

Research on the Construction of a Multi-Stakeholder Curriculum Evaluation System Based on CIPP: A Case Study of Chemical Production Safety Technology

Hui Li*

Guangdong Polytechnic of Environmental Protection Engineering, Foshan, 528216, China

*Corresponding author: xiaotulihui@126.com

Abstract: Curriculum Teaching Quality directly affects Educational Quality. The CIPP evaluation model is a decision-oriented type of evaluation that covers all stages in the development of the curriculum. Based on the above context evaluation, input evaluation, process evaluation, product evaluation and other reasons, a curriculum evaluation system was established in accordance with the CIPP model, and multi-stakeholder curriculum evaluations were conducted for the course Chemical Production Safety Technology.

Keywords: CIPP Model, Evaluation System Construction, Multi-stakeholder Evaluation

Article 43 of the Vocational Education Law of the People's Republic of China provides that vocational schools and vocational training institutions shall establish and improve education quality evaluation systems, involve industry organizations, enterprises and others in the evaluation, promptly disclose relevant information, accept educational supervision and social oversight. As the quality of curriculum teaching directly impacts educational quality, this paper will establish a system of curriculum evaluation indicators, adjust curriculum arrangements, enhance training objectives, enrich curriculum content, evaluate the effectiveness of the curriculum, and improve students' class participation.

1. Introduction

A curriculum evaluation system based on the CIPP model will be established in this study to identify deficiencies and defects in the curriculum, scientifically and objectively measure the quality of the evaluation system itself, and thus boost students' interest in learning and improve their academic performance.

In 1967, American scholar D. L. Stufflebeam adapted Tyler's behaviourist objective model to his own way of thinking and developed the CIPP model. The four evaluation activities of the CIPP model are actually Context evaluation, Input evaluation, Process evaluation and Product evaluation.

2. Construction of the Evaluation Index System

The teaching context is taken as the basis for the curriculum evaluation system, diagnostic evaluation is carried out on the orientation of a course, teachers and teaching materials, and "context evaluation" is refined into two second-level indicators: curriculum standard objective setting and teaching input. Based on the teaching preparation determined by the evaluation of the input, this step will determine whether the teaching plan is feasible and effective, and thus, "input evaluation" will be refined into four second-level indicators: setting the curriculum content, setting practical content, teacher qualifications and textbook evaluation. Given that the basis of the teaching process is process evaluation, according to the main participants in the teaching activities, it assesses both the teacher's teaching and the students' learning in the classroom, and divides "process evaluation" into three second-level indicators: teaching methods and means, implementation of teaching plans, and curriculum implementation. Based on product evaluation of teaching effectiveness, according to the composition of the course, summative assessments will be conducted to determine the extent of gains achieved by teachers and students in teaching activities, teaching efficiency and outcomes, etc.; the two second-level indicators of "product

evaluation" are student assessment performance and teacher growth.

The four first-level indicators, the 11 second-level indicators and the 28 third-level indicators, make up the system of curriculum evaluation indices. The five levels of the Likert scale are: 5 (very necessary), 4 (necessary), 3 (moderately necessary), 2 (not very necessary), and 1 (not necessary). Staff of frontline enterprises, in-service teachers and students will be invited to score the evaluation indicators, and different weights will be given according to the importance of each indicator.

Table 1: Curriculum Evaluation Indicator System

First-level indicators	Secondary indicators	Third-level indicators	Weight	Evaluation Score				
				5	4	3	2	1
Content evaluation	Curriculum objective setting	1. The course will meet the skills needs of the chemical safety operation site						
		2. The course will help the students know how to avoid danger						
		3. The course will teach students about emergency response						
	Teaching input	1. All the chemical practical training equipment in the course is complete						
		2. The course will cover the cost of participating in the chemical safety competition						
		3. Teachers will be given some special training courses each year						
Input evaluation	Curriculum content setting	1. The courses are the safety operation bases for general chemical unit processes						
		2. The courses are the safety technical requirements of general chemical processes						
		3. The Course is Safety Technical Requirements for Chemical Maintenance Processes						
	Practical content setting	1. The first is general training in the operation of construction machinery						
		2. The course will teach how to deal with emergencies						
		3. The course will introduce you to some problems that can occur on a construction site						
	Teacher qualification	1. Teachers have obtained the qualification of Certified Safety Engineer						
		2. Teachers have Master's degrees in the field of safety						
		3. A team of full-time and part-time chemical safety teachers has been formed						
	Textbook evaluation	1. The textbook content covers the curriculum requirements						
		2. The Textbook Content Meets the Demands of Frontline Enterprise Work						
Process evaluation	Teaching methods and means	1. In addition to providing information, this course will also have some virtual laboratories and other simulated chemical facilities that are similar to actual workplaces						
		2. The class has introduced many teaching methods, such as in-situ training, actual work situations and group activities						
	Implementation of teaching plans	1. The course will carry out the teaching according to the teaching plan						
		2. The intended goals of teaching will be realised						
	Curriculum implementation	1. Students are active in the class						
		2. Teachers help students complete the class work well						
Product	Student assessment	1. Students will know the requirements of the various practical training projects						

evaluation	t performan ce	2. Students can learn the requirements of all the chemical safety theories						
		3. The mean of the end-of-term exam is over 70						
	Teacher growth	1. Teachers' Professional Competence Has Been Enhanced 2. Teaching Methods and Tools have been improved						

3. Evaluation Sample Statistics

3.1 Sample Distribution

A total of 112 people were surveyed in this study, and among them, the proportion of students was the highest at 55.36%, followed by enterprise staff at 25.89%, and teachers were at the lowest level at 18.75%. The subjects of the survey include teachers, students and industry and enterprise personnel, etc.; the sample is very representative.

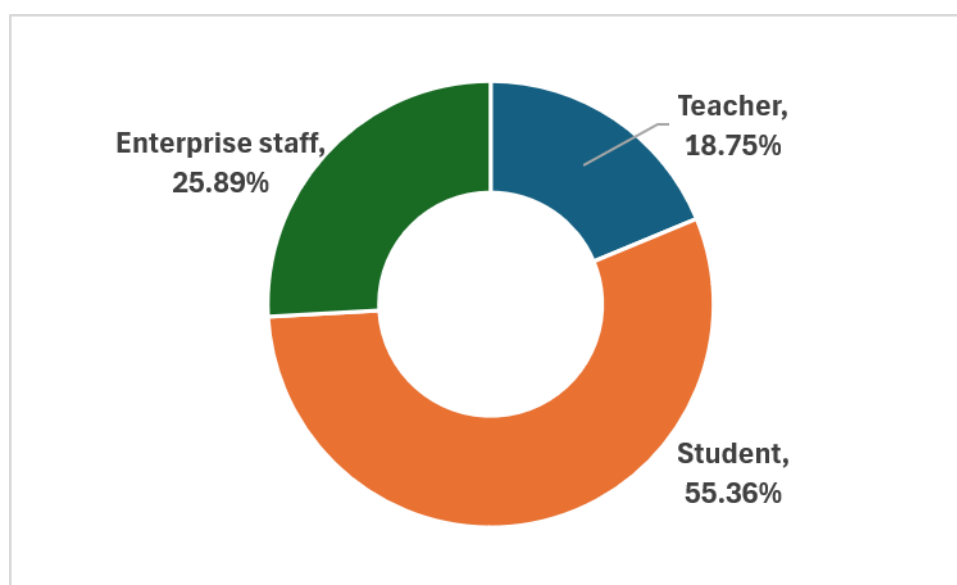


Figure 1: Sample Proportion Statistics

3.2 Third-Level Indicator Analysis

3.2.1 Set Curriculum Goals

None of the three third-level indicators of the curriculum objective-setting were regarded as unimportant by any of the respondents. The proportion of "extremely important" ratings in the index of cultivating students' emergency response ability is the highest (76.79%), and it covers the main emergency demands of the chemical safety course. Both the index of "meeting on-site skill demands" and the index of "fostering a sense of responsibility for safety" were above 70%, so they were regarded as "extremely necessary". Therefore, the three main aims of the curriculum in this study are job skills, hazard awareness and emergency response.

3.2.2 Course Content

The three main modules of the course content are well-known. "Safety Operation Points for Chemical Unit Operations" is the first one, and 69.64% of the respondents considered it very necessary; "Safety Technical Requirements for Chemical Processes" and "Safety Technical Requirements for Chemical Maintenance" were the other two, and both exceeded 62% in the very necessary category. No one thought that the corresponding indicators were not needed; therefore, it can be concluded that both the industry and teachers/students want the course to cover all aspects of basic operations, process specifications and maintenance safety.

3.2.3 Teaching Input

The three indices of teaching input were generally popular among the respondents. "Complete chemical practical training equipment" led all the way with 66.07% of the respondents rating it as extremely necessary, making it the most desired type of input factor. "Special training opportunities for teachers" and "special funds for chemical safety competitions" also received very high marks at 60.71% and 55.36%, respectively, and very few people thought they were neither necessary nor desirable. Therefore, the practical training hardware, teacher training and competition promotion are all considered to be necessary parts of the input for curriculum teaching.

3.2.4 Set Practical Contents

The three skill indices for practical training were all relatively high. "On-site hazard identification and handling skills" was the highest at 71.43%, had a good rating of "very important", and was followed by "emergency response practical training skills" at 70.54% and "basic on-site practical training skills" at 66.96%. Only a very small number of people said they were slightly anxious. Therefore, the practical teaching content should be the identification of hazards, emergency response and basic job-site training.

3.2.5 Teacher Qualifications

The three indices of teacher qualifications have very different levels of recognition. The construction of a full-time and part-time chemical safety teacher team ranked first, with 54.46% of the people considering it very necessary; next was the qualification of a Certified Safety Engineer, but the proportion of people who thought that a master's degree in a safety-related field was very necessary was only 33.04%, and a certain number of respondents rated it as moderately important or not important; thus, compared to academic background, industry practice qualifications and the establishment of a teaching team have attracted more attention.

3.2.6 Textbook Evaluation

The indices of the two textbooks were relatively high. The proportion of people who rated "textbook content meets the requirements of frontline enterprise work" as very important was 67.86%, higher than the 62.5% for "textbook content meets curriculum objectives", and no one gave it a negative rating. Therefore, the compilation and selection of textbooks should be in line with the needs of enterprise jobs and the goals of curriculum training.

3.2.7 Teaching Methods and Tools

Both the indicator of "combination of information-based simulation with real scenarios" and the indicator of "diversified teaching methods" were judged to be very important by the respondents; the respective percentages were 66.07% and 64.29%, and only a small number gave them a medium weight. Therefore, most of the respondents believe that the traditional classroom should be augmented by all sorts of new teaching methods, such as virtual simulations, in-situ simulations, group activities, etc.

3.2.8 Implementation of Teaching Plans

Most of the indices for the execution of teaching plans were positive. The proportion of people who rated "achieving the expected teaching objectives" as very important was 60.71%; it was higher than the 55.36% for "carrying out teaching according to the plan", and no one rated them as unimportant. Therefore, the implementation of teaching should be in accordance with the plan and also aim to achieve the objectives of teaching.

3.2.9 Curriculum Implementation

In the course of implementing the curriculum, the indices for "students' active participation in classroom activities" and "teachers' ability to guide the classroom" received very high marks of 61.61% and 58.93%, respectively, and only a very small number gave a moderate importance rating. Therefore, to achieve good results in the implementation of the curriculum, teachers and students need to communicate well, take the initiative, and be active learners.

3.2.10 Student Assessment Performance

Both the indicator for "students' mastery of practical training skills" and the indicator for "students' mastery of safety theoretical knowledge" exceeded 60% in the very important category, and these were significantly higher than the 43.75% for the indicator of "average final examination score above 70 points". A small number of the respondents did not find the final score indicator necessary, so it can be concluded that students' practical abilities and solid theoretical knowledge are given more weight than

written examination scores.

3.2.11 Teacher Training

Both the index of "enhancement of teachers' professional ability" and the index of "improvement in teaching methods and materials" received a very high score above 56%, and only a small number of people did not believe in their importance; therefore, in curriculum development, continuous improvement of teachers' professional skills and innovation of teaching methods should be pursued simultaneously.

3.3 Overall Weight Analysis of Secondary Indicators

The weights of the 11 secondary indicators are not the same. The weight of practical content setting is the highest at 12.17%, and it is the most important item in the evaluation system. Teaching input, teacher development, setting curriculum goals, etc., all have weights of more than 9%, and the weight for implementing teaching plans is the lowest at 7.09%. In short, the above show that the focus of practical teaching is to balance guarantees for input, curriculum goals, teacher development and teaching improvement.

3.4 Weights of Third-Level Indicators in Curriculum Objective Setting

The weights of the set for curriculum objectives are as follows: meeting on-site skill demands in the chemical industry (36.15%) > fostering emergency response capabilities (33.68%) > building hazard identification and handling skills (30.17%). Job adaptation skills are the main focus of the curriculum goals, and the weight given to the three indicators is relatively uniform.

3.5 Summary of Weights of Third-Level Indicators in Teaching Input

Among the three indicators of teaching input, the weight of practical training equipment allocation is the highest at 39.64%; next is special training opportunities for teachers at 32.97%; and the weight of special funds for competitions is the lowest at 27.38%. The foundation of the teaching materials will be hardware practical training conditions.

3.6 Summary of Weights for Third-Level Indicators in Curriculum Content Setting

Among the three indicators for setting the curriculum content, the weight of safety operation points in chemical unit operations is the highest at 36.46%, followed by safety technical requirements for chemical maintenance processes at 32.83%, and then safety technical requirements for chemical processes at 30.71%. The first few steps of the process will be taught in class.

3.7 Summary of Weights for Third-Level Indicators in Practical Content Setting

The three indices of practical training have the same weight, and the basic practical skills are slightly higher at 34.55%; hazard identification and handling skills are at 32.76%; and emergency response skills are at 32.69%. The three indicators are at the same level in actual teaching and are all required.

3.8 Summary of Weights for Third-Level Indicators in Teacher Qualification

Among the reasons for teacher qualifications, the proportion of full-time and part-time teacher team construction is the highest at 41.3%; the share of certified safety engineer qualifications is 31.44%, and the weight of academic background is the lowest at only 27.26%. The structure of the teacher team is given more weight than individual academic achievements and professional qualifications.

3.9 Summary of Weights for Third-Level Indicators in Textbook Evaluation

In textbook evaluation, the weight of the indicator "meeting the requirements of frontline enterprise work" is 58.57%, and it is much higher than the 41.43% given to "meeting curriculum objectives". Thus, the job-adaptability of textbooks has been taken as the main indicator.

3.10 Summary of Weights of Third-Level Indicators in Teaching Methods and Means

Among the dimensions of teaching methods, the proportion of various types of teaching modes, such as in-situ observation and group activities, is 56.97%, and it is relatively high compared to the 43.03% for combined information-based simulation and real-life scenarios. It can be seen that many types of teaching innovation are popular.

3.11 Summary of Weights of Third-Level Indicators in the Implementation of Teaching Plans

In the course of carrying out the teaching plan, the proportion of achieving the expected teaching goals was 53.38%, which is higher than the 46.63% achieved in teaching according to the plan. Therefore, the aim of results is higher than that of process.

3.12 Summary of Weights for Third-Level Indicators in Curriculum Implementation

The two indicators of curriculum implementation have equal weights. The proportion of "teachers guide students to effectively complete classroom tasks" at 51.5% is slightly higher than that of "students participate actively in classroom activities" at 48.5%, so teacher guidance is given relatively more weight.

3.13 Summary of Weights of Third-Level Indicators in Student Assessment Performance

Among the three indicators of student assessment, the weight given to mastering the requirements of the practical training project is the highest at 40.31%, followed by the mastery of theoretical knowledge at 31.68%, and the weight for meeting the average final examination score is the lowest at 28.01%. Grades will be according to students' actual performance and not test scores.

3.14 Summary of Weights for Third-Level Indicators in Teacher Growth

In terms of the dimension of teacher growth, the weight of "improvement in teaching methods and means" is 55.58%, and it is higher than the 44.42% for "improvement in professional ability". Teachers' teaching innovation and optimisation of teaching methods are thus given more attention than to the improvement of professional quality.

4. Conclusion

A total of 112 people were interviewed about their views on the curriculum for Chemical Unit Operation Safety Technology. The subjects of the study are students, teachers and employees of enterprises; they are various but representative. In general, most respondents gave high ratings to all levels of importance for the third-level indicators, such as curriculum goals, teaching resources, course content, practical training, textbook construction, teaching methods, curriculum implementation, teacher-student assessment and teacher development. In particular, the alignment of the course with the skills of on-site chemical work, hazard identification, development of emergency response ability, practical training hardware and the core status of practical skills training were highly valued; on the other hand, the importance of teachers' academic qualifications and final written examination average scores was relatively low. According to the results of the weight assignment for the secondary indicators, practical content setting has the highest weight, followed by teaching input, teacher growth and curriculum objective setting; the implementation of teaching plans has the lowest weight, indicating that the main focus of the evaluation system is on practical teaching. The internal weights of the third-level indicators under each secondary indicator also show that allocation of practical training equipment, adaptation of job skills, adaptation of enterprise job requirements, teacher team building, assessment of practical ability and innovation in teaching methods have been given relatively high weights, while academic background, competition funds, mere plan execution and written examination scores have been given relatively low weights. In short, it can be seen from the above that teachers, students and enterprise experts have agreed that course evaluation should be based on the actual needs of the chemical industry; thus, practical training, emergency and hazard handling abilities, teacher teams, enterprise adaptation of textbooks, innovation in teaching models, etc., need to be emphasized, and the tendency of evaluation to place too much weight on academic credentials, examination scores and formalistic teaching implementation should be reduced. It will provide a good basis for the data and offer an application case in the construction of an effective and reasonable CIPP curriculum evaluation system for the field of chemical

unit operation safety technology.

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