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

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Abstract: *Curriculum teaching quality directly affects educational quality. The CIPP evaluation model is a decision-oriented evaluation model that emphasizes evaluation throughout the entire process of curriculum development. This study, focusing on context evaluation, input evaluation, process evaluation, product evaluation, and others, established a curriculum evaluation system based on the CIPP evaluation model and conducted multi-stakeholder curriculum evaluation 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 stipulates: "Vocational schools and vocational training institutions shall establish and improve education quality evaluation systems, involve industry organizations, enterprises, and others in evaluation, and promptly disclose relevant information, accepting educational supervision and social oversight." Since curriculum teaching quality directly affects educational quality, this study, through establishing a curriculum evaluation indicator system, adjusts curriculum arrangements, improves training objectives, enriches curriculum content, evaluates curriculum effectiveness, and enhances students' class participation.

1. Introduction

This study establishes a curriculum evaluation system based on the CIPP evaluation model to evaluate the deficiencies and defects in the curriculum, professionally and objectively measure the scientificity and effectiveness of the evaluation system, and aims to improve students' learning interest and enhance their learning outcomes.

The CIPP model was proposed in 1967 by American scholar Stufflebeam, D.L., based on his reflection on Tyler's behavioral objective model. The CIPP evaluation model consists of the initial letters of four evaluation activities: Context evaluation, Input evaluation, Process evaluation, and Product evaluation.

2. Construction of the Evaluation Indicator System

This curriculum evaluation system takes the teaching context based on context evaluation as the premise, conducts diagnostic evaluation on the orientation of a course, teachers, and teaching objects, and refines "context evaluation" into two second-level indicators: curriculum standard objective setting and teaching input. Taking the teaching preparation based on input evaluation as the starting point, it evaluates the feasibility and effectiveness of the teaching plan, and refines "input evaluation" into four second-level indicators: curriculum content setting, practical content setting, teacher qualification, and textbook evaluation. With the teaching process based on process evaluation as the core, according to the main participants of teaching activities, it evaluates the teacher's teaching and 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. Taking the teaching effectiveness based on product evaluation as the key, according to the composition of the course, it

conducts summative evaluation on the gains of teachers and students in teaching activities, teaching efficiency and outcomes, and breaks down "product evaluation" into two second-level indicators: student assessment performance and teacher growth.

This curriculum evaluation indicator system consists of 4 first-level indicators, 11 second-level indicators, and 28 third-level indicators. The evaluation adopts a 5-point Likert scale, graded as 5 (extremely important), 4 (very important), 3 (moderately important), 2 (unimportant), and 1 (not needed). Frontline enterprise staff, in-service teachers, and students are invited to participate in scoring the evaluation indicators, and weights are assigned based on 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
Context evaluation	Curriculum objective setting	1. The course can meet the skill requirements of chemical safety operation sites						
		2. The course can cultivate students' ability to identify and eliminate hidden dangers						
		3. The course can cultivate students' emergency response capability						
	Teaching input	1. The course is equipped with complete chemical practical training equipment						
		2. The course allocates special funds for participation in chemical safety competitions						
		3. The course provides teachers with opportunities for special training every year						
Input evaluation	Curriculum content setting	1. The course includes safety operation points for common chemical unit operations						
		2. The course includes safety technical requirements for common chemical processes						
		3. The course includes safety technical requirements for chemical maintenance processes						
	Practical content setting	1. The course includes basic practical training skills for the work site						
		2. The course includes emergency response skills under urgent circumstances						
		3. The course includes skills for identifying and handling hidden dangers at the work site						
	Teacher qualification	1. Teachers hold the qualification of a Certified Safety Engineer						
		2. Teachers hold a master's degree in a safety-related discipline						
		3. A team of full-time and part-time chemical safety teachers has been established						
	Textbook evaluation	1. The textbook content meets the curriculum objectives						
		2. The textbook content satisfies the requirements of frontline enterprise work						
Process evaluation	Teaching methods and means	1. The course adopts teaching methods that combine information-based approaches (such as virtual simulation software and simulated chemical equipment) with actual workplace scenarios						
		2. The course adopts various teaching methods, such as on-site simulation, real workplace scenarios, and group tasks						
	Implementation of	1. The course can carry out teaching work in accordance with the teaching plan						

		2. The expected teaching objectives can be effectively achieved						
	Curriculum implementation	1. Students participate actively in classroom activities						
		2. Teachers guide students to effectively complete classroom tasks						
Product evaluation	Student assessment performance	1. Students can master the requirements of various practical training projects						
		2. Students can master the requirements of various chemical safety theories						
		3. The average final examination score is above 70 points						
	Teacher growth	1. Teachers' professional ability has been improved 2. Teaching methods and means have been improved						

3. Evaluation Sample Statistics

3.1 Sample Distribution

A total of 112 valid participants were involved in this survey, with the student group accounting for the highest proportion at 55.36%, followed by enterprise staff at 25.89%, and teachers at the lowest proportion of 18.75%. The survey covered teachers, students, and industry/enterprise personnel, with a diverse sample structure, and the results are highly representative.

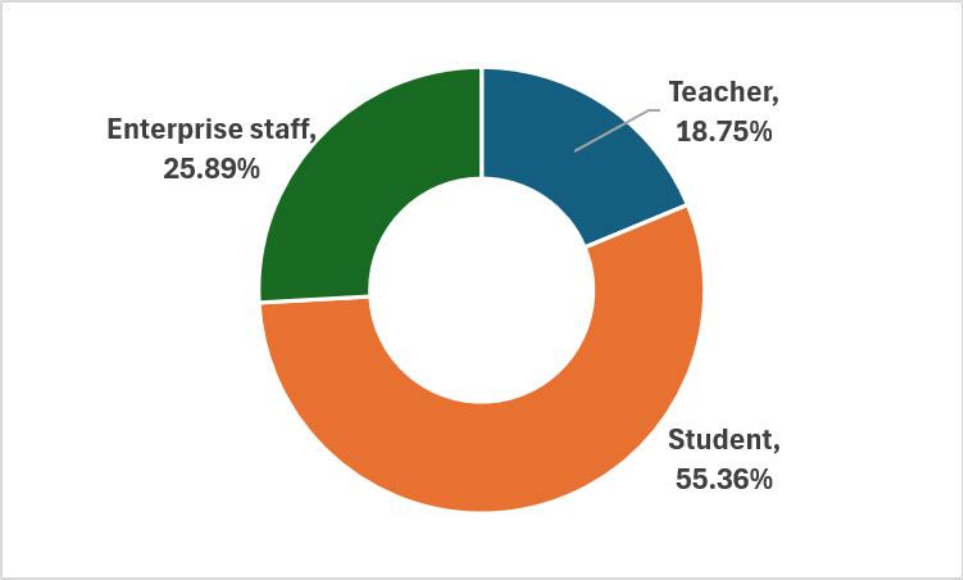

Figure 1: Sample Proportion Statistics

3.2 Third-Level Indicator Analysis

3.2.1 Curriculum Objective Setting

None of the three third-level indicators under curriculum objective setting were considered unimportant by any respondent. The indicator "cultivating students' emergency response capability" received the highest proportion of "extremely important" ratings (76.79%), which aligns with the core emergency needs of the chemical safety course. The indicators of "meeting on-site skill requirements" and "cultivating the ability to identify and eliminate hidden dangers" also received over 70% of "extremely important" ratings. This indicates that respondents generally recognize that curriculum objectives should focus on three core competencies: job skills, hazard identification, and emergency

response.

3.2.2 Course Content

The three core modules of course content are highly recognized. "Safety operation points for chemical unit operations" ranks first, with 69.64% of respondents rating it as very important, followed by "safety technical requirements for chemical processes" and "safety technical requirements for chemical maintenance," both exceeding 62% in the very important category. No respondent considered the related indicators unimportant, highlighting the strong demand from industry and teachers/students for the course to cover all dimensions of basic operations, process specifications, and maintenance safety.

3.2.3 Teaching Input

The three indicators of teaching input received generally high recognition. "Complete chemical practical training equipment" ranked first, with 66.07% of respondents rating it as extremely important, making it the most valued input factor. "Special training opportunities for teachers" and "special funds for chemical safety competitions" received extremely important ratings of 60.71% and 55.36%, respectively, with only very few respondents considering them moderately important or unimportant. This indicates that practical training hardware, teacher development, and competition empowerment are all regarded as key components of curriculum teaching input.

3.2.4 Practical Content Setting

The three skill indicators of practical training received high recognition. "On-site hazard identification and handling skills" ranked first, with 71.43% rating it as very important, 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 respondents gave a rating of moderately important. This reflects that practical teaching should focus on hazard identification, emergency operations, and basic job-site training.

3.2.5 Teacher Qualification

The three indicators of teacher qualification show obvious differences in recognition. The construction of a full-time and part-time chemical safety teacher team ranks first, with 54.46% rating it as very important, making it the most valued teacher-related factor; followed by the qualification of Certified Safety Engineer, while the very important proportion for a master's degree in a safety-related discipline is only 33.04%, with a certain proportion of respondents rating it as moderately important or even unimportant, indicating that compared with academic background, industry practice qualifications and teaching team building are more recognized.

3.2.6 Textbook Evaluation

The two evaluation indicators for textbooks received high recognition. The indicator "textbook content meets the requirements of frontline enterprise work" was rated as very important by 67.86% of respondents, higher than the 62.5% for "textbook content meets curriculum objectives," and no negative evaluations were given. This indicates that textbook compilation and selection should take enterprise job requirements as the core, while also ensuring alignment with curriculum training objectives.

3.2.7 Teaching Methods and Means

The two indicators, "combination of information-based simulation with real scenarios" and "diversified teaching methods," received very important ratings of 66.07% and 64.29%, respectively, with only a few respondents rating them as moderately important. This indicates that respondents generally recognize that traditional classrooms need to integrate multiple modern teaching models such as virtual simulation, on-site simulation, and group tasks.

3.2.8 Implementation of Teaching Plans

The indicators related to the implementation of teaching plans received generally favorable recognition. The indicator "achieving the expected teaching objectives" was rated as very important by 60.71% of respondents, higher than the 55.36% for "carrying out teaching according to the plan," and no respondents considered them unimportant. This indicates that teaching implementation should not only adhere to the planned arrangements but also take the achievement of teaching objectives as the core focus.

3.2.9 Curriculum Implementation

During the curriculum implementation process, the indicators of "students' active participation in classroom activities" and "teachers' ability to guide the classroom" received very important ratings of 61.61% and 58.93%, respectively, with only a very small number giving a rating of moderately important. This highlights that two-way interaction between teachers and students, effective teacher guidance, and active student participation are key to high-quality curriculum implementation.

3.2.10 Student Assessment Performance

The indicators of "students' mastery of practical training skills" and "students' mastery of safety theoretical knowledge" both exceeded 60% in the very important category, far higher than the 43.75% for the indicator of "average final examination score above 70 points." Moreover, a small number of respondents considered the final score indicator unimportant, indicating that compared with written examination scores, students' practical abilities and solid theoretical knowledge are more valued.

3.2.11 Teacher Growth

The two indicators, "improvement of teachers' professional ability" and "improvement of teaching methods and means," both received very important ratings exceeding 56%, with only a very few individuals denying their importance, reflecting that curriculum development should simultaneously take into account the continuous growth of teachers' professional competence and teaching innovation capability.

3.3 Overall Weight Analysis of Secondary Indicators

The weight distribution of the 11 secondary indicators shows clear differences. Practical content setting ranks first with a weight of 12.17%, making it the most important dimension in the evaluation system. Teaching input, teacher growth, and curriculum objective setting all have weights exceeding 9%, while implementation of teaching plans has the lowest weight at 7.09%. Overall, this reflects an evaluation orientation that prioritizes practical teaching while balancing input guarantee, curriculum objectives, teacher development, and teaching improvement.

3.4 Weights of Third-Level Indicators within Curriculum Objective Setting

The internal weights for curriculum objective setting are as follows: meeting on-site skill requirements in chemical industry (36.15%) > cultivating emergency response capability (33.68%) > cultivating hazard identification and handling capability (30.17%). Job-adaptation skills are regarded as the primary consideration in curriculum objectives, and the weight distribution among the three indicators is relatively balanced.

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

Among the three indicators within teaching input, the weight of practical training equipment allocation is 39.64%, ranking the highest; followed by special training opportunities for teachers (32.97%); and the weight of special funds for competitions is the lowest (27.38%). Hardware practical training conditions are the core focus of teaching input.

3.6 Summary of Weights of Third-Level Indicators within Curriculum Content Setting

Among the three indicators within curriculum content setting, the weight of safety operation points for chemical unit operations ranks first at 36.46%, followed by safety technical requirements for chemical maintenance processes at 32.83%, and safety technical requirements for chemical processes at 30.71%. Basic unit operations remain the core component of curriculum content.

3.7 Summary of Weights of Third-Level Indicators within Practical Content Setting

The three indicators of practical training have similar weights, with basic practical training skills slightly higher at 34.55%, hazard identification and handling skills at 32.76%, and emergency response skills at 32.69%. The three indicators are essentially equal in status within practical teaching and are all indispensable.

3.8 Summary of Weights of Third-Level Indicators within Teacher Qualification

Within the teacher qualification dimension, the weight of full-time and part-time teacher team construction is far ahead at 41.3%, followed by Certified Safety Engineer qualification at 31.44%, and the academic background weight is the lowest at only 27.26%, highlighting that the overall teacher team structure is more important than individual academic credentials or practice certificates.

3.9 Summary of Weights of Third-Level Indicators within Textbook Evaluation

In textbook evaluation, the weight of the indicator "meeting the requirements of frontline enterprise work" is 58.57%, which is significantly higher than the 41.43% for "meeting curriculum objectives." This indicates that the job-adaptability of textbooks has become the core evaluation criterion.

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

In the dimension of teaching methods, the weight of diversified teaching methods such as on-site simulation and group tasks is 56.97%, which is higher than the 43.03% for teaching means combining information-based simulation with real scenarios. This indicates that diversified innovation in teaching forms is more valued.

3.11 Summary of Weights of Third-Level Indicators within Implementation of Teaching Plans

In the implementation of teaching plans, the weight of achieving expected teaching objectives is 53.38%, which is higher than the 46.63% for carrying out teaching according to the plan. This indicates that result orientation is superior to process orientation.

3.12 Summary of Weights of Third-Level Indicators within Curriculum Implementation

The two indicators under curriculum implementation have similar weights. The indicator "teachers guide students to effectively complete classroom tasks" accounts for 51.5%, slightly higher than the 48.5% for "students participate actively in classroom activities," indicating that teacher-led guidance plays a slightly more critical role.

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

Among the three indicators under student assessment, the weight for mastering practical training project requirements is the highest at 40.31%, followed by mastery of theoretical knowledge at 31.68%, and the weight for meeting the average final examination score is the lowest at 28.01%. The assessment tends to prioritize practical ability while deemphasizing single written examination scores.

3.14 Summary of Weights of Third-Level Indicators within Teacher Growth

In the teacher growth dimension, the weight of "improvement of teaching methods and means" is 55.58%, which is higher than the 44.42% for "improvement of professional ability." This indicates that teachers' teaching innovation and method optimization are more valued than mere professional ability enhancement.

4. Conclusion

This study conducted 112 valid questionnaire surveys on the curriculum evaluation system for the course Chemical Unit Operation Safety Technology. The respondents included students, teachers, and enterprise staff, with a diverse sample structure and strong representativeness. In terms of the importance evaluation of third-level indicators, respondents generally showed high recognition across all dimensions, including curriculum objectives, teaching input, course content, practical training, textbook construction, teaching methods, curriculum implementation, teacher-student assessment, and teacher growth. In particular, the course's alignment with on-site chemical job skills, hazard identification, emergency response capability development, practical training hardware, and the core status of practical skills training were highly valued, whereas the importance of teachers' academic qualifications and final written examination average scores was relatively less recognized. The weight

assignment results of secondary indicators indicate that practical content setting ranks first, followed by teaching input, teacher growth, and curriculum objective setting, while implementation of teaching plans has the lowest weight, highlighting that the evaluation system takes practical teaching as its core orientation. The internal weights of third-level indicators within each secondary indicator further demonstrate that practical training equipment allocation, job skill adaptation, enterprise job requirement adaptation, teacher team building, practical ability assessment, and teaching method innovation are all assigned higher weights, while academic background, competition funds, mere plan execution, and written examination scores account for relatively lower proportions. Overall, this reflects that teachers, students, and enterprise experts unanimously agree that the course evaluation should be based on the actual job requirements of the chemical industry, emphasize practical training, emergency and hazard handling capabilities, teacher team building, enterprise adaptability of textbooks, and innovation in teaching models, while downplaying the evaluation tendency that overemphasizes academic credentials, examination scores, and formalistic teaching implementation. This provides solid data support and a practical basis for constructing a scientific, reasonable, and industry-needs-oriented CIPP curriculum evaluation system for chemical unit operation safety technology.

References

[1] Li Na. Research on Quality Evaluation of Community Education Curriculum Based on CIPP Evaluation Model. Journal of Guangxi Radio and TV University, Vol.33, No.3, May 2022.

[2] Yang Fan et al. Research on the Construction of Teaching Reflection Evaluation System for High School Mathematics Teachers Based on CIPP Evaluation Model. Monthly Journal of Middle School Mathematics, No.4, 2023.

[3] Chen Fengli. Research on Curriculum System of Primary School Outdoor Sports Camp Based on CIPP Evaluation Model. Chengdu Sport University, April 2022.

[4] Zhou Juan. Construction of Evaluation Index System for Ideological and Political Education in Higher Vocational English Courses Based on CIPP Evaluation Model. Journal of Changzhou College of Information Technology, October 2022.

[5] Zhang Tengfei. Constructing Evaluation System for Ideological and Political Education in Foreign Language Courses in Universities Based on CIPP Evaluation Model. Contemporary Research and Teaching Series, September 2022.

[6] Xu Xiangyun et al. Construction of Comprehensive Evaluation Index System for Ideological and Political Education in University Courses ——A Theoretical Framework Based on CIPP Evaluation Model. Higher Education Management, December 2021.