> • special textbook of EIA, strengthening case analysis and practice ability training • courseware
Teaching method	<ul style="list-style-type: none"> • lecture • discussion • on-site survey • EIA report presentation 	<ul style="list-style-type: none"> • lecture • autonomous learning • discussion • on-site survey • EIA and extracurricular project report presentation
Teaching period	<ul style="list-style-type: none"> • teacher's teaching time (90%) • student's presentation time (10%) 	<ul style="list-style-type: none"> • teacher's teaching time (80%) • student's practice and presentation time (20%)
Student's engineering practice ability	<ul style="list-style-type: none"> • compiling EIA report in the practice base on campus (one time) • team defense 	<ul style="list-style-type: none"> • extracurricular project (students collect material by themselves, then randomly selecting student to make presentation after they finish

		the reports) (one time) <ul style="list-style-type: none"> • compiling EIA report in the practice base on campus (one time) • team defense
Regular grade	<ul style="list-style-type: none"> • attendance record • homework grade • grade of EIA report quality and presentation 	<ul style="list-style-type: none"> • attendance record • homework grade • grade of EIA report quality and presentation • grade of extracurricular project report quality and presentation
Final grade	<ul style="list-style-type: none"> • final exam grade (80%) • regular grade (20%) 	<ul style="list-style-type: none"> • final exam grade (60%) • regular grade (40%)

IMPLEMENTATION AND ASSESSMENT

Implementation of Course Reform

EIA course reforms are explored based on CDIO idea, then reform plan has been applied to grade 2012 environmental science majors in 2014 (1 class, and 40 students) and grade 2013 environmental science majors in 2015 (1 class, and 43 students). The basic information of EIA course can be seen in Table 2.

Table 2. Basic information of EIA course in CUIT

Course Title	Environment Impact Assessment			
Credit	3			
Student	Environment Science			
Hour and Distribution	Total Hour 48			
	Teaching 38	Experiment 0	Practice 10	Computer Practice 0
Course Category	Core			
Assessment Method	Exam, regular assessment			

Assessment of Course Reform

Reference to the standards of CDIO and Excellence Engineer's Education Program in China, and combining the situation of EIA course, the evaluation index system has been explored and constructed from teaching condition, teaching content, teaching method and teaching effect, in order to test the effect of curriculum reform, which consists of 11 secondary indicators, it's showed in table 5.

The evaluation method is integrated with quantitative and qualitative evaluation in order to improve the reliability and comparability of evaluation result. Total score of evaluation index is 100, which is calculated by comprehensive evaluation. And calculation equation is,

$$M = \sum K_i M_i \quad (1)$$

M is total score of comprehensive evaluation, K_i is ranking coefficient, and coefficient of A, B, C, D is 1.0, 0.8, 0.6, 0.4 respectively (Han Xiang-yun et al., 2014), M_i is score of each secondary index.

Preliminary evaluation content and criterion are established on the basis of major factors involved in teaching condition, teaching content, teaching method and teaching effect. It is showed in table 3.

Table 3. Evaluation content and criterion of EIA course

Secondary index	Evaluation content	Evaluation criterion
Teaching material	Textbook, courseware, handout	<ul style="list-style-type: none"> ● selection of excellent textbook or compiling high quality textbook. ● providing good and valid documents to students' self-learning and research learning.
Practice teaching condition	Advanced and opened practice base	<ul style="list-style-type: none"> ● space and equipment of practice teaching can meet requirements. ● providing comprehensive practice, and the effect is obvious.
Network teaching	Website construction, rich teaching resources	<ul style="list-style-type: none"> ● teaching website is running normally, good hardware and keeping update. ● meeting the teaching requirement, and playing an important role.
Curriculum framework and content	Course plan and content design	<ul style="list-style-type: none"> ● reasonable curriculum system, content is new and focused. ● course notes and teaching plan are available. ● practice teaching scheme is reasonable.
Content organization, teaching arrangement	Course schedule and content arrangement	<ul style="list-style-type: none"> ● linking theory with practice, knowledge transference, ability training and quality oriented education as a whole. ● reasonable arrangement of classroom teaching and practice teaching.
Engineering practice, teaching method	Practice teaching content and method	<ul style="list-style-type: none"> ● engineering practice can meet the requirements of cultivating professional students. ● practice teaching has obvious effect in training students to find, analyse and solve problems. ● practical teaching method is flexible, effect is significant.
Teaching method, evaluation method	Advanced method and examination reform	<ul style="list-style-type: none"> ● advanced teaching methods are adopted flexibly. ● effectively arouse the enthusiasm of students, promote to think independently, stimulate their innovation ability.
Audio-visual teaching method	Audio-visual aids and application effect	<ul style="list-style-type: none"> ● making full and proper use of modern education technology. ● obtaining actual effect in inspiring students' learning interest, learning initiative, and improvement of the teaching effect.
Peer review	Feedback of peer review	<ul style="list-style-type: none"> ● material is real and reliable, and good evaluation.
Teaching evaluation by	Feedback of student's	<ul style="list-style-type: none"> ● student's evaluation material is real and reliable, and good evaluation.

student	evaluation	
Teaching results	Classroom teaching and practice teaching situation	<ul style="list-style-type: none"> • students' attendance rate is high, and lively discussion is often emerged in classroom. • quality of EIA report, project report is good. • presentation effect is good, more students can involve in discussion, and interaction effect is good. • the ability of students is improved greatly.

According to the evaluation content and criterion, teachers (3 teachers) and students (10 students in each grade, a total of 20 students) participate in the primary survey. Additionally, students don't need to determine the rank of teaching content and teaching effect because they are not familiar with these parts, so only 3 teachers make a survey. Then the data is collected (see table 4), we take teaching condition as an example. Probably, some ranks are controversial, such as network teaching (see table 4), teachers will discuss and determine the final rank. The final ranks are showed in table 5.

Table 4. The evaluation rank of teaching condition

Secondary index	2014			2015		
	by student	by teacher	final rank	by student	by teacher	final rank
Teaching materials	5A, 15B	1A, 2B	B	16A, 4B	3A	A
Practice teaching condition	20B	3B	B	2A, 18B	3B	B
Network teaching	6A, 14B	1A, 2B	B	15A, 5B	2A, 1B	A

Based on the evaluation index and relevant data, the reform effects in 2014 and 2015 are evaluated, and the results are also showed in table 5. The total score is 83.6 in 2014, and 88.8 in 2015, it shows that the result is significant through continuous improvement of the course. However, the evaluation results of some indexes are not good, such as practice teaching, teaching content and method, which need to be improved later.

Table 5. Evaluation index system of EIA course

Primary index (score)	Secondary index	Score (M _i)	Evaluation rank (K _i)				2014	2015
			A	B	C	D		
			1.0	0.8	0.6	0.4		
Teaching condition (22)	Teaching materials	8					B 6.4	A 8
	Practice teaching condition	8					B 6.4	B 6.4
	Network teaching	6					B 4.8	A 6
Teaching content (33)	curriculum framework and content	12					B 9.6	A 12
	content organization, teaching arrangement	6					B 4.8	B 4.8

	Engineering practice, teaching method	15					B 12	B 12
Teaching method (15)	Teaching method, evaluation method	10					B 8	B 8
	audio-visual teaching method	5					B 4	B 4
Teaching effect (30)	Peer review	8					A 8	A 8
	Teaching evaluation by student	10					A 10	A 10
	Teaching results	12					B 9.6	B 9.6
Total score (M)		100					83.6	88.8

CONCLUSION

Cultivation of students' engineering practice ability is an important task in EIA course, which need a good coordination of multi-level, multi-faceted factors. EIA course reforms are explored according to the principles of CDIO and excellence engineer's education program in China. The course materials, classroom teaching, practice base, EIA report compiling, report presentation and evaluation system are connected together, and engineering practice teaching is strengthened. During 2 years of reform practice in two grades of environmental science majors, the effect is significant on the basis of evaluation results.

Through the reform and practice of EIA course, some major problems also have been found, which need to be researched in the future.

1. In the case of fixed total course hour, how to allocate hour will be more reasonable? If teaching time is too little, some contents cannot be taught. Conversely, students' engineering practice training will be affected.
2. How to scientifically evaluate the teaching effect, and quickly find the problems? More evaluation index, more data, and some indexes data is difficult to obtain or quantify, it leads to a big deviation between final evaluation result and actual situation. In addition, determination of index value or weight also need further discussion in that the difference of different courses is very large.

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