

Method and Practice of the Education Quality Evaluation on Master of Engineering in Control Engineering of China

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Abstract: This paper describes the guiding principles, criteria and methodology of the education quality evaluation on master of engineering degree in control engineering of China. The practice of two-year long “point, line and plane” comprehensive evaluation methods (PLPEM) is summarized, which includes the self-evaluation within every university, evaluation on selected universities and evaluation on a specific aspect of education process. The effective evaluation result feedback mechanism (EERFM) is also introduced. The effectiveness of evaluation is finally justified by the scoring data. This paper also explores and practices the establishment of the long-term self-regulatory based education quality assurance system of master of engineering in control engineering of China.

1. INTRODUCTION

In 1997, the master of engineering (ME) degree was formally established in China. Up to now, 40 engineering fields and 205 education units for ME have been founded. More than 40,000 students are enrolled every year, and more than 120,000 ME students are in learning (Wenxiu Z, Tsinghua University Press and Secretariat of the Committee, Tsinghua University Press). Control engineering, as one of the 40 fields, is related to many key aspects of national economy, society and defence, so the cultivation of ME in control engineering of China (MECE-China) has been developed very rapidly since its establishment. So far, there are 108 education units of MECE-China, which are mainly universities. With the constantly expanding in scale, the quality of education has gradually become the focus of concern and discussion. To further improve the quality of education and promote the sense of identity about the quality of MECE-China, the education quality evaluation of MECE-China is imperative.

The Chinese government has attached great importance to the quality of ME education since its inception, especially to the foundation of effective long-term quality assurance system. The quality evaluation in each engineering field or education unit is a key work which the National Master of Engineering Education Guiding Committee of China (hereinafter referred to the Committee) always emphasizes. Early in 2002, the Committee put the work for the Master of Engineering Education Quality Evaluation into practice in 10 universities in electronic and communication engineering fields (the Group in electronic and communication engineering, 2002) and 8 in mechanical engineering (the Group in mechanical engineering, 2002), and assessed the quality of these universities autoptically, meanwhile, tested and improved the national criteria system of the quality evaluation for the ME education.

From 2004 to 2005, the evaluation practice for MECE-China, which was organized by the National Master of Engineering Education Collaborative Group in Control Engineering (hereinafter referred to the Group) was carried out under the guidance of the Committee and achieved significant results (Quan P, et al., 2006).

The rest of the paper is structured as follows. Section 2 presents the guiding principles of the education quality evaluation of MECE-China. Section 3 presents its criteria system, describes the “Point, Line and Plane” Evaluation Method (PLPEM) and the Effective Evaluation Results Feedback Mechanism (EERFM). The effectiveness of the evaluations is discussed in section 4. Section 5 concludes the paper.

2. THE GUIDING PRINCIPALS OF EDUCATION QUALITY EVALUATION OF MECE-CHINA

The main principles on the quality evaluation of engineering master in control engineering of China include (Quan P, et al., 2005): final destination of promoting the education system construction, emphasis on self-evaluation and comprehensive consideration on autoptic evaluation of selected universities and focused aspect, such as curriculum, dissertation, etc. Under these principles, a self-regulatory, independent, standard and high-quality education mechanism of MECE-China can be gradually founded by establishing or completing the education quality self-regulatory system in every university and the assurance system of all universities in control engineering field as a whole.

Control engineering covers many vocations and has over a hundred units, thus the comprehensive method of “point, line and plane” evaluation method (PLPEM) is utilized, namely the combination of self-evaluation of every university,

evaluation on selected universities and evaluation on a specific aspect. Among these three self-evaluations is the emphasis which aiming at generally concluding education experiences, standardizing teaching process and degree grant process, completing and practicing management regulations and institutions, building different education features so that more capable ME graduates can be cultivated for the country. Meanwhile, the evaluation on selected universities and evaluation on a specific aspect can complement and verify the results of self-evaluation. Such PLPEM can benefit the foundation of effective self-regulatory mechanism so that an education quality standard of the whole engineering field can be formed.

3. THE CRITERIA SYSTEM OF EDUCATION QUALITY EVALUATION OF MECE-CHINA

The criteria system of education quality evaluation of MECE-China is created on the basis of the national criteria system of ME evaluation, which is established by the Committee. The main principles of it are pointing out the right direction of improvement, showing the right way to ameliorate and easy to be applied. The criteria system includes 5 first level indicators and 19 second level indicators which are shown in Table 1. This Criteria system is mainly used for the self-evaluation and the evaluation on selected universities.

The first part, enrolling, mainly considers the enrolling conditions and quality of applicants, which includes whether the enrolling conditions have reached the basic requirement, the background of enrolled students, the results of their

entrance examination of the applied university and national examination of general courses (including GCT results); Curriculum and Teaching. The second part, mostly examines the teaching process of universities, which involves whether the education documents are completed, whether the setup of curriculum is reasonable, whether the courses are overall and stable, the quality level of teachers, the organization and effectiveness of teaching; The Dissertation part assesses the quality of students' dissertation including topic selection, contents, literature and the process of working on the dissertation including supervisor guidance, research condition, field proposal, mid term examination and thesis defence, etc; Management part mainly considers whether the management mechanisms, regulation and documentations of universities are healthy, standard and feasible. The above four parts are the basis of the criteria system with a full score of 100, while the last part of Characteristics and effect of School Running is the supplementary which performs as the encouragement for the universities having outstanding education features and conditions.

The scoring process of this criteria system includes the following steps: firstly, based on the requirement of the Group, every university in control engineering of China does the scoring by its self according to the criteria system and finishes a self-evaluation report; secondly, experts in control engineering form an evaluation committee which assesses several randomly selected universities autoptically and finishes the scoring by averaging the scores given by every expert. The selected-evaluation report is submitted by the committee.

Table 1: Criteria System on the Education Quality Evaluation of MECE-China

First-level	Second-level	Contents	score
Enrolment (20 points)	Conditions for application	Minus 1 point for each of the candidates not meeting the basic condition, the maximum deduction is 20 points.	4
	Sources of Candidates	The professional backgrounds and the major of candidates are corresponding with the field of control engineering.	4
		Admission candidates dispersed; NOT satisfy above clause.	0
	Professional foundation and comprehensive examination	Subjects of examination reflect the professional characteristics; proposition, marking and management are up to standard; reasonable distribution of examination results.	6
		NOT satisfy above clause.	0
	National Curriculum exam results	National Curriculum exam results (including the results of GCT) stay above the average; the ultra-low-score candidates are not enrolled.	6

First-level	Second-level	Contents	score
		Satisfy the first part of above clause; Results rank does not fall into the last 40%; the number of ultra-low- score candidates enrolled (ULSCe) is less than 1%.	4
		Satisfy the first part of above clause; Results rank does not fall into the last 20%; ULSCe is less than 3%.	2
		NOT Satisfy the first part of above clause; Results rank does not fall into the latter 10%; ULSCe is less than 5%.	1
		The average scores of two courses are ultra low or ULSCe accounts for more than 5% of the total.	0
Curriculum & Teaching (30 points)	Teaching documents	Documents on training programs, training plans and teaching schemes are complete and normative.	4
		Documents on teaching are not complete or normative.	0
	Curriculum	Reasonable and scientific curriculum; reflecting the postgraduate level, and the characteristics, the frontier, the integration, the application of the domain.	6
		NOT satisfy above clause.	0
	Course Construction	Having suitable text books, courseware and experiments.	4
		NOT satisfy above clause.	0
	Teachers	Teachers have strong ability of engineering practice and the majority of them have senior title; Employ high level teachers in the enterprises to open courses; Set frontier academic courses and lecture normally.	6
		NOT satisfy above clause.	2
	Teaching organization and implementation	Having good teaching conditions and the teaching methods are suitable; having high-level academic lecture and time of studying in school lasted more than six months; having strict Evaluation norms.	6
		NOT satisfy above clause.	0
	Teaching Results	Strict and standard examination, reasonable distribution of results; good judgment of experts, good feedback of students and good evaluation of the enterprises.	4
		NOT satisfy above clause.	0
Dissertation (35 points)	Topic Selection	More than 80% of thesis topics come from the practice in enterprises; having clear engineering background and strong engineering application.	10
		More than 65% of that of above clause.	7
		More than 50% of that of above clause.	5
		More than 35% of that of above clause.	3

First-level	Second-level	Contents	score
	Guidance and Research conditions	Less than 20% of that of above clause.	0
		Executing the bi-tutorial system between universities and enterprises with serious and responsible instructors; having adequate funding for research and good working conditions and the time can be guaranteed.	5
		NOT satisfy above clause.	0
	Working Process	1. Serious proposal, good implementation of midterm check, standard procedures of formal reply and having experts in the enterprise attended. 2. There should be more than three years of engineering practice before the thesis reply; Completing the graduate thesis combining with engineering tasks.	5
		NOT satisfy above clause.	0
	Quality	1. More than 80% of dissertations have standard format, clear consecution, accurate expression, substantial content, good summary and full workload. 2. More than 50% of dissertations have high technical content and good social evaluation.	15
		1. More than 70% of that of clause 1 in above clauses. 2. More than 30% of that of clause 2 in above clauses.	12
		More than 60% of that of clause 1 in above clauses.	8
		More than 50% of that of clause1 in above clauses.	4
		More than 50% (including 50%) degree thesis can not meet the basic requirements for a master of engineering.	0
	Management (15 points)	Organization	Sound organization ability and responsibility.
NOT satisfy above clause.			0
Rules and regulations		Sound rules and regulations, complete documentations, and good implementations.	5
		NOT satisfy above clause.	0
File Management		Files on recruiting, teaching and degrees are complete and the management is normative.	6
		NOT satisfy above clause.	0
Features and effect of School Running (10 points)	Features	Explore ways to innovate school running and having obvious characteristics of running a school.	5
		NOT satisfy above clause.	0
	Graduates achievements and social impacts	Graduates have outstanding achievements.	5
		NOT satisfy above clause.	0

4. THE METHODOLOGY OF EDUCATION QUALITY EVALUATION OF MECE-CHINA

4.1 The "Point, Line and Plane" Evaluation Method (PLPEM)

Considering the facts that control engineering covers many aspects of vocations and technologies, the number of member universities is quite large and the education of MECE-China has unique features, the evaluation work is divided into three phases based on the above criteria system, namely self-evaluation by every university, evaluation on selected universities and evaluation on a specific aspect, which make the "point, line and plane" evaluation method (PLPEM). This comprehensive method finally constructs the engineering field self-regulatory based MECE-China education quality insurance system. The three steps of PLPEM are discussed one by one as follows.

"PLANE", Self-evaluation by every member university, is the core of PLPEM which costs the most time and efforts. It is practiced on the basis of general participation of member universities. For each university performing self-evaluation, its ME education branch and professional department organize the assessing group who examines every aspect of its overall education process and finish a conclusion report. The Group summarizes and analyses the data and situations in submitted reports and finally concludes the self-evaluation in whole engineering field. The scores of member universities are properly ranked by the Group and reported back. In order to ensure the coverage of self-evaluation in the field so that the results are statistically reliable, every university having the granting right of MECE-China is theoretically required to perform the self-evaluation. However, some of them are recently established and have not enrolled any student, thus the actual number of participated universities is less than the total number of member universities. Nevertheless, any that already has MECE-China graduates must be involved.

"POINT", the evaluation on selected universities, is a kind of autoptic and comprehensive evaluation executed by a group of experts in or out of the engineering field whose objectives are several typical member universities. The aim of selected evaluation is to verify and supplement the result of self-evaluation so that the outcome of PLPEM can be reliable and convincing. The criteria system, assessing process and contents of selected evaluation are almost the same with self-evaluation, while the differences are the assessing group of selected evaluation are formed by experts from universities in and out of the control engineering field, and the evaluated universities are randomly selected according to their education status and locations, so that they can be representative and the results can be fairly reasonable.

"LINE", evaluation on a specific aspect (Xiong W, et al. 2005), is to examine one or several focused aspects of ME education process in the engineering field, such as dissertation, curriculum, etc. It is also a kind of response and supplementation to the self-evaluation. The evaluated

universities and materials are randomly selected. For example, the dissertation or curriculum materials of the students are randomly selected according to student ID. And the examination of these materials is firstly executed by a group of anonymous experts at different locations in form of postal letters, then, executed in a conference organized by the Group. The final results are the combination of that of these two steps.

According to the general number of year for education of MECE-China, the self-evaluation is performed in a period of four years, while the period of evaluation on selected universities and a specific aspect is five years.

4.2 Effective Evaluation Results Feedback Mechanism (EERFM)

The Effective Evaluation Results Feedback Mechanism (EERFM) is founded in order to make sure that the outcome of PLPEM is positive and effective to build a long-term self-regulatory based education assurance system for MECE-China.

EERFM includes two fundamental aspects, document analysis and results notification. Document analysis is the process of summarizing and analyzing the data and situations included in the reports collected in PLPEM. The aim of this work is to give each university a proper rank and draw the whole education quality map of the engineering field. The reports submitted by member universities have a very large amount and most of them contain a lot of information on the education process of ME in detail. Thus, they are summarized mostly in five aspects, enrolment, curriculum and teaching, dissertation, management and education features, which are consistent with five first level indicators of the criteria system. Meanwhile, the scoring results from three evaluations of PLPEM are ranked respectively. Further, the comparison of scores between self-evaluation and the other two evaluations are made to justify the effectiveness of PLPEM. All the analysis and summarization mentioned above are finally reported back, namely the results notification, which is executed mainly in two different means: notification to universities within control engineering field and report to the leadership such as the Committee. EERFM performs the function of feedback, thus forms a closed circle system with PLPEM to ensure the work of evaluations can gradually build up a long-term self-regulatory based education assurance system for MECE-China.

5. THE EFFECTIVENESS OF EDUCATION QUALITY EVALUATION OF MECE-CHINA

The notice file of self-evaluation was first published by the secretariat of the Committee in September 2004. Until August 2005, the Group has collected 70 self-evaluation reports from universities in control engineering field. In October 2005, the conference of the Group was held in Lan Zhou, China on which a presentation of "The Analysis and Conclusion of Self-evaluation on MECE-China" was released, which marked the end of the first phase of self-evaluation. In August 2005, the evaluation on selected universities was

taken into practice. Five universities were selected including Beijing Jiaotong University, Nanjing University of Science and Technology, Chongqing University, Hunan University and Harbin Engineering University, which are evaluated in September 2005. And the “Conclusion Report of Evaluation on Selected Universities in Control Engineering of China” was finished at the same time. In July 2006, the Group decided to take the quality of dissertation as the evaluated objective to perform the evaluation on specific aspect. From June to September of 2007, dissertations of 52 MECE-China graduates from 7 universities including Beijing Jiaotong University, Shanghai Jiaotong University, National University of Defence Technology, Beihang University, Harbin Institute of Technology, Harbin Engineering University and Wuhan University of Technology. Each of the dissertations was anonymously examined by 2 of 12 experts in the control engineering field. Its conclusion report will be published in the Fifth National Colloquium of MECE-China which will be held in Nanning, November 2007.

The comparison of the Average Scores between self-evaluation and selected evaluation is shown in Table 2 which indicates that the average score of each indicator of self evaluation is very close to that of the selected evaluation, thus the effectiveness of evaluation work is justified.

Table 2. Comparison of the Average Scores between Selected-evaluation and Self-evaluation

Item	E	C&T	D	M	SUM	F
Self-E	18.3	26.4	26.2	14.1	85.1	6.3
Selected-E	17.7	25.6	31.4	13.2	87.9	7.6

In Table 2, E stands for enrolment, C&T stands for curriculum and teaching, D stands for dissertation, M stands for management, F stands for features of education and SUM stands for the sum of scores of above four items.

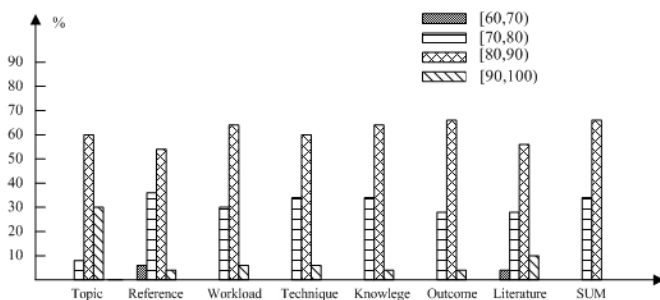


Fig. 1. Percentile of Scores of Evaluation on Dissertations

In the evaluation on specific aspect 2007, the dissertations were scored on 7 indicators which are topic selection, references, difficulty and workload, technology creativity, knowledge creativity, outcome impact and literature. The average and sum scores of each these indicators are shown in Fig 1 which indicates that over 50 percent of the scores are between 80 and 90, only less than 5 percent are lower than 60.

6. CONCLUSIONS

In this paper, the guiding principles of the education quality evaluation of MECE-China are presented. Based on the principles, the criteria system of evaluations is established according to the national criteria system. Then, PLPEM and EERFM, a closed circle evaluation methodology, is introduced. From the result of tow-year long practice in almost 100 universities in China, the effectiveness of this criteria system and methods are strongly proved. However, to construct a feasible and effective long-term self-regulatory based education quality assurance system of MECE-China is one of the final destinations of the Group. Even though, the evaluation work mentioned above is just the beginning. We believe that after lasting efforts on this work, our final objectives can be realized in near future.

ACKNOWLEDGEMENT

The authors want to express their sincere thanks to the people who have provided valuable suggestions or dedicated efforts in the process of the evaluation work. They are, but not limited to, Professor Genke Yang from Shanghai Jiaotong University, Professor Guangfu Ma from Harbin Institute of Technology, Professor Yongji Wang from Huazhong University of Science and Technology, Professor Xiaozhong Liao from Beijing Institute of Technology, Professor Jihong Du from Tsinghua University, Professor Yi Chai from Chong Qing University, Ms. Peiqin Jiang and Huijuan Zhang from Northwestern Polytechnical University.

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