TEACHING EVALUATION SYSTEM ON ENGINEERING FOR APPLIED UNIVERSITY IN CHINA

MINGMING LUO

A DISSERTATION SUMMITED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF DOCTOR OF EDUCATION PROGRAM IN VOCATIONAL EDUCATION FACULTY OF TECHNICAL EDUCATION RAJAMANGALA UNIVERSITY OF TECHNOLOGY THANYABURI ACADEMIC YEAR 2023

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วิทยานิพนธ์ฉบับนี้เป็นงานวิจัยที่เกิดจากการค้นคว้าและวิจัย ขณะที่ข้าพเจ้าศึกษาอยู่ในคณะครุศาสตร์อุตสาหกรรม มหาวิทยาลัยเทคโนโลยีราชมงคลธัญบุรี ดังนั้น งานวิจัยในวิทยานิพนธ์ฉบับนี้ถือเป็นลิขสิทธิ์ของมหาวิทยาลัยเทคโนโลยีราชมงคลธัญบุรี และข้อความต่าง ๆ ในวิทยานิพนธ์ฉบับนี้ ข้าพเจ้าขอรับรองว่าไม่มีการคัดลอกหรือนำงานวิจัยของผู้อื่นมานำเสนอในชื่อของข้าพเจ้า

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Program	Vocational Education
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ABSTRACT

This research presented a new model of a teaching evaluation system in engineering, designed to enhance the quality of education in Chinese applied universities for engineering programs. The research objectives were to: 1) synthesize theories related to teaching evaluation systems of engineering for applied universities and 2) identify and develop teaching evaluation systems on engineering for applied universities.

The samples in this study consisted of nine experts from China selected using the purposive sampling method. All evaluators were qualified and have worked at least five years as assistant professors at the same university. A focus group discussion was utilized to discuss the system of engineering education evaluation in Chinese applied universities. The data gained from the discussion was evaluated using the CIPP model, the evaluation index system, and AHP to rank the indicators. SPSSPRO was utilized to assess the data and emphasize the reliability of the questionnaire. In the reliability analysis, Cronbach's alpha score was .823, and the reliability coefficient was applied in this study.

The results revealed an average score of 4.6358, *SD* = 0.4655, CV = 0.1008, and IQR = 1. The consensus among experts was congruent, and the experts' opinions were strongly in agreement. The study employed the Analytic Hierarchy Process (AHP) for weighting the analysis of indicators and assessing matrix consistency. The data showed CR = .039 <.1 and suggested that the judgments made in the matrix were considered to be sufficiently consistent for decision-making. The index system comprises 4 first-level, 12 second-level, and 52 third-level indexes. A case study was conducted using a new evaluation index system and examined the engineering education procedures at Sichuan University of Science and Engineering. The study discovers issues within the program and provides suggestions to address them. To some extent, the evaluation system reflects the actual relationship among the indexes, providing a reference for the quality evaluation of engineering education.

Keywords: teaching evaluation system, engineering, focus group, CIPP, applied university, AHP

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Mingming Luo

Table of Contents

Table of Contents (Continued)

List of Tables

Page

List of Tables

Page

List of Tables

Page

List of Tables

Page

List of Tables

Page

List of Tables

List of Figures

CHAPTER 1
INTRODUCTION

1.1 Background and Statement of the Problem

1.1.1 National policy requirements

In 2020, the CPC Central Committee and The State Council issued the Overall Plan for Deepening the Reform of Educational Evaluation in the New Era and issued a notice requiring all regions and departments in the country to earnestly implement it in light of the actual conditions. The general requirements of the document are education evaluation is related to the direction of education development, and what kind of evaluation baton, there is what kind of school guidance. We should accelerate the modernization of education, build a strong country in education, and ensure that education is satisfactory to the people, so as to fundamentally solve the baton problem of educational evaluation.

1.1.2 The need to improve the quality of teaching

Evaluation ensures the quality of international higher education and talent training. The US, UK, France, Germany, Japan, South Korea, and other industrialized nations actively employ evaluation to improve higher education and teaching. They have legal and regulatory systems and institutional systems for higher education quality assurance, assessing course quality, professional quality certification, college evaluation, teaching evaluation, and scientific research evaluation. Modern educational and management principles have transformed Chinese college and university teaching evaluation. The index system has extensive coverage and great operability, and teaching has always been the school's focus, student-oriented, results-oriented, and positioned. China's government and universities are boosting engineering specialty evaluation indexes. The evaluation process considers teaching quality, course content and structure, faculty qualifications and professional development, student performance, and learning outcomes, facilities and infrastructure, research and innovation, student feedback and satisfaction, and employment and career prospects. Reviewing research output, student input, instructor qualifications, and career opportunities. However, Chinese universities and educational institutions have different evaluation standards and weights.

40 years of practice has proved that evaluation plays an irreplaceable role in promoting the quality of higher education and ensuringg its healthy development. Audit and evaluation is an important part of the quality assurance system of higher education. It is an urgent task to accelerate the institutionalization and long-term realization of the quality assurance system of higher education to develop an audit and evaluation program, build an audit and evaluation system with Chinese characteristics and in line with the needs of The Times, and establish and improve the diagnosis and improvement mechanism of collaboration between campus and campus.

The last round of audit and evaluation plays an obvious role in guiding universities to "strengthen connotation and promote characteristics". The evaluation concept has formed a broad consensus in the front of higher education, and has become a brand of higher education evaluation, and has a positive impact on the international community. However, there are still some deficiencies, such as insufficient efforts to promote the establishment and improvement of the implementation mechanism of moral education in colleges and universities, unclear classification of evaluation, weak rigidity of evaluation results and weak rectification of evaluation. Based on the new development stage, it is urgent to reform and innovate the audit and evaluation work on the basis of inheriting experience.

Evaluation is an important mechanism to ensure the level of higher education and the quality of talent training in the field of international higher education. Undergraduate evaluation has become a common means to govern higher education in most countries and international organizations. The United States, the United Kingdom, France, Germany, Japan, South Korea and other developed countries are actively using assessment to improve higher education and teaching and promote the healthy development of higher education. They have generally established legal and regulatory systems and institutional systems for the quality assurance of higher education and carried out quality assessment work such as course quality assessment, professional quality certification, college evaluation, teaching evaluation and scientific research evaluation. The audit and evaluation aims at the needs of quality assurance when higher education enters the popularization stage, embodies the commonness trend of international higher education evaluation, and is conducive to the organic unification of

internal quality assurance and external quality assurance, and mutual integration and mutual promotion.

Teaching evaluation is the activity of judging the teaching process and results according to the teaching objectives and serving the teaching decision. It is the process of judging the actual or potential value of teaching activities. Teaching evaluation is the process of studying the value of teachers' teaching and students' learning. Teaching evaluation generally includes the evaluation of teachers, students, teaching content, teaching methods, teaching environment, teaching management and other factors in the teaching process, but mainly the evaluation of students' learning effect and teachers' teaching work process.There are diagnostic evaluation, formative evaluation, summative evaluation, relative evaluation, absolute evaluation, individual difference evaluation and so on. According to the different implementation functions, it can be divided into diagnostic evaluation, formative evaluation, and summative evaluation. According to the different criteria used, it can be divided into relative evaluation, absolute evaluation, and intra-individual difference evaluation. According to the different evaluation subject, it can be divided into external evaluation and internal evaluation.

1.1.3 The type and nature of undergraduate universities in our country are diverse with the development of modern teaching evaluation theory and practice, combined with the actual situation of China, the current teaching evaluation of Chinese colleges and universities has made a lot of adjustments and improvements compared with the past, more absorbed modern educational thoughts and management ideas, has sufficient scientific and factual basis; Pay attention to structure and development, emphasize connotation, highlight characteristics; The index system has wide coverage and strong operability. Teaching has always been placed in the centre of the school's work, student-oriented, results-oriented, clear positioning. However, based on investigation, the type and nature of undergraduate colleges and universities in our country are diversified (see Table 1.1, 1.2, 1.3), the unified guidance of teaching evaluation classification is not obvious, and the phenomenon of "one scale to measure different classes of universities" still exists. In addition, there are many problems in teaching evaluation index system, such as orientation deviation of evaluation index,

condition index being more important than result index. Index connotation is not clear, connotation interwoven.

Table 1.1 the settings of different types of ordinary undergraduate universities

Source: National Undergraduate Education and Teaching Quality Report (2020)

Type of institution	Number of schools	Proportion (%)
First-class universities to build universities	41	3.3
Building universities with first-class disciplines	96	7.7
Ordinary undergraduate university	493	39.6
undergraduate universities	372	29.9
Independent college		
Newly established	243	19.5
total	1245	100.0

Table 1.2 General undergraduate institutions of different natures

Source: National Undergraduate Education and Teaching Quality Report (2020)

Nature of institution	Number of schools	Proportion (%)
Comprehensive university	387	31.1
Science and technology university	326	26.2
Normal university	123	9.9
Finance and economics college	122	9.8
Medical college	107	8.6
Art college	45	3.6
Agricultural college	38	3.0
College of political science and law	35	2.8
Chinese college	27	2.2

Physical education institution	16	1.3
Colleges and universities for nationalities	14	1.1
Forestry college	5	0.4
total	1245	100.0

Table 1.3 The scale and structure of undergraduate students in different disciplines

Source: National Undergraduate Education and Teaching Quality Report (2020)

Subject category	Professional points	Enrollment number (ten thousand)	The number of students enrolled(ten thousand)	Number of fresh graduates(ten thousand)
engineering	18822	128.4	701.8	136.7
management	9228	64.8	362.5	78.9
literature	5790	40.5	213.4	40.9
art	6473	40.2	210.9	39.4
Medical science	2537	31.0	170.0	28.1
neo-Confucianism	4574	25.5	139.8	27.3
pedagogy	2101	20.3	95.8	17.0
economics	2858	19.4	116.9	24.7
jurisprudence	1849	14.3	76.4	14.7
agronomy	1111	6.8	35.4	7.1
history	365	2.1	10.5	1.9
philosophy	89	0.2	1.2	0.2
total	55797	393.6	2134.5	416.7

1.1.4 The standard of engineering teaching evaluation system

Reviewing the materials and conducting literature research, currently, there is no standardized "Teaching Evaluation Engineering System" in China. There is only an education and teaching audit evaluation system for undergraduate universities. In some universities or institutions, engineering majors may have their specific teaching evaluation mechanisms or customized parts based on the unique requirements of engineering education, specifically tailored for certain specific majors. However, there is still no unified teaching evaluation system for engineering majors at present.

The evaluation framework may have changed since the last update. To attain academic excellence and produce competitive engineering graduates, Chinese universities have rigorous teaching evaluation systems. Applied universities provide specialized and practical education to prepare students for the continually changing engineering landscape. China's Teaching Evaluation System on Engineering for Applied Universities evaluates and improves engineering education. The Teaching Evaluation System adapts to changing engineering industry needs and stakeholder expectations, including students, faculty, employers, and society. It is essential for assessing teaching methods, curriculum design, faculty qualifications, research contributions, and infrastructure support. The system analyzes these critical components to improve applied universities and ensure educational excellence. Practical Chinese universities apply theory to real-world situations. Thus, the Teaching Evaluation System stresses hands-on learning and real-world projects in engineering. This method deepens engineering knowledge. It fosters creativity and problem-solving, helping students become well-rounded professionals who can contribute to industry and society after graduation. The Teaching Evaluation System encourages everyone to contribute to improvement. Students contribute valuable input on their learning experiences and improvement suggestions during the evaluation process. Professional development helps professors stay current and enhance their teaching. Technology and industry demands have transformed engineering dramatically. The Chinese Teaching Evaluation System on Engineering for Applied Universities now incorporates developing engineering fields and multidisciplinary courses. Engineers need critical thinking, teamwork, communication, and adaptability. It encourages critical thinking, teamwork,

communication, and adaptability—essential skills for engineering graduates.(Khoo and Zegwaard et al., 2020)

In view of the above situation, it is necessary to rethink, repair, change, improve and even rebuild the existing evaluation scheme and index system. The key to solve this problem lies in the feasibility of the evaluation program and the scientificity of the index system.

This paper intends to take the engineering major of science and technology university (Sichuan University of Science & Engineering) as the research object, and on the basis of its teaching implementation, based on its particularity, combined with relevant theories, construct a new teaching evaluation index system, and realize the classification of evaluation index system, with the purpose of improving the science and rationality of evaluation index system and the reliability and validity of evaluation.

CIPP model is the embryonic form of teaching evaluation system on engineering for applied university. The selection of indicators and main observation points at all levels is based on the grasp of education and teaching objectives, and the classification, grading and decomposition of indicators are based on the classification of background evaluation, input evaluation, process evaluation and result evaluation. After careful consideration of the expressions and standards of indicators and observation points, a CIPP model-based teaching evaluation index system for engineering majors in applied universities is preliminarily established.

After empirical analysis of the evaluation index system and expert consultation survey, the weights of each index and main observation points are finally determined and selected and modified according to expert opinions and suggestions. Finally, a new CIPP model-based teaching evaluation index system for engineering majors in applied universities is established.

1.2 Research Questions

1.2.1 How can an effective teaching evaluation system on engineering for applied university in China?

1.2.2 What are the key factors in identifying and developing a teaching evaluation system on engineering for applied university in China?

1.3 Research Objectives

The objectives of the study are as follows:

1.3.1 To synthesize theories related to teaching evaluation system on engineering for applied university in China;

1.3.2 To identify and develop teaching evaluation system on engineering for applied university in China.

1.4 Research Scope

The scope of this study is divided into two phases:

1.4.1 Phase I: To synthesize teaching evaluation system on engineering for applied university in China.

1.4.1.1 Participants chosen for this study consisted of 9 experts who were all located in China. Each expert was chosen through the purposive sampling method. All experts were qualified in teaching evaluation specialists. Two experts were qualified in teaching evaluation of undergraduate education in ordinary colleges and universities in China, four experts were qualified in school teaching supervision, and three experts were qualified in engineering. All of them had doctoral or master's degrees and had worked for over five years at least in the position of Assistant Professor or Professor (Table 1.4).

Table 1.4 The Focus groups participate in a summary of experts.

	Expert type situation	person
1	Doctor's degree	4
2	Master's degree	4
3	National evaluation expert	2
4	School level assessment specialist	4
5	Professorial title	9
6	Engineering specialist	8

1.4.1.2 This study was to synthesize the theories of; (1) Developmental evaluation (2) Stakeholder theory

1.4.1.3 The theoretical perspectives of the review of these theories focus on four terms, namely; (1)Context evaluation, (2)Input evaluation;(3)Process evaluation; (4)Product evaluation

1.4.1.4 The Focus group technique was used to synthesize teaching evaluation system on engineering for applied university.

1.4.1.5 The Analytic Hierarchy Process (AHP) was used to synthesize teaching evaluation system on engineering for applied university in China.

1.4.2 Phase II: To identify and develop teaching evaluation system on engineering for applied university in China.

1.4.2.1 Sichuan University of Science & Engineering was selected as participant. The university is a national public university and a general full-time applied university. It included engineering, science, management, education, literature, history, art, law, economics and other nine disciplines. The university has 20 colleges, ten colleges of which are engineering colleges. Engineering is the main major of the university.

1.4.2.2 The survey and participatory observation were used for the identification and development of teaching evaluation system on engineering for applied university.

1.5 Definition of Terms

a.Evaluation refers to an activity in which the information received is analyzed and studied in accordance with certain procedures to judge its effect and value according to certain goals, standards, technologies or means. The evaluation report is the page material formed on this basis to evaluate and demonstrate the scheme to decide whether to adopt it.

b. Teaching is A special human talent training activity composed of teachers' teaching and students' learning. Through such activities, teachers guide students to learn and master cultural and scientific knowledge and skills in a purposeful, planned, and organized way, promote the improvement of students' quality, and make them become

the people needed by society. A. Audit and evaluation is guided by the results-oriented audit and evaluatiodevelopment andaduate teaching work, and the core of the self-evaluation and supervision of the undergraduate teaching quality assurance system is whether the university is perfect, adhere to "measure yourself by your own ruler", pay attention to the characteristic development and connotation construction of the university, in line with the current development requirements of our economic and social development, and can better docking with the international higher education evaluation.

c. System refers to an organic whole with specific functions formed by a number of interrelated systems of things or certain consciousness, such as industrial system, ideological system, combat system, etc.

d. Teaching evaluation is an activity that values the teaching process and results according to the teaching objectives and serves the teaching decision. It is a process of judging the actual or potential value of teaching activities. Teaching evaluation is the process of studying the value of teachers' teaching and students' learning. Teaching evaluation generally includes the evaluation of teachers, students, teaching content, teaching methods and means, teaching environment, teaching management and other factors in the teaching process, but mainly the evaluation of students' learning effect and teachers' teaching working process. There are two core links of teaching evaluation: evaluation of teachers' teaching work (teaching design, organization, implementation, etc.) evaluation of teachers' teaching (classroom, extracurricular), evaluation of students' learning effect examination and test. The evaluation methods mainly include quantitative evaluation and qualitative evaluation.

e. Teaching evaluation system refers to the evaluation of the teaching quality of a subject, including the achievement of teaching objectives, the effectiveness of teaching methods, the utilization of teaching resources, the evaluation of students' learning outcomes, etc. The establishment of teaching evaluation system can help teachers better understand students' learning situation, timely adjust teaching methods and teaching content, and improve teaching effect.

f. Applied university refers to an application-oriented undergraduate institution of higher learning focusing on undergraduate education, which is opposite to the concept of an academic university. There are two directions to build an application-oriented

university, namely application-oriented university, and application-research (academic) mixed university.

g. Engineering is an engineering discipline with practical engineering and technology as its main research object; A series of disciplines related to engineering, such as machinery, architecture, water conservancy, automotive, and other studies of applied technology and technology. Engineering is a discipline developed by applying the principles of basic sciences such as mathematics, physics and chemistry and combining the technical experience accumulated from production practice. The aim of engineering training is to be a senior engineering and technical talent engaged in planning, exploration, design, construction, raw material selection, research, and management in the corresponding engineering field.

h. The audit and evaluation of undergraduate teaching work is guided by the results-oriented review and evaluation, and the core of the self-evaluation and supervision of the undergraduate teaching quality assurance system is whether the university is perfect, adhere to "measure yourself by your own ruler", pay attention to the characteristic development and connotation construction of the university, in line with the current development requirements of our economic and social development, and can better docking with the international higher education evaluation.

i. CIPP model, also known as decision oriented or improvement-oriented evaluation model, is a curriculum evaluation model advocated by American educational evaluator Stavre Beam. It believes that evaluation is the process of providing information service for managers to make decisions. Context Evaluation, Input Evaluation, Process Evaluation, and Product Evaluation comprise the CIPP evaluation model.

J. AHP The Analytic Hierarchy Process (AHP) is a method for organizing and analyzing complex decisions, using math and psychology. It was developed by Thomas L. Saaty in the 1970s and has been refined since then. It contains three parts: the ultimate goal or problem you’re trying to solve, all the possible solutions, called alternatives, and the criteria you will judge the alternatives on. AHP provides a rational framework for a needed decision by quantifying its criteria and alternative options, and for relating those elements to the overall goal.

1.6 Limitations of the Study

The following is a list of limitations of this study:

1.6.1 The results were determined by a specific number of experts, of whom Participants chosen for this study consisted of 9 experts who were all located in China. Each expert was chosen through the purposive sampling method. All experts were qualified in teaching evaluation specialists .They all had a doctoral or master's degrees and had worked for over five years at least in the position of Assistant Professor or Professor. (1) The results and interpretations reflect the bias of the analyst. (2) Communication was by meeting, and the questionnaire was handed to all experts on their appointment.

1.7 Expected Benefits

This study will make some contributions to the evaluation of engineering teaching quality in applied universities in China. By reading a large number of Chinese and foreign literature and related books, this study combs the content, problems, historical process and related theories of the evaluation of the quality of education and teaching in Chinese universities. On this basis, taking the evaluation index system of undergraduate education and teaching audit and evaluation in Chinese colleges and universities as the framework, taking Sichuan University of Science & Engineering as an example, and supported by a large number of data, the review and evaluation situation of Sichuan University of Science & Engineering is studied in detail. Data collection, including interviews, surveys, and analysis of policy sources. Questionnaire survey analysis,Focus Group and Analytic Hierarchy Process were used to analyze the teaching evaluation system for applied universities.Through questionnaire survey and interview, suggestions are put forward from the three aspects of teachers, administrators and students to develop a suitable teaching evaluation system on engineering for applied universities.

This paper examines China's Engineering Teaching Evaluation System for Applied Universities. We examine its essential components, evaluation criteria, and effects on engineering education to determine how well this system trains the next generation of talented engineers. Understanding this evaluation system's strengths and

weaknesses helps us comprehend applied universities' attempts to improve engineering education and promote China's engineering sector.

1.8 Concept Framework

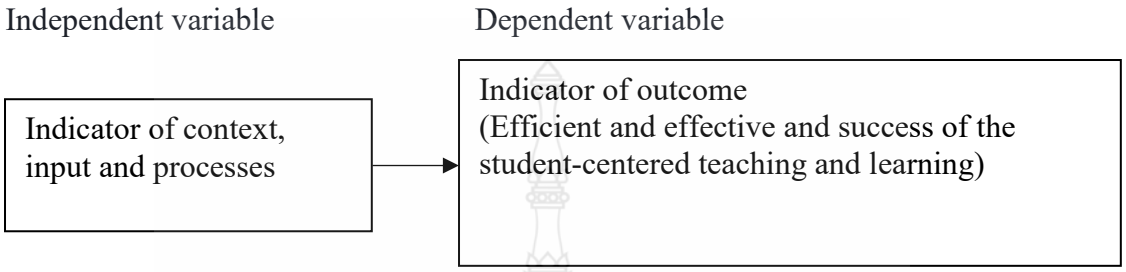

Figure 1.1 Conceptual framework of teaching evaluation system on engineering for applied university.

CHAPTER 2
LITERATURE REVIEW

This paper makes a literature review on the formation and development of teaching evaluation in Chinese colleges and universities, explains the related concepts and principles of teaching evaluation system theoretically, and analyzes the current teaching evaluation model.

1.1 Applied university theory

1.2 Higher Education Teaching Evaluation Theory

1.3 CIPP model

1.4 Progress in Research on Undergraduate Teaching Evaluation in China

1.5 Development for applied university based on CIPP

1.6 Focus Group

1.7 Analytic Hierarchy Process

1.8 The teaching evaluation index of engineering specialty in China

1.9 China Performance Excellence Education Criteria

2.1 Applied university theory

An applied university, often referred to as an "applied sciences university" or "university of applied sciences," is a type of higher education institution that focuses on providing practical, hands-on education and training in specific fields of study. These universities typically offer programs that are directly related to professional careers and industries, such as engineering, technology, business, healthcare, and other applied sciences.

In accordance with the classification referenced by the 36th session of the UNESCO General Conference's Education Committee, known as the International Standard Classification of Education 2011 (ISCED-2011), higher education is divided into 6 levels (ranging from 3 to over 4 years)(Liang, 2017). This classification effectively distinguishes between academic bachelor's degrees and professional bachelor's degrees. It laid the theoretical foundation for the classification of higher education institutions in our country. In June 2014, the State Council issued the "Decision on Accelerating the

Development of Modern Vocational Education," which proposed guiding local regular undergraduate colleges to transform into technical-type applied undergraduate institutions, and independent colleges should determine their educational orientation as technical-type applied institutions, promoting undergraduate vocational education through pilot programs and demonstrations(Renzhong, 2014).

Applied universities, as one of the indispensable types of higher education, have taken on different forms in major developed Western countries. In the United States, so-called applied universities often manifest as 'land-grant colleges' because these institutions advocate for 'universities' active involvement in specific social affairs within their respective states, considering the entire state as their educational domain.' This concept aligns with the educational mission of applied universities. In the United Kingdom, there has been a surge in the establishment of new universities, where 'the regional aspect of higher education is not only reflected in the local demand for higher education by industry and commerce but also in the demand for higher education by local educational institutions(Yunqing, 2008).' In Germany, applied science and technology universities have almost dominated the landscape of higher education, being considered not only 'equally valuable as research-oriented universities' but also representing 'another type of higher education,' providing significant talent and technological support for Germany's industrial and economic advancement.

Applied universities are a product of higher education shifting from elite to mass education. In developed countries, applied universities have a long history and have experienced rapid development, resulting in the establishment of numerous high-quality applied science institutions. In Germany, universities are categorized into comprehensive universities, applied science and technology universities, and arts and music colleges, with applied science and technology universities accounting for approximately 54%. In Japan, higher education institutions are divided into three categories: universities, junior colleges, and technical colleges. Among these, the primary focus on applied talent development lies within junior colleges and technical colleges. Based on the literature reviewed, foreign scholars have primarily concentrated their research on the educational philosophy, teaching methods, industry-academia collaboration, and faculty development in applied universities. Throughout the development of applied universities,

scholars have conducted in-depth research on various aspects of their educational philosophy and teaching methods.

Professor Pan Maoyuan categorizes higher education in China into three types: The first type focuses on imparting practical knowledge to students, aiming to cultivate front-line professionals for production, management, and service industries. These are typically vocational and technical colleges. The second type focuses on teaching specialized knowledge to nurture applied high-level specialists. These are professional universities or colleges. The third type emphasizes teaching fundamental and theoretical knowledge in both basic and applied disciplines to develop outstanding innovators. These are research-oriented universities(Maoyuan, 2010).Applied universities fall into the second category, primarily serving their local communities. They prioritize teaching while also engaging in research activities. Their primary mission is to educate well-rounded undergraduate students who possess knowledge, skills, theoretical foundations, and practical capabilities in their respective fields(Maoyuan and Rushan, 2009).

Domestic academics have been researching applied universities more and more in recent years, but there is still no agreement on how applied universities should be positioned. A review of the literature reveals that researchers have thoroughly examined a range of applied university topics, including their core values, talent development, and faculty development.

Regarding the essence of applied universities, Pan Maoyuan (2010) identified four characteristics: 1) a focus on cultivating applied talents, 2) a primary emphasis on undergraduate education, 3) a predominant focus on teaching, and 4) a strong orientation towards the local context(Maoyuan, 2010). Hu Tianyou (2013) summarized various opinions within the academic community regarding the positioning of applied universities and believed that the characteristics of applied universities identified by scholars did not fundamentally differ from those of industry-specialized undergraduate institutions. Based on this, he regarded applied universities as a pre-existing concept within typological paradigms(Hu, 2013). Wang Mingyi (2014) argued that the key focus of applied universities should be on practical applications, guided by contemporary perspectives on talent, education, and quality. These universities should be characterized by close integration with the local economy, aiming to nurture highly competent and

adaptable applied talents(Wang, 2014).

Studying the Development of Applied University Talents. While the placement of applied universities is a topic of debate among scholars, the development of applied talents is generally agreed upon. It is generally agreed that in the process of developing talent, emphasis should be placed on both the cultivation of practical skills and the transmission of knowledge, with the aim of fostering applied and innovative talents. Qinghua (2017) took foreign examples of industry-academia collaboration and university-enterprise cooperation in talent development as a starting point to analyze the current issues faced by applied universities. He pointed out that both universities and enterprises can promote the training of applied talents through methods such as co-building professional curriculum systems, establishing 'double-teacher' teaching teams, co-establishing practical training demonstration bases, creating university-enterprise 'mutually beneficial and win-win' cooperation platforms, and transforming government functions(Qinghua, 2017). Liu Xianjun (2018) believes that when applied universities train applied talents, they should change their educational concepts, optimize their disciplinary structures, continuously improve talent development plans, and emphasize that the training of applied talents is a new endeavor that should not remain merely theoretical but should be carried out more deeply in practice(Liu, 2018).

In terms of the construction of faculty teams in applied universities, based on the literature I have reviewed, there is currently a trend of continuous growth in the faculty teams of applied universities, but there are still some issues to address. Liu Xiao (2013) pointed out that faculty is the soul of a university, and the construction of faculty teams in applied universities can start from expanding the sources of faculty, enhancing the practical abilities of the teaching staff, ensuring sufficient funding for faculty team construction, improving the practical capabilities of faculty teams, and refining the structure of faculty teams(Xiao, 2013). Wei Xiaoyan (2015), starting from the problems currently existing in faculty teams, proposed measures for the construction of faculty teams in applied universities: establishing a faculty reserve pool to enrich the sources of faculty; promoting regional teacher development through cooperation in resources and experience sharing; enhancing teachers' teaching and practical abilities through practice; focusing on practice and teaching, and refining teachers' development concepts(Xiaoyan,

2015). Fu Bajun (2017) believes that internal training is the main source of faculty teams in applied universities, and he proposed three key points for the construction of faculty teams in applied universities through internal training: shifting the focus to research is the prerequisite for training applied faculty; strengthening practical experience is the guarantee for training applied faculty; and curriculum development is the fulcrum for training applied faculty(Bajun, 2017).

Applied universities are distinct from vocational colleges and also differ from research universities. Vocational colleges focus on providing technical skills training to students, primarily cultivating frontline technical talents. Relying solely on this type of education cannot meet the talent demands for upgrading industrial structures. Research universities primarily emphasize training in fundamental theoretical scientific research and primarily cultivate research-oriented academic talents(Furong, 2018). Applied universities represent an intermediate form between research-oriented and vocational education(Hu, 2013).

Application-oriented colleges play a significant role in promoting China's economic and social development, advancing the accessibility of higher education to the masses, and contributing to the improvement and enhancement of vocational education. They are an integral part of China's higher education system, serving as a safeguard for social harmony, stability, and the country's sustainable economic development, while also providing robust intellectual support.

Although there is no unified definition for application-oriented undergraduate colleges in China, a consensus among various experts and scholars can be summarized as follows: Application-oriented colleges mainly include local regular higher education institutions that transitioned to offering bachelor's degrees after 1999, private undergraduate colleges, and independent colleges. The educational mission of application-oriented colleges is to serve local communities and regional economies. Their primary task is to cultivate talent with practical and technical skills, employing a teaching model that integrates academia, industry, and research, with a focus on teaching and industry collaboration. Their curriculum emphasizes vocational education, and they primarily offer undergraduate programs, with the flexibility to also provide diploma education. Outstanding and distinctive institutions may offer application-oriented and technical graduate programs.

2.2 Higher Education Teaching Evaluation Theory

2.2.1 Teaching Evaluation; Teaching evaluation is an educational activity that is based on teaching objectives, grounded in scientific assessment standards, and employs reasonable assessment methods to measure and assess the teaching process and outcomes, determining the educational value(Bingbing, 2020). Teaching evaluation serves three main purposes: firstly, it allows for the timely diagnosis of issues within the teaching process; secondly, it serves as a motivational tool for both teachers and students in their teaching and learning efforts; thirdly, it promotes teaching reform and facilitates informed decision-making through feedback from the evaluation results(Chen, 2019).

In defining the evaluation of higher education teaching, let's first focus on teaching evaluation. The 'Concise International Encyclopedia of Education' defines teaching evaluation as follows: 'When individuals assess purposeful actions in the completion of a task. The effectiveness of assessment depends on three equally important steps or stages: standard tasks or a series of tasks, documented records, and grading criteria(Hussen, 1992).' Due to variations in scholars' methodological approaches and disciplinary backgrounds, there is no uniform consensus within the domestic theoretical community regarding the understanding of teaching evaluation. This article summarizes and organizes different scholars' typical perspectives on teaching evaluation (table2.1).

Table 2.1 Typical Understandings of Teaching Evaluation Among Different Scholars

	Held Viewpoint
Education theory researcher	In accordance with educational goals and requirements, the process of describing and determining teaching methods following certain principles and rules is an essential component of all stages of education. Its purpose is to assess, diagnose, and facilitate the teaching and learning process. It should have specific criteria for measurement during implementation, and evaluation should not be done solely for the sake of evaluation. The value judgments and evaluation conclusions drawn should serve as the basis for future decision-making by educational leadership.
Economic	Teaching evaluation should first comprehensively utilize multiple

perspective	approaches to systematically collect teaching information, quantitatively analyze all aspects of teaching and learning, and use the evaluation results as the basis for the rational redistribution of educational resources, aiming to achieve effective improvements in educational efficiency.
Systemist	Define educational assessment as an information feedback channel used to provide relevant information about the education and teaching system. The premise for conducting educational assessment is to grasp the characteristics of the subject being assessed, establish evaluation criteria, and then collect, process, and evaluate feedback information from the education and teaching system using scientific methods. This process involves comparing the feedback against the established standards to identify deviations and analyzing the reasons for these deviations, ultimately achieving the goal of predicting the state of the education and teaching system.
Epistemologist	Educational evaluation is a type of human cognitive activity, and this cognitive process relies on the evaluator's understanding of the teaching situation and teaching principles as a prerequisite, leading to value judgments regarding the subject of teaching activities. The entire cognitive activity is purposeful and planned.

Despite the differences in the statements above, when considering various perspectives collectively, regardless of their presentation forms, the essence of what is described remains the same. Educational assessment is conducted to enhance the effectiveness and benefits of teaching. Educational assessment is an activity that involves evaluating the value of the teaching process and its outcomes based on educational objectives, serving as a basis for educational decisions. It is the process of making judgments about the real or potential value of teaching activities. Educational assessment is the process of assessing the value of both teaching and learning, involving evaluation of various factors during the teaching process, including teachers, students, teaching content, teaching methods and tools, teaching environment, and teaching management. However, its primary focus is on evaluating student learning outcomes and the teaching

process of the teacher. The two core components of educational assessment are the evaluation of teacher's teaching work (teaching design, organization, implementation, etc.) teacher evaluation (in-class and extracurricular) and the evaluation of student learning outcomes namely, examinations and tests. Evaluation methods mainly include quantitative assessment and qualitative assessment. Educational assessment is a process that measures and assigns value judgments to the teaching process and its outcomes based on educational objectives, using all effective technical means according to scientific standards. Educational assessment involves measuring, analyzing, and assessing the quality of teaching work. It includes evaluating student academic performance, assessing the quality of teaching by teachers, and conducting course evaluations (Hussen, 1992).

2.2.2 University Teaching Evaluation

Universities, abbreviated as "high schools," are the carriers of higher education and have a similar meaning to universities. Article 68 of the "Higher Education Law of the People's Republic of China" provides clear provisions: higher education institutions generally refer to universities, independently established colleges, and higher vocational colleges, including higher vocational schools and adult higher education institutions. In this article, the term "university" specifically refers to full-time public undergraduate institutions in our country and does not include other levels and types of educational institutions (Xin, 2016).

University teaching evaluation, guided by scientific values, follows the objective laws of educational development, is goal-oriented, and focuses on the entire process and various aspects of university teaching. It is based on certain standards, uses scientific methods, and means for data collection, evaluates the entire process of teaching, including its background, process, and outcomes. The purpose is to provide direction for teaching reform and quality improvement and to provide practical basis for educational decision-making by the education administrative departments. The objects of evaluation are the background of teaching, the process of teaching, and the outcomes of teaching. The standards for evaluation are the indicator system, including various levels of indicators, standard definitions, and conclusions. Evaluation methods and means should adhere to the combination of quantitative and qualitative aspects, the combination of subjectivity and objectivity, and the combination of experimental and

non-experimental methods. Teaching evaluation can be broadly categorized into general and specific evaluations, and the same applies to university teaching evaluation. General university teaching evaluation refers to a comprehensive evaluation of teaching work, including not only the teaching process itself but also the teaching background and outcomes. Specific teaching evaluation refers only to the evaluation of teaching activities beyond the classroom. The university teaching evaluation referred to in this study is the general university teaching evaluation. Therefore, the object of university teaching evaluation in this article is full-time public undergraduate institutions in the fields of science and engineering.

2.2.2.1 Principles of Higher Education Teaching Evaluation; University Teaching Evaluation is a systematic and complex endeavor, as well as a scientific process of value judgment. Therefore, its operation should adhere to scientific principles.

2.2.2.1.1 Directional Principle; The directional principle of university teaching evaluation refers to the need to maintain the correct direction in the evaluation of teaching. China is a socialist country, and our higher education is socialist education. Higher education management systems and educational models have their own characteristics. Implementing the directional principle of university teaching evaluation means consistently adhering to the guidelines, policies, regulations, and educational objectives set by the Party and the state for higher education. It involves scientifically designing evaluation schemes, conducting evaluations in an organized manner, guiding higher education institutions to steadfastly follow the socialist direction, improving educational efficiency, and nurturing many builders and successors of the socialist modernization cause.

2.2.2.1.2 Objectivity Principle; the objectivity principle means that in conducting teaching evaluations, the attitudes of evaluators, the scales of evaluation, the methods of evaluation, and the conclusions drawn should all be based on objective realities. Evaluations should not be made blindly or subjectively, and personal emotions should not be mixed in. The purpose of teaching evaluation is to objectively present and scientifically judge the entire teaching and learning process. Lack of objectivity renders the evaluation meaningless and can lead to serious consequences, even decision-making errors.

2.2.2.1.3 Holistic Principle; the holistic principle means that when conducting teaching evaluations, one must consider not only various aspects of the teaching activities but also grasp the teaching activities. Teaching is a complex system, and teaching tasks tend to be diverse, so teaching quality manifests as a comprehensive entity reflected in various aspects of teaching effectiveness. To truly reflect teaching effectiveness, a combination of multiple methods is necessary, including qualitative and quantitative, subjective, and objective, experimental, and non-experimental approaches. These methods should complement each other to assess the practical effects of teaching comprehensively and accurately. It is important to distinguish between primary and secondary factors, focus on the key factors and main aspects that affect teaching and learning.

2.2.2.1.4 Guiding Principle; the guiding principle means that when conducting teaching evaluations, one should not merely focus on the current situation but should integrate evaluation and guidance. It is important to help the evaluation subjects define their goals, systematically analyze evaluation results, identify causal relationships, and provide timely, specific, and inspiring feedback based on objective diagnosis of problems. The goal is to effectively play the role of guidance, diagnosis, and improvement.

2.2.2.1.5 Scientific Principle; the scientific principle means that when conducting teaching evaluations, modern educational theories should guide the process, following the laws of educational development and starting from the unity of teaching and learning. It should be based on the teaching objective system, reasonably establish evaluation standards, scientifically create, pre-test, and revise evaluation tools. During implementation, scientific and effective measurement methods and statistical techniques should be used. The evaluation process should be rigorously regulated, and data handling should be precise and rigorous to ensure the reliability and accuracy of evaluation conclusions. Intuitive experience and blind subjective judgment, especially the infusion of personal emotions, must be avoided to ensure the scientific nature of the evaluation.

2.2.2.1.6 Diversity Principle; University teaching evaluation is a complex and systematic project, and to ensure the scientific, rational, and effective execution of evaluation work, the diversity principle must be adhered to. This means that during the evaluation process, there should be diversity in terms of the evaluation subjects, evaluation content, and evaluation methods. Evaluation subjects can include educational authorities, social organizations, or the universities themselves. Universities can also involve teachers, students, and staff in the evaluation process. Evaluation content should encompass not only the content, process, and methods of teaching but also various aspects related to school teaching work, such as teachers, students, and teaching support systems. Evaluation methods should be scientific and diverse, emphasizing the combination of quantitative and qualitative, subjective, and objective approaches, advocating for diversified teaching evaluation.

2.2.2.1.7 Developmental Principle; as a value judgment process, university teaching evaluation aims to enhance the quality of teaching and promote educational reform. Current reforms in university teaching evaluation should undergo a complete transformation from the previous emphasis on horizontal and selective evaluations to a focus on the process of evaluation and the development of the evaluation subjects as the fundamental purpose of teaching evaluation. Teaching evaluation aims not only to understand the past, present, and problems but also to help the evaluation subjects clarify their direction, identify issues, and provide a basis for the scientific development of the evaluation subjects.

2.2.2.1.8 Democratic Principle; the democratic principle emphasizes the fairness of the entire university teaching evaluation process and strives to eliminate the mystery surrounding the evaluation work. Evaluation tools, standards, methods, and procedures should be publicly disclosed and widely solicited for opinions, with corresponding adjustments made. During the implementation of the evaluation, transparency should be ensured, and evaluation results should be thoroughly discussed and debated. Adequate communication with the evaluated units should take place to ensure that the evaluation results are convincing. The democratic principle also requires the establishment of an appeals mechanism for evaluation results. When the evaluated parties have objections to the evaluation results, they should have the opportunity to

appeal to relevant higher authorities within a specified timeframe for a revaluation of the results.

2.2.2.2 Types of Higher Education Teaching Evaluation; Higher education teaching evaluation is a systematic undertaking, encompassing a wide range of elements with complex content. To achieve the objectives of teaching evaluation, it is necessary to assess the value of the subject of evaluation from various perspectives and levels. Therefore, we attempt to classify higher education teaching evaluation into internal evaluation and external evaluation based on the evaluating entity.

2.2.2.2.1 Internal Evaluation of Higher Education Institutions; internal evaluation of higher education institutions, also known as self-assessment, is a teaching evaluation activity organized by the institution itself. It involves the development of evaluation criteria based on the school's educational philosophy, development plans, and educational objectives, enabling systematic value judgments on the teaching and learning activities within the institution. For example, a university may establish teaching supervision teams to assess the quality and level of undergraduate teaching, conduct regular assessments of teachers' professional titles and development levels, and assess students' academic performance and character. All these activities fall under the umbrella of self-assessment by the institution. The purpose of conducting internal evaluation of teaching is to reexamine the central role of teaching, guide various units within the institution to prioritize and strengthen teaching, identify, and address issues, engage in teaching reforms, continually enhance teaching quality, and cultivate high-quality talent. In this process, the institution should also change its thinking and understanding, recognizing that internal teaching evaluation is not only an individual and spontaneous action of a higher education institution but also a necessary measure for national macro-control and management of higher education institutions. Internal teaching evaluation in higher education institutions has the following characteristics: the evaluation activities are initiated by the institution itself, making the institution the primary evaluator; evaluation criteria and indicator systems are tailored to the institution's unique characteristics, flexible, adaptable, practical, and targeted, enabling the comprehensive collection of information and the formation of accurate judgments; internal teaching evaluation also serves as preparation for external teaching evaluations

conducted by educational administrative authorities, to some extent standardizing documentation, accumulating data, and familiarizing institutions with the processes, thereby reducing the workload of external evaluations and improving efficiency.

2.2.2.2.2 External Evaluation of Higher Education Institutions; external evaluation of higher education institutions is an evaluation conducted by external organizations on higher education institutions as the objects of evaluation. Depending on the evaluating entity, external evaluation can be categorized as government evaluation and societal evaluation.

Government evaluation is carried out by the educational administrative department on the teaching evaluation activities organized by higher education institutions. According to the "Four Elements" mentioned earlier, the government evaluation is conducted by the educational administrative authorities, with the target being the current state of undergraduate education and the quality of talent cultivation. The evaluation is based on the criteria set forth in the "Guidelines for the Evaluation of Undergraduate Teaching in Ordinary Higher Education Institutions (Trial Implementation)," issued by the Ministry of Education in 2004. The purpose of government evaluation is to strengthen the supervision of higher education institutions' educational and teaching work, elevate the level of education, and ensure orderly and healthy development. Compared to internal teaching evaluation conducted by higher education institutions, government evaluation has several characteristics: it is carried out by the educational administrative department, falls under the category of external evaluation, and is more objective than internal evaluation; the evaluation criteria, content, and methods are derived from the policies and guidelines formulated by the Ministry of Education, strict and more focused on the macro-level, but may lack specificity; the evaluation results serve as the basis for national macro-control and policy formulation.

Societal evaluation is conducted by societal organizations to assess the teaching activities of higher education institutions. The implementing entities of societal evaluation are societal intermediary organizations such as professional committees, academic institutions, and employers. The evaluation targets include student academic performance, research levels, faculty status, institutional management, and societal perceptions, among others. The purpose of societal evaluation is to examine and

test higher education institutions' teaching work from the perspective of societal needs, provide information feedback channels for their teaching reforms, educational management, and educational decision-making, and promote the healthy development of institutions. Societal evaluation not only provides an objective assessment of the quality of education in higher education institutions but also facilitates their development and the formation of distinctive characteristics. Societal evaluation has several fundamental characteristics: societal intermediary organizations take the lead in and implement the evaluation, distinguishing it from self-assessment and government evaluation, which are typically conducted by the institutions themselves or their supervisory authorities, making it more objective; evaluation criteria, content, and methods are determined based on societal needs; and the evaluation results place a greater emphasis on indicators, sometimes overlooking the examination of the educational and teaching processes.

2.2.2.3 The Functions of Higher Education

2.2.2.3.1 Diagnostic function; it is reflected in its adherence to educational assessment standards by using assessment tools to diagnose the elements and processes of education and teaching, examining whether they conform to the developmental trends of education and teaching, as well as the degree to which they align with established goals. It identifies existing problems, attributes the causes of these problems, and then takes corrective measures based on the causal relationships of the issues. This, in turn, provides a basis for higher education teaching reform and creates conditions for the healthy and scientific development of universities.

2.2.2.3.2 Incentive function; in order to prepare for the higher education department's evaluation of universities, higher education institutions first conduct internal self-assessment and self-examination. Based on the evaluation results, they address areas of weakness, improve infrastructure, enhance teaching management, and raise the quality of education and teaching. This is beneficial for fully motivating the enthusiasm of teachers, students, and staff, representing a rare and significant opportunity for university development. At the same time, the incentive function of university teaching evaluation is also reflected in the university's recognition of its own evaluation results. After the teaching evaluation is completed, experts rate the university's teaching overall, categorizing it as excellent, good, pass, or fail. Universities themselves should

have a rational understanding of the evaluation results. Those with outstanding results should continue to strive for excellence, while those with less satisfactory results should impose strict standards on themselves in order to improve.

2.2.2.3.3 Improvement Function; the improvement function is closely linked to the diagnostic function. The purpose of university teaching evaluation is not only to arrive at evaluation conclusions or assign grades to participating universities; its primary goal is to enhance the overall teaching quality and the quality of talent cultivation in the university, thus playing a constructive role. Therefore, during the implementation of teaching evaluation, expert groups primarily engage in on-site observation and guidance, diagnose issues, and propose solutions, while also offering constructive suggestions for the university's unique development, positioning, and strategic planning. At the conclusion of the entire teaching evaluation process, participating expert groups form objective evaluation reports based on the evaluation process and results, and participating universities should write summary reports based on the expert assessment conclusions and constructive feedback, subsequently revising their goals and development plans.

2.2.2.3.4 Discriminatory Function; One purpose of university teaching evaluation is to rate the participating universities based on evaluation results through thorough discussions, categorizing them as excellent, good, pass, or fail. Throughout the evaluation process, various elements of university teaching must also be assessed, analyzing the achievement of each element's objectives, such as the quantity and structure of the teaching staff, teacher's teaching skills, and students' academic performance.

2.2.2.3.5 Guidance Function; the guidance function is primarily reflected in the establishment of the evaluation index system in the teaching evaluation plan at all levels. This system serves as the measurement tools and basis for judgment in the evaluation work. The evaluation index system is developed and refined by the education administrative department using scientific methods and is conveyed to participating universities as part of the evaluation plan in the form of documents. The A and C level standards for the main observation points in the university teaching evaluation index system are clearly defined and specific. They serve as the basis and

guiding principles for improving various aspects of teaching in higher education institutions in response to the evaluation criteria and requirements, preparing for the education department's university teaching evaluation work.

2.2.2.3.6 Decision-Making and Consultation Function; another important function of university teaching evaluation is decision-making and consultation. The education administrative department, using the results of the university teaching evaluation, gains a specific understanding of the universities' teaching levels, acknowledging achievements, and identifying problems. This information serves as an important source for educational decision-making. Based on the evaluation conclusions, the education administrative department can make corresponding adjustments to educational planning and administrative allocations, thereby facilitating scientific educational planning and the rational allocation of educational resources. Furthermore, the conclusions of university teaching evaluation also serve as the basis for further decision-making by the university's party committee and administrative departments, promoting comprehensive and healthy development in higher education institutions.

2.3 CIPP model

CIPP evaluation model is a Program evaluation model which was developed by Daniel Stufflebeam and colleagues in the 1960s. CIPP is an acronym for Context, Input, Process and Product. CIPP is an evaluation model that requires the evaluation of context, input, process, and product in judging a programme's value. CIPP is a decision-focused approach to evaluation and emphasises the systematic provision of information for programme management and operation(Robinson, 2002).The CIPP framework was developed as a means of linking evaluation with programme decision-making. It aims to provide an analytic and rational basis for programme decision-making, based on a cycle of planning, structuring, implementing and reviewing and revising decisions, each examined through a different aspect of evaluation –context, input, process and product evaluation(Stufflebeam, 2000).

The CIPP model is an attempt to make evaluation directly relevant to the needs of decision-makers during the phases and activities of a programme. Stufflebeam's context, input, process, and product (CIPP) evaluation model is recommended as a

framework to systematically guide the conception, design, implementation, and assessment of service-learning projects, and provide feedback and judgment of the project's effectiveness for continuous improvement(Young Lee and Shin et al., 2019).

2.3.1 Specific Components of the CIPP Model; each component of the CIPP model serves a specific purpose in the evaluation process: Context Evaluation (C): This phase focuses on understanding the context in which the program operates. It aims to identify the needs, problems, and opportunities that led to the creation of the program. Assessing the background, stakeholders, and environmental factors that affect the program's development and implementation. This includes analyzing the goals, objectives, and constraints(Jiang and Liu, 2021).Input Evaluation (I) Input evaluation examines the resources and strategies put into the program before it begins. It assesses whether these inputs are appropriate for achieving the program's goals. Evaluating the curriculum, materials, staff qualifications, funding, and other resources allocated to the program. This phase also considers the alignment of inputs with program objectives (Ebtesam and Foster, 2019).Process Evaluation (P):Process evaluation focuses on how the program is being implemented. It assesses whether the program is being carried out as intended and identifies any areas for improvement in program delivery. Observing program activities, monitoring the quality of services, and collecting data on program implementation. Process evaluation helps identify strengths and weaknesses in the program's execution(Burke and Hennessy, 2021).Product Evaluation (P):Product evaluation assesses the outcomes and impacts of the program. It examines whether the program has achieved its intended goals and objectives. Measuring the program's outcomes and impacts, including student learning outcomes, changes in behaviour, and the overall effectiveness of the program. This phase also considers the long-term effects and sustainability of the program (Sopha and Nanni, 2019).

The CIPP model is often used iteratively, with each phase informing the next. It helps organizations and evaluators make informed decisions about program development, improvement, and modification. By considering context, input, process, and product, stakeholders can gain a comprehensive understanding of the program and its effectiveness, leading to more informed decision-making and better program outcomes (Lee and Lee et al., 2019).

2.3.2 Characteristics of the CIPP Model

2.3.2.1 Emphasis on Decision-Oriented Evaluation; stufflebeam believed that evaluation should not be limited to the extent of achieving predetermined goals but should provide useful information for educational decision-makers. Stufflebeam divided the entire process of educational decision-making into planning decisions, organization decisions, implementation decisions, and management decisions, fully emphasizing the role of educational evaluation as a source of information for educational decision-making. Consequently, the most significant feature of CIPP is its focus on being decision-oriented rather than goal-oriented in education (Sankaran and Saad, 2022).

2.3.2.2 Emphasis on the Improvement Role of Evaluation; Stufflebeam once famously said, 'not to prove but to improve.' This statement highlights another important characteristic of the CIPP evaluation model, which is not merely to identify problems and discover issues but to emphasize problem-solving and educational improvement. Through the conduct of process evaluation during evaluation implementation, the program's implementation is monitored, and effective feedback is provided to ensure reasonable control over the entire educational process(Yudan, 2022). Additionally, background evaluation and input evaluation are used to clarify objectives, guide programs, and enhance their improvement. Outcome evaluation not only produces final evaluation reports but also requires interim summaries during the program's implementation to identify and address issues promptly.

2.3.2.3 Emphasis on the Organic Integration of Diagnostic, Formative, and Summative Evaluation. The CIPP model places greater importance on formative evaluation but does not neglect the utility of diagnostic and summative evaluation. It attempts to comprehensively apply these three forms of evaluation in evaluation practices, allowing them to serve different purposes effectively. The flexibility and integrated use of these methods make the CIPP model widely applicable and adaptable, allowing evaluators to use them as needed, both before and during program implementation (Stufflebeam and Zhang, 2017).

2.4 Progress in Research on Undergraduate Teaching Evaluation in China

Regarding the fundamental theories of teaching evaluation, as people's understanding of teaching assessment deepens and the expansion of practical domains, fundamental theoretical issues of teaching evaluation have gradually entered people's field of vision. From the perspective of theoretical consistency, research on undergraduate teaching evaluation in China, for the most part, has been conducted by scholars in several dimensions, including the definition of undergraduate teaching evaluation, evaluation criteria, evaluation types, evaluation methods, evaluation value orientation, and evaluation subjects (Lin and Li et al., 2019).

2.4.1 Study on the Connotation of Undergraduate Teaching Evaluation; the earliest research on teaching evaluation among Chinese scholars was conducted by Zhou Xuehai, who defined teaching evaluation as the process of collecting information about the entire teaching system or a specific aspect and making objective measurements and judgments about the teaching or experimental effectiveness based on the obtained information. Scholars such as Li Congming from Taiwan, Wang Hanlan, Wu Gang, and Chen Yukun from China have provided explanations of the connotation of undergraduate teaching evaluation. The essence of teaching evaluation is to provide value confirmation to teaching activities from the perspectives of outcomes and impacts and guide teaching activities towards achieving predetermined goals (Lee, 2000). Some scholars agree that it is "the measurement, analysis, organization, and value judgment of teaching activities as preparation, process, and outcome." Others believe that teaching evaluation involves measuring, analyzing, and assessing teaching activities based on teaching objectives. Teaching evaluation mainly includes assessing student academic achievements, evaluating the quality of teaching by teachers, and evaluating the curriculum (Guo, 2021). Li Bingde considers teaching evaluation as a value judgment of the teaching process and its results. Zhong Qiquan believes that teaching evaluation is about objectively grasping the changes that occur in students through teaching activities to maximize educational effectiveness. Leng Zebing sees teaching evaluation as a comprehensive value judgment of various aspects of the teaching process and teaching effectiveness. Xu Wenbin views teaching evaluation as the measurement, analysis,

organization, and value judgment of teaching activities as preparation, process, and outcome.

2.4.2 Research on the Value Orientation and Function of Undergraduate Teaching Evaluation

The essence of undergraduate teaching evaluation is determined by its value orientation, which directly influences the purpose and function of higher education assessment and the design of assessment indicators. Value orientation belongs to the domain of value philosophy and refers to a certain inclination of the subject in the process of value selection and decision-making. Value orientation reflects the values pursued by the subject and influences their behavior based on specific value standards(Lu, 2007). Chen Yukun believes that a certain value orientation in educational evaluation can guide the construction of specific value models and influence the conduct of educational evaluation activities. People can influence what type of education to create and what kind of talents to nurture through the value orientation of educational evaluation(Yao, 2000). Using "behavioral orientation" to define value orientation, such as: value orientation is the direction chosen in the process of value selection. Value orientation refers to the direction of behavior choices made by individuals according to their own values regarding different value goals(Ling, 2000).

Wang Kunqing believes that the value orientation of humanistic education primarily focuses on the position of the individual in education, the debate between "individual-centered" and "society-centered" possibilities for human development, and the pursuit of the development of a sound personality(Wang, 1999). Shi Zhongying believes that teaching is intentional, bilateral, intermediary, and ethical, and therefore, teaching must conform to the value rationality of teaching, the communication rationality of teaching, the instrumental rationality of teaching, and the practical rationality of teaching(Zhiqiong, 2004). Some scholars also believe that value orientation refers to the purposes that teaching evaluation seeks to achieve through its activities. For teaching evaluation itself, the fundamental purpose is to improve teaching quality, but the improvement of teaching quality depends on two key factors: student development and teacher development. Therefore, in the process of achieving the ultimate goal, teaching evaluation must have student development and teacher development as its value

orientation (Huiyan, 2013). Li Rumi believes that no matter what kind of teaching evaluation, it is ultimately a means to promote and improve teaching and learning. Compared to this fundamental purpose of ensuring students' healthy development, other functions are secondary (Rumi, 2015). Scholars generally agree on the guiding, motivating, and feedback functions of teaching evaluation, while other functions are derived from their respective perspectives.

2.4.3 Research on the Undergraduate Teaching Evaluation Indicator System, Standards, Policies, and Systems

In the research on the undergraduate teaching evaluation indicator system, Wei Hong and Zhong Binglin believe that "the evaluation of research universities should emphasize the cultivation of innovative talents, the autonomy and characteristics of the school, and the positioning of undergraduate education in the development of the school."(ZHONG and Wei et al., 2009) The undergraduate teaching assessment indicator system in China serves as the beginning point for Bai Qian's master's thesis, "A Study on the Indicator System of Undergraduate Teaching Evaluation in China." It examines the history of evaluation of the quality of undergraduate instruction in Chinese higher education institutions as well as the process of evaluation development. It also evaluates the current teaching evaluation indicator system and assesses its flaws. According to Yang Lun, we can only encourage the better development of higher education by developing the accurate perception of the quality of higher education, changing the way the government operates, and allowing numerous evaluation indicator systems to coexist. According to Zhang Ying, the school's features play a significant role in the evaluation system for undergraduate instruction. A school's qualities can be divided into multiple sorts depending on different criteria, and some schools fail to include elements that ought to be there, which causes others to misunderstand such elements. In his article titled "Several Thoughts on Advancing the Construction of Undergraduate Teaching Evaluation Indicator System in Universities," Liu Xiaozhe highlights current problems with the development of the undergraduate teaching evaluation indicator system, such as the failure to emphasize and ensure the central role of teaching work, the rigidity of "hard indicators," and the flexibility of "soft indicators."

Regarding undergraduate teaching evaluation, Chen Yukun believes that the concept of standards is generally understood in two ways: firstly, standards refer to measurement questionnaires and scales; secondly, standards refer to the critical points of material changes, the rules of quantity during the process of material change. Some scholars believe that teaching evaluation standards represent the criteria or scales on which value judgments based on basic indicators or so-called final pointers are made. Because basic indicators are directly measurable, each basic indicator corresponds to an evaluation standard. This forms a collection of evaluation standards, and the evaluation indicator system also has a corresponding evaluation standard system(Zhou and Tian et al., 2010). Several scholars have studied the combination of ISO 9000 standards and the undergraduate teaching evaluation indicator system from the perspective of quality assurance, attempting to introduce ISO 9000 standard systems from the business world into undergraduate teaching evaluation. Research on undergraduate teaching evaluation also includes interpretations of the Ministry of Education's "Basic Issues in the Evaluation System for Undergraduate Teaching Work in Ordinary Higher Education Institutions" and "An Analysis of the Basic Issues in the New Round of Undergraduate Teaching Evaluation," as seen in articles such as Zhong Binglin's "Adhere to Classified Guidance, Establish Classification Standards, and Implement Classified Evaluation - An Analysis of the Basic Issues in the New Round of Undergraduate Teaching Evaluation (Part II)."(ZHONG and Wei et al., 2009) Some scholars emphasize the consistency between teaching evaluation standards and quality evaluation standards. In "Establishing Scientific Teaching Evaluation Standards to Stimulate Competition in the Teaching Field,"(Lang, 1991) He Liaoran argues that teaching evaluation standards should be characterized by thoughtfulness, academic quality, and teaching skills. Kong Xiangfa analyzed the education evaluation standards set by the Educational Evaluation Standards Consortium, composed of 15 education organizations in the United States in 1975, and found that the practical standards, feasibility standards, appropriateness standards, and accuracy standards of American education evaluation standards have obvious reference significance for establishing teacher evaluation standards and formulating teacher evaluation goals in China. Some scholars have also studied foreign evaluation questionnaires, including nominal questionnaires, ordinal questionnaires, interval

questionnaires, ratio questionnaires, fuzzy questionnaires, etc. Chen Yuxiang discusses the establishment of undergraduate teaching quality standards in China from the perspective of the connotation of standards. Wang Hong and Shen Qin in "Research on the Design Principles of Evaluation Standards for Local Characteristic Undergraduate Colleges" (Mingfu, 2013)focus on the principles of education evaluation standard design, foreign undergraduate education evaluation models and trends, the design of evaluation indicator systems for local characteristic undergraduate colleges, and indicator weights.

Shi Yusheng and Lin Rongri contend in their paper titled "A Study of Policy Tools in the Reform of the Evaluation System for Ordinary Undergraduate Teaching in China" (Yusheng and Rongri, 2015)that the policy tools selected and used in the reform of the evaluation system for ordinary undergraduate teaching in China are relatively single, with a higher frequency of using mandatory tools and mixed tools and less use of voluntary tools. This is in reference to research on policies for undergraduate teaching evaluation. They propose that to maximize the complementarity of policy tools, policy tool planning needs to be reinforced and the toolkit should be enriched. According to Zhou Xianglin, who wrote "Construction and Analysis of a Four-Dimensional Gradual Decision-Making Model for Educational Policies: Taking the Evolution of Policies on Undergraduate Teaching Evaluation in Chinese Universities as an Example,"(Zhou, 2011) the conventional gradual decision-making model has some theoretical drawbacks. He advises developing a four-dimensional gradual decision-making model for educational policies based on historical, structural, and goal-oriented factors. In a piece titled "Policy Analysis of the Main Problems in Undergraduate Teaching Evaluation in Higher Education Institutions,"(Runyong and Ling, 2008) it is claimed that certain institutions display "abnormal" behaviours in the evaluation of undergraduate teaching, like "rushing investment" and "processing teaching data." Additionally, there is a decline in "self-assessment" and "rectification." These issues are inextricably linked to the weaknesses and flaws in many components of undergraduate evaluation, including the primary body of evaluation, the content of evaluation standards, methodologies, and procedures, etc., from the standpoint of education policy analysis. In "Value Analysis of Policies for Undergraduate Teaching Evaluation in Higher Education Institutions," (Yuliang, 2008)Wang Yuliang examines the value of policies for undergraduate teaching

evaluation from three perspectives: the importance of selecting the best policies, the reliability and efficacy of undergraduate teaching evaluation, and the value of having a thorough understanding of these policies. In "Issues and Suggestions Regarding the Undergraduate Teaching Evaluation Policies in China's Higher Education Institutions," (Zhang and Li, 2008)Zhang Zhengyi argues that evaluators of higher education should thoroughly examine pertinent evaluation policy provisions, fully utilize the role of evaluation subjects at all levels, swiftly revise and adjust the evaluation indicator system, and establish a variety of evaluation standards.

In the research on the system of undergraduate teaching evaluation, Professor Zhong Binglin, in his paper "An Analysis of Several Hot Issues in Undergraduate Teaching Evaluation - Discussion on the Value Orientation, System Design, Classification Evaluation Framework, and Corresponding Indicator System Design and Methodological System Construction of the New Round of Evaluation," (Chung, 2009)expounds his views on the value orientation, system design, classification evaluation framework, and the corresponding design of indicator systems and methodological systems of the new round of undergraduate teaching evaluation. In the article "Institutional Analysis of University Behavior in Undergraduate Teaching Evaluation,"(Zhou, 2011) Zhou Xianglin argues that under specific institutions, universities, as strategic actors, always seek more satisfactory results. In the first round of undergraduate teaching evaluation, due to the regulation and temptation of the system, universities weighed various factors such as ideas, interests, and power, both taking substantial actions to improve the quality of undergraduate teaching work in accordance with the evaluation indicator system and adopting some opportunistic behaviour’s, which reduced the effectiveness of the first round of undergraduate teaching evaluation system operation. Zhang Yongli, in "Research on the Establishment and Development of the System of Undergraduate Teaching Evaluation in Higher Education Institutions," analyses the achievements and shortcomings of the first round of teaching evaluation work from 2003 to 2008 and discusses the development and improvement of the system of undergraduate teaching evaluation in Chinese higher education institutions since 2011. Yao Yuhua, in "Reflections on the Evolution of the Undergraduate Teaching Evaluation System in China: A Perspective of Social Accountability," (Yao, 2016)argues that

China's undergraduate teaching evaluation is mainly government-led and belongs to a typical administrative accountability model. Based on the examination of five dimensions of the social accountability mechanism, it can be found that the evaluation system in China mainly adopts incentive methods with a punitive mechanism, with low levels of institutionalized social participation, shallow social participation, and a small range of participants."

2.4.4 Formation and Development of Higher Education Assessment in China

China's higher education assessment began in the 1980s, marking 40 years of remarkable progress. It can be broadly divided into four developmental stages: inception, experimentation, expansion, and innovation, with each stage spanning a decade. The first decade (1980s) was characterized by initial explorations supported by research and pilot programs. The focus was on addressing questions about whether and how to assess higher education in China. Drawing from advanced experiences of developed countries, the Ministry of Education introduced the "Interim Provisions on the Evaluation of Higher Education in Regular Undergraduate Institutions," outlining the basic principles and implementation framework for higher education assessment in China.

The second decade (1990s) emphasized the accumulation of experience through various forms of assessment practices. The Ministry of Education organized assessments of over 200 universities, covering three types: qualified, excellent, and random assessments. This period witnessed a variety of explorations in assessment practices.

The third decade (the first decade of the 21st century) marked comprehensive advancement with the organization of the first nationwide assessment. At the turn of the century, as China's higher education transitioned from "elite education" to "mass education," ensuring education quality became a top priority. In this context, the nation conducted a large-scale assessment with the goal of achieving full coverage of universities. The initial assessment played a crucial role in improving overall educational conditions and enhancing teaching infrastructure at universities. It also fostered a sense of quality assurance and standardized educational practices across universities.

The fourth decade the most recent decade has been characterized by innovative development, notably the establishment of a "Five-in-One" assessment system tailored to China's specific conditions. Building upon the lessons learned from previous

experiences, particularly addressing issues exposed during the first nationwide assessment, the Ministry of Education strategically planned the development of higher education assessment. This resulted in the establishment of the "Five-in-One" quality assurance system, which includes self-assessment by universities, institutional assessments, program accreditation, regular monitoring of basic teaching conditions, and international assessments. Over the course of a decade, this system has continued to mature and has played a crucial role in promoting the development of higher education with a focus on quality and content.

Reviewing 40 Years of Higher Education Assessment in China's History of Striving On the one hand, tremendous progress has been made in the construction of the assessment system, continuous innovation in assessment concepts, constant improvement in assessment standards, and the gradual perfection of the assessment system and mechanisms. This has led to the development of a higher education assessment 'Chinese solution' that suits our national conditions. On the other hand, the role played by higher education assessment has achieved remarkable results. Assessment and the development of China's higher education reform have gone hand in hand. At every major historical development juncture, it has played a significant role in ensuring the steady and far-reaching development of higher education and made important contributions. In addition, China's assessment level and quality have been gradually recognized and acknowledged by the international higher education community, generating broad and positive influence worldwide. The accreditation of higher engineering education and medical education by the corresponding international organizations composed of developed countries as formal members is the best evidence of this.

Today, we stand at a new historical starting point, facing profound changes in the situation. The development of higher education must adapt actively. In summary, higher education needs to actively respond to the changes in new societal demands. With the rapid advancement of technological revolutions and industrial transformations, new industries, new professions, and new technologies are constantly emerging, resulting in significant changes in society's demand for higher education. Higher education must actively respond to its new mission. Based on the unprecedented global changes and the

strategic goal of the great rejuvenation of the Chinese nation, General Secretary Xi Jinping pointed out, 'Our need for higher education is more urgent than ever before, and our thirst for scientific knowledge and outstanding talent is stronger than ever before.' We must accurately grasp the era's mission of higher education and actively respond to the new development of higher education itself. China's gross enrollment rate in higher education reached 51.6% in 2019, entering the stage of popularization, achieving another new leap forward. In the new era, the status, role, development stage, and strategic position of higher education are undergoing profound historic changes. The new goal and task of higher education reform and development is to achieve connotative high-quality development, accelerate the modernization of the governance system and governance capacity of higher education, and accelerate the construction of a strong higher education nation. Strengthening the construction of the higher education assessment system is an important content and guarantee for achieving this goal. In the next five or ten years, we will focus on six important aspects to accelerate the modernization of China's higher education assessment system, making the assessment system more mature, more perfect, and more standardized, and forming a higher-level Chinese characteristic higher education assessment system.

2.4.5 Characteristics Orienting the Chinese Higher Education Assessment System

2.4.5.1 Clearer Goal Orientation in Assessment

The "two imperatives" should be more forcefully prioritized in assessment. The primary duty of "cultivating virtues and nurturing talents" is one. The Ministry of Education's Party Committee recently presented an overarching strategy of "focusing on the fundamentals and promoting four returns," organized a conference on undergraduate education, and unveiled a number of policies and initiatives. Universities have also started to act more broadly, with attempts to cultivate talent clearly increasing. On a deeper level, however, the issue of "insufficient investment in the four teaching inputs" still exists to various degrees, and universities' important role in talent development has not yet completely developed. It is crucial to establish, reinforce, and emphasize through assessment the crucial function of universities in talent development as well as the essential duty of "cultivating virtues and nurturing talents." Implementing

the fundamental standards for "cultivating virtues and nurturing talents" is another imperative. We should improve the assessment indicator system with the effectiveness of cultivating virtues and fostering abilities at its center by utilizing the steering effect of assessment. As a result, universities will be forced to take "cultivating virtues and nurturing talents" seriously as the primary standard for judging all their efforts. To effectively nurture students, all schools, faculties, teachers, and courses must take on this responsibility, uphold a clear sense of duty, steadfastly follow the socialist model for operating educational institutions, put into practice the educational tenets of value formation, capacity development, and knowledge transmission as an integrated whole, and create an all-encompassing framework for doing so. This will enable "cultivating virtues and nurturing talents" to become deeply ingrained in all parts of school life.

2.4.5.2 More Advanced Assessment Concepts; our goal is to make this advanced thinking the central idea guiding the entire assessment process by including globally advanced principles like "student-centeredness," "outcome orientation," and "continuous improvement." For all kinds of evaluations, it should become a common and conscious belief in the philosophy of assessment. It should be underlined that improving the quality of talent development requires strengthening the student-centered ideology, which places student development at its core, and promoting students' learning enthusiasm and potential. This will make it easier for the talent development model to shift from being "teacher-centered" to being "student-centered." Enhancing the outcome-oriented philosophy places an emphasis on the value of educational outcomes, avoids evaluating educational standards solely on the basis of explicit indicators, and places an emphasis on evaluating the degree to which the objectives of improving talent development, social adaptation, student satisfaction, and societal satisfaction have been achieved. Strengthening the continuous improvement philosophy encourages universities to proactively establish a quality assurance mechanism and a culture of quality in higher education that is self-reflective, self-disciplined, self-checked, and self-rectified. This is especially true by making the assessment of school quality assurance mechanisms and capabilities a focal point. As a result, issues will be quickly identified, and work will be continuously improved.

2.4.5.3 A More Scientific Classification System for Evaluation; china's higher education has seen two major changes in less than 20 years, moving from elite education to mass education and then to universal education. The idea of classification and development has become a no-brainer given the size, complexity, and diversity of higher education institutions across the nation. Although the concept of classification and development has existed in China for a long time and has been positively explored in various provinces and cities, such as Shanghai, there has not been much advancement on a national level. It is yet not fully clear how colleges will be categorized, developed, and promoted for their unique qualities using an evaluation-oriented methodology.

It is necessary to actively create a more scientific and period-appropriate classification and evaluation system in order to adjust to the peculiarities of higher education throughout the era of universalization. The evaluation criteria should be clarified and expanded upon, flexible classification techniques should be used, and various "evaluation packages" for universities should be offered. It ought to serve as a roadmap for some universities as they strive to establish themselves as top-tier institutions, concentrating on strengthening their capability for ensuring the quality of their instruction and instruction. Additionally, it should encourage some universities to put an emphasis on the development of academic talent, stressing the relationship between research and teaching and making contributions to regional and national plans. Additionally, it need to motivate some colleges to concentrate on cultivating employable skills, fostering regional social and economic advancement, and emphasizing area peculiarities. Every university is simultaneously urged to determine its place in relation to society demands, its own historical growth, and its current circumstances, and work toward intrinsic development and distinguishing characteristics. This will hasten the development of a new higher education landscape with clear institutional positioning, distinct types, and noticeable features.

2.4.5.4 Evaluation as a Catalyst for Stronger Reforms

Higher education has developed as a result of reform, which is its primary driving factor. After 40 years of reform and progress, China's higher education reform has reached a "deep water zone," which is characterized by greater hurdles, systemic complexities, and difficulties. At the moment, even though colleges are placing

more focus on developing talent, there is not enough general reform momentum, in-depth research, or resolve to take on challenging problems.

Utilizing evaluation as a "baton" to steer changes is crucial, with a focus on encouraging universities to make advancements in at least three crucial areas and achieve breakthroughs in reform. First, institutional procedures need to be changed. A structure and process should be put in place that promotes active involvement in educational reform, removes institutional hurdles, and supports educational reform by integrating resources from the public sector, private sector, corporations, and non-profit organizations. Reforming the educational system should come second. Further optimization and integration of the curriculum system should be carried out to effectively align with the demands of the era, bridge the gap between theory and practice, and connect various courses with one another as we face future reforms and reshape the structure of knowledge and competency. Reforming teaching methods should be the third area of concentration. There should be a considerable change in teaching strategies and classroom procedures, guided by the new idea of student-centered education. In order to promote problem-based learning, case-based discussions, and other creative techniques to promote active learning, critical thinking, problem-solving skills, self-directed learning, lifelong learning, and teamwork among students, this should include a deep integration of information technology with teaching.

2.4.5.5 Enhancement of Assessment Systems and Methods with a More Modern Approach, Its improved scientific rigor, simplicity, and efficiency are what define modernity. By enhancing self-assessment, improving institutional assessments, expanding professional evaluations and certifications, improving regular monitoring, and encouraging international exchanges, the assessment system becomes more scientifically sound. This attempts to increase the scientific breadth of the "Five-in-One" quality assurance system. The significant use of contemporary information technologies, such as the internet and big data, simplifies the assessment procedures. Innovative assessment techniques make it easier to fully integrate information technology and evaluation techniques, leading to a "integrated" approach to both online and offline examinations. By coordinating multiple assessment kinds, pooling assessment resources, decreasing

redundant assessments, easing the load on educational institutions, and enhancing assessment efficacy greatly, the functioning of this system is made more efficient.

2.4.5.6 Improved Management Systems; Assessment management system reforms should proceed within the institutional framework of "separating management from evaluation." The absence of institutionalized systems for hierarchical assessments between central and local authorities and the active participation of social stakeholders in assessments is currently a significant problem. An evaluation organization management system that ensures a clear division of responsibilities, rational task allocation, effective execution, and guaranteed efficacy at both the central and provincial levels should be quickly established. This will strengthen the provincial-level evaluation work mechanism and capacity building. The objective is to improve the overall standardization and professionalism of national exams. Additionally, there should be a focus on fortifying the connections between the educational system and pertinent industries, creating collaborative mechanisms for broad and deep industry and enterprise involvement in assessment monitoring, such as by extending professional certification areas.

2.5 Development for applied university based on CIPP

2.5.1 Related concept; University, the scientific name of ordinary higher education, is a unique function of the organization, is connected with the economic and political institutions of society and the establishment of inheritance, research, integration and innovation of advanced academic institutions of higher learning. It is not only the product of the development of human culture to a certain stage, but also on the basis of long-term school-running practice, through historical accumulation, its own efforts and the influence of external environment, it has gradually formed a unique university culture.

The university has a history of thousands of years from its emergence to the present, dating back to its emergence, it is mainly from Germany, Britain and other countries the earliest development.The development of applied universities refers to the growth and evolution of institutions of higher education that prioritize practical and hands-on learning experiences to prepare students for specific careers or industries.

Here's a brief summary of the key aspects of the development of applied universities: Specialized Programs: Applied universities focus on offering specialized degree programs and courses that align with the needs of industries and job markets. These programs are designed to provide students with practical skills and knowledge that are directly applicable in their chosen fields. Industry Collaboration: Applied universities often collaborate closely with industry partners. These partnerships can include internships, co-op programs, research projects, and advisory boards composed of industry professionals. This ensures that curriculum and training remain relevant and up to date. Hands-On Learning: A hallmark of applied universities is the emphasis on experiential learning. Students engage in hands-on activities, labs, simulations, and real-world projects to gain practical experience and problem-solving skills. Career-Oriented Focus: The primary goal of applied universities is to prepare students for successful careers. This includes providing career counseling, job placement services, and networking opportunities to help graduates transition smoothly into the workforce. Faculty Expertise: Faculty members at applied universities often have extensive industry experience in addition to academic qualifications. They bring real-world insights into the classroom and connect students with industry contacts. Flexibility and Innovation: Applied universities tend to be more flexible in adapting to changing industry needs. They can quickly update their curriculum and introduce new programs to meet emerging demands. Research and Innovation: While the primary focus is on practical skills, applied universities may also engage in research and innovation relevant to their respective fields. This research can lead to advancements in technology and practices. Global Perspective: Many applied universities offer international experiences and collaborations, recognizing the global nature of industries. This includes study abroad opportunities, partnerships with foreign universities, and exposure to international business practices. Continuous Improvement: Applied universities regularly assess and improve their programs to ensure they meet industry standards and produce graduates who are job ready. This involves feedback from students, alumni, faculty, and industry partners. Diversity and Inclusion: Applied universities often strive to create diverse and inclusive learning environments that reflect the global workforce. This encourages varied perspectives and prepares students to work in diverse teams. Lifelong Learning: Recognizing the need for ongoing

skill development, applied universities may offer continuing education and professional development opportunities to alumni and industry professionals.

The development of applied universities is driven by the need for a highly skilled workforce in today's rapidly changing industries. These institutions play a crucial role in bridging the gap between education and employment by equipping students with practical skills and knowledge that can be immediately applied in their chosen careers.

Modern Chinese universities originated in the West, and modern western universities evolved gradually from medieval European universities, British universities, German universities to American universities. Universities in any era are the creative inheritance of previous universities rather than negation. Universities are social organizations based on ideals, values and traditions. Although the stage of university activities is in the present, when they prepare to create the future, the source of their power comes from the past."(Richard and Wang et al., 2021) "At present, the accelerated reform of the global governance system constitutes the social background of the profound reform of higher education, and the in-depth development of information technology constitutes the technical background of the comprehensive reform of higher education. If Chinese universities want to become the center of higher education in the world, they must identify and stick to their own development path.(Wang, 2023)

As the main front of cultural education, the university and the national culture in the same direction, shoulder the new era of national culture creative transformation and reconstruction mission. Universities should be built on the basis of excellent traditional culture, in the process of inheriting and carrying forward the excellent traditional culture of China, do a good job as the guardian of modern social culture, devote themselves to opening up the road of development with characteristics, reflect Chinese culture, Chinese characteristics, Chinese style and Chinese style, and contribute Chinese wisdom to the world (Galina and Hong et al., 2022). Quality assurance systems for higher education have emphasized the quality of undergraduate education in recent years. The assessment of undergraduate education quality involves a comprehensive examination of the students(Lin and Geng, 2019). Undergraduate education spans a long duration, requires the most resources, and has a direct relationship with the quality of all types of master’s and doctoral programs (Ministry of Education of the People’s Republic

of China, 2021b). In China, several assessment initiatives have been launched by the Teaching and Learning Evaluation Center of the Ministry of Education since 2013, such as the report on the quality of undergraduate teaching in colleges and universities (Higher Education Evaluation Center of the Ministry of Education, 2020).It is considered to improve the quality of China's engineering talent cultivation (Zhao and Xudong et al., 2020). Therefore, it is evident that undergraduate education presently places great emphasis on evaluating university majors and undergraduate education (Zhang & Guo, 2009).Professional evaluation has become independent from educational evaluation and has played an important part in the assessment of higher education institutions in recent years, while educational evaluation has covered higher education(Wang, 2016).

At this stage, because the teaching evaluation indicators of colleges and universities in China are too unified and there is no difference in treatment, classified evaluation can better play the guiding role of evaluation, guide colleges and universities at different levels and different disciplines to develop their own characteristics and guide the peaceful mentality of all kinds of schools. The acceptance of evaluation is of great significance and should be used as an important reference for the formulation of a new round of evaluation indicators. The integrity of the evaluation system is more conducive to improving the level of teaching work (Li and Hu, 2022).

2.5.2 Domestic Research Progress; researchers like Lingling Ma et al. have utilized the CIPP model, taking investigation-based activities in primary and secondary schools as an example, to construct an evaluation index system for activity-based courses. This system comprises four primary indicators, eleven secondary indicators, and forty-two tertiary indicators, encompassing 'Curriculum Development,' 'Curriculum Design,' 'Curriculum Implementation,' and 'Curriculum Effectiveness.' It offers valuable insights for the effective assessment of comprehensive practical activity courses in primary and secondary schools (Lingling, 2020).

Kuang et al. adopted the CIPP model to establish a systematic analytical framework of 'Background - Input - Process - Outcome' and used the Delphi method and Analytic Hierarchy Process. Following principles of scientific rigor, completeness, and comprehensiveness, they developed an effective evaluation system for practical teaching

in applied undergraduate institutions, promoting the successful implementation of practical teaching assessments (Liang, 2019).

Yan Zhang, based on the CIPP model, constructed an education quality evaluation index system suitable for applied undergraduate institutions. The aim was to provide guidance for the transformation and development of local colleges and universities (Yan, 2018).

Zhili Hu, using the CIPP evaluation model as the theoretical basis, focused on talent cultivation goals in local applied undergraduate colleges. They constructed a talent cultivation quality evaluation index system with four primary indicators and corresponding secondary indicators in dimensions of Background Evaluation, Input Evaluation, Process Evaluation, and Outcome Evaluation, including the determination of indicator weights (Zhili, 2022).

Xiangyun Xu et al. followed the theoretical framework of the CIPP evaluation model and policies such as the 'Higher Education Curriculum Ideological and Political Construction Guidelines' from the Ministry of Education. They conducted qualitative interviews and, based on initial evaluation indicators for ideological and political education activities, collected research samples using measurement tools (scales). This process led to the formation of a stable four-dimensional structure comprising 'Context Evaluation,' 'Input Evaluation,' 'Process Evaluation,' and 'Product Evaluation.' Through project analysis, factor analysis, and reliability testing, they extracted eleven secondary indicators (common factors), including political environment, curriculum resources, teaching plans, and teaching effectiveness. Additionally, they allocated weights to various indicators using factor analysis-generated factor scores, thereby completing the construction of the index system (Xu and Wang, 2022) .

2.5.3 Foreign Research Developments

Abroad, extensive research has also been conducted in the field of course evaluation based on the CIPP model. Hakan Tuna and his colleagues aimed to assess the effectiveness of undergraduate programs in tourism education using the CIPP model(Tuna and Ba C S Dal, 2021). In this context, they examined undergraduate programs by considering the interrelated components of the CIPP model, which include

context, input, process, and product elements. They employed a quantitative research method and conducted a survey with students from four universities in Turkey. The results, based on students' opinions, revealed both strengths and weaknesses in the curricula of tourism undergraduate programs concerning the fundamental components of the CIPP model. AbdiShahshahani et al. conducted a similar evaluation, aiming to assess the reproductive health PhD program based on the CIPP model in the domains of context, input, process, and product in five nursing and midwifery schools in Iran where the program has been established(AbdiShahshahani and Ehsanpour et al., 2015). Additional studies on this topic include those by Aziz et al., 2018(Aziz and Mahmood et al., 2018); Karataş and Fer, 2009(Karatas and Fer, 2009); Limouei & Hoseinzadeh, 2016(Limouei and Hoseinzadeh, 2016).

2.5.4 Review of Current Research Status on Domestic and International Levels

There is a wide range of scholarly investigation, according to a thorough study of the development state and research findings surrounding the teaching systems in engineering programs at applied undergraduate institutions, both domestically and abroad. Some academics take a broad view of this subject, highlighting the importance of education systems and their role in talent development. Others explore into many facets of the educational system, such as its objectives, curriculum, administration, and support, throughout numerous fields. Additionally, there are researchers who perform studies on either the entire teaching system or components with a focus on diverse stakeholders including teachers, students, and educational administrators.

Even though China has achieved great advancements in this field by studying and learning from the experiences of industrialized Western countries, domestic research on this topic is still in its infancy and lags behind foreign research in two key areas. First, there is a dearth of thorough and organized research on the teaching methods used in applied undergraduate engineering programs in China. There is still a lack of thorough and organized research, even though certain scholars have investigated particular components of these instructional approaches. Second, not enough in-depth study has been done on the subject matter of the teaching methods used in engineering programs at applied undergraduate universities. Although some academics have held speculative

debates about certain problems in these systems, there aren't many exhaustive and empirical studies available.

Future initiatives characterized by increasing systematization and diversification are required to address the current research gaps in the teaching systems for engineering programs at applied undergraduate schools. Problems with talent development in higher education can only be fundamentally solved by continuously improving practical teaching methods. By making such efforts, we will be able to produce more exceptional advanced applied talents, contribute more effectively to local economic development, and better meet social progress' more general objectives.

2.6 Focus Group

2.6.1 Concept

A focus group is a research method that brings together a small group of people to answer questions in a moderated setting. The group is chosen due to predefined demographic traits, and the questions are designed to shed light on a topic of interest (Morgan, 1996).

Focus groups are a type of qualitative research. Observations of the group’s dynamic, their answers to focus group questions, and even their body language can guide future research on consumer decisions, products and services, or controversial topics (Morgan and Krueger et al., 1998).

Focus groups are often used in marketing, library science, social science, and user research disciplines. They can provide more nuanced and natural feedback than individual interviews and are easier to organize than experiments or large-scale surveys (Stewart and Shamdasani, 2014)

A focus group is a group interview involving a small number of demographically similar people or participants who have other common traits/experiences. Their reactions to specific researcher/evaluator-posed questions are studied. Focus groups are used in market research to understand better people's reactions to products or services or participants' perceptions of shared experiences. The discussions can be guided or open. In market research, focus groups can explore a group's response

to a new product or service. As a program evaluation tool, they can elicit lessons learned and recommendations for performance improvement. The idea is for the researcher to understand participants' reactions. If group members are representative of a larger population, those reactions may be expected to reflect the views of that larger population (Jump, 2018; Jung, 2018).Thus, focus groups constitute a research or evaluation method that researchers organize to collect qualitative data through interactive and directed discussions (Jung, 2018).

A focus group is also used by sociologists, psychologists, and researchers in communication studies, education, political science, and public health (Davidov and Schmidt et al., 2018).Marketers can use the information collected from focus groups to obtain insights on a specific product, controversy, or topic(Davidov and Schmidt et al., 2018).Used in qualitative research, the interviews involve a group of people who are asked about their perceptions, attitudes, opinions, beliefs, and views regarding many different topics (e.g., abortion, political candidates or issues, a shared event, needs assessment). Group members are often free to talk and interact with each other. Instead of a researcher/evaluator asking group members questions individually, focus groups use group interaction to explore and clarify participants' beliefs, opinions, and views. The interactivity of focus groups allows researchers to obtain qualitative data from multiple participants, often making focus groups a relatively expedient, convenient, and efficacious research method (Davidov and Schmidt et al., 2018).

While the focus group is taking place, the facilitator either takes notes and/or records the discussion for later note-taking in order to learn from the group. Researchers/evaluators should select members of the focus group carefully in order to obtain useful information. Focus groups may also include an observer who pays attention to dynamics not expressed in words e.g., body language, people who appear to have something to add but do not speak up.

2.6.2 Steps and Process

Focus group methodology is a qualitative research technique used to gather insights and opinions from a diverse group of participants about a specific topic or issue. It involves a structured and moderated discussion among participants to explore their

perspectives, attitudes, and experiences. Here are the detailed steps involved in conducting a focus group:

A:Define the Research Objective: Clearly define the research question or objective you want to address through the focus group. What specific information or insights are you seeking to gather?

B:Participant Selection: Identify and recruit participants who represent the target demographic or group relevant to your research question. Typically, focus groups consist of 6-12 participants, but group size can vary based on your research goals.

C:Moderator Selection: Choose a skilled moderator or facilitator who is experienced in conducting focus groups. The moderator should be able to guide the discussion effectively, remain neutral, and encourage participation.

D:Develop Discussion Guide: Create a structured discussion guide that outlines the key questions, topics, or themes you want to explore during the focus group. The guide serves as a roadmap for the discussion.

E:Choose a Suitable Location: Select a comfortable and neutral venue for the focus group session. Ensure it has proper audio and video recording equipment if needed.

F:Obtain Informed Consent: Before starting the focus group, obtain informed consent from participants. Explain the purpose of the session, assure confidentiality, and let them know their participation is voluntary.

G:Conduct the Focus Group: The focus group session typically follows these stages. Introduction: The moderator introduces themselves, explains the purpose of the group, and sets ground rules. Icebreaker**: Use an icebreaker activity or question to help participants feel more comfortable and encourage participation. Discussion: Follow the discussion guide, asking open-ended questions to elicit responses from participants. Encourage group interaction and exchange of ideas. Probing: The moderator may probe deeper into specific responses or ask follow-up questions to explore nuances. Wrap-Up: Summarize key points and ask participants if they have any additional insights to share.

H:Record and Transcribe: Record the focus group session with participants' consent. Later, transcribe the audio or video recordings to have a written record of the discussion.

I:Data Analysis: Analyze the transcribed data to identify recurring themes, patterns, and insights. Coding and thematic analysis are common techniques used in this phase.

J:Report Findings: Compile the findings into a report that summarizes the key insights, quotes, and themes from the focus group. Use these findings to answer your research question or address your research objective.

K:Dissemination:Share the results of the focus group with stakeholders, colleagues, or the broader audience, depending on the purpose of your research.

L:Consider Follow-Up Research: If needed, consider conducting additional focus groups or follow-up studies to delve deeper into specific aspects or to validate your findings.

M:Ethical Considerations: Throughout the entire process, adhere to ethical guidelines for research involving human participants, including maintaining confidentiality and obtaining informed consent.

Focus group methodology is a valuable tool for gathering qualitative data, providing rich insights, and understanding the perspectives of diverse groups on various topics or issues. Proper planning, execution, and analysis are crucial to ensure the success of a focus group research project(Guerrero and Xicola, 2018).

2.7 Analytic Hierarchy Process

2.7.1 Theory; in the theory of decision making, the analytic hierarchy process (AHP), also analytical hierarchy process(Forman and Gass, 2001), is a structured technique for organizing and analyzing complex decisions, based on mathematics and psychology. It was developed by Thomas L. Saaty in the 1970s (Saaty, 1988); Saaty partnered with Ernest Forman to develop Expert Choice software in 1983, and AHP has been extensively studied and refined since then. It is a precise method for calculating the relative importance of the various decision-making factors. Through pair-wise comparisons, the experiences of individual experts are used to assess the relative magnitudes of components. Using a specially created questionnaire, each respondent compares the relative value of each pair of elements.

2.7.2 Uses and applications; AHP is targeted at group decision making(Saaty and Peniwati, 2013) ,and is used for decision situations, in fields such as government, business, industry,(Saracoglu, 2013) healthcare and education. Instead than outlining a "correct" course of action, the AHP assists decision-makers in identifying the course of action that best satisfies their objectives and their comprehension of the issue. It offers a thorough and logical framework for constructing a decision problem, expressing and measuring its components, connecting those components to overarching objectives, and assessing potential solutions.

The AHP requires users to break down their choice problem into a hierarchy of simpler subproblems that may each be independently assessed. The hierarchy's components can be applied to any part of the decision problem, whether it be tangible or intangible, precisely measured or merely guessed, well or poorly understood, or anything else that relates to the current decision.

Once the hierarchy is built, the decision makers evaluate its various elements by comparing them to each other two at a time, with respect to their impact on an element above them in the hierarchy. In making the comparisons, the decision makers can use concrete data about the elements, and they can also use their judgments about the elements' relative meaning and importance. Human judgments, and not just the underlying information, can be used in performing the evaluations.(Saaty, 2008)

These evaluations are transformed by the AHP into numerical values that may be analyzed and compared throughout the whole issue space. Each element of the hierarchy is given a numerical weight or priority, which enables varied and frequently incommensurable items to be compared to one another un a logical and consistent manner. The AHP stands out from other decision-making processes thanks to its feature. For each of the decision alternatives, numerical priority are determined in the process's last step. These statistics indicate how effectively each choice will achieve the chosen course of action, allowing for an easy comparison of the numerous options.While it can be used by individuals working on straightforward decisions, the Analytic Hierarchy Process (AHP) is most useful where teams of people are working on complex problems, especially those with high stakes, involving human perceptions and judgments, whose

resolutions have long-term repercussions (Bhushan and Rai, 2004). Decision situations to which the AHP can be applied include:

Choice – The selection of one alternative from a given set of alternatives, usually where there are multiple decision criteria involved.

Ranking – Putting a set of alternatives in order from most to least desirable.

Prioritization – Determining the relative merit of members of a set of alternatives, as opposed to selecting a single one or merely ranking them

Resource allocation – Apportioning resources among a set of alternatives

Benchmarking – Comparing the processes in one's own organization with those of other best-of-breed organizations.

Quality management – Dealing with the multidimensional aspects of quality and quality improvement.

Conflict resolution – Settling disputes between parties with apparently incompatible goals or positions(Saaty and Peniwati, 2013)

The applications of AHP include planning, resource allocation, priority setting, and selection among alternatives(Bhushan and Rai, 2004).

Other areas have included forecasting, total quality management, business process reengineering, quality function deployment, and the balanced scorecard. Other uses of AHP are discussed in the literature:

Deciding how best to reduce the impact of global climate change (Fondazione Eni Enrico Mattei)(Berrittella and Certa et al., 2007)

Quantifying the overall quality of software systems (Microsoft Corporation)(Maleti V C and Maleti V C et al., 2014)

Selecting university faculty (Bloomsburg University of Pennsylvania)(Grandzol, 2005)

Deciding where to locate offshore manufacturing plants (University of Cambridge)(Atthirawong and MacCarthy, 2002)

Assessing risk in operating cross-country petroleum pipelines (American Society of Civil Engineers)(Dey, 2003)

Deciding how best to manage U.S. watersheds (U.S. Department of Agriculture)(De Steiguer and Duberstein et al., 2003)

More Effectively Define and Evaluate SAP Implementation Approaches (SAP Experts)

Integrated evaluation of a community's sustanaibility in terms of environment, economy, society, institution, and culture(Wu and Duan et al., 2017).

Accelerated Bridge Construction Decision Making Tool to assist in determining the viability of accelerated bridge construction (ABC) over traditional construction methods and in selecting appropriate construction and contracting strategies on a case-by-case basis.(Salem and Salman et al., 2018)

AHP is sometimes used in designing highly specific procedures for particular situations, such as the rating of buildings by historical significance(Lippiatt and Weber, 1995).It was recently applied to a project that uses video footage to assess the condition of highways in Virginia. Highway engineers first used it to determine the optimum scope of the project, and then to justify its budget to lawmakers.(Larson and Forman, 2007)

The weights of the AHP judgement matrix may be corrected with the ones calculated through the Entropy Method. This variant of the AHP method is called AHP-EM.(Duan and Mu et al., 2016; Wu and Duan et al., 2017)

2.7.3 Model the problem as a hierarchy

The first step in the analytic hierarchy process is to model the problem as a hierarchy. In doing this, participants explore the aspects of the problem at levels from general to detailed, then express it in the multileveled way that the AHP requires. As they work to build the hierarchy, they increase their understanding of the problem, of its context, and of each other's thoughts and feelings about both(Saaty, 2001)

2.7.3.1 Hierarchies defined

A hierarchy is a stratified system of ranking and organizing people, things, ideas, etc., where each element of the system, except for the top one, is subordinate to one or more other elements. Though the concept of hierarchy is easily grasped intuitively, it can also be described mathematically.(Saaty, 2010) Diagrams of hierarchies are often shaped roughly like pyramids, but other than having a single element at the top, there is nothing necessarily pyramid-shaped about a hierarchy.

Human organizations are frequently hierarchically organized, with the hierarchical system being utilized to delegate tasks, exercise leadership, and improve

communication. Typical hierarchies of "things" place the tower unit of a desktop computer at the "top," with the display, keyboard, and mouse "below."

In the world of ideas, hierarchies are used to help us learn in-depth information about complex reality. We arrange reality into its component components, and these in turn into their own component parts, progressing as far down the hierarchy as we choose. At each level, we concentrate on comprehending just one part of the whole while momentarily ignoring the other parts at this and all other levels. Through this process, we broaden our comprehension of the complex reality we are researching.

Consider the hierarchical approach that medical students take when studying anatomy: they first look at the musculoskeletal system, which includes parts and subparts like the hand and its individual muscles and bones, before moving on to the circulatory system, which has a wide range of levels and branches, the nervous system, which has a wide range of parts and subsystems, etc., until they have covered all the systems and the significant divisions of each. The subdivision is carried on by advanced students all the way down to the level of the cell or molecule. The "big picture" and a good deal of its specifics are finally understood by the students. Additionally, they are aware of how the various components relate to one another. They have developed a thorough understanding of anatomy by working hierarchically. Similarly, when we approach a complex decision problem, we can use a hierarchy to integrate large amounts of information into our understanding of the situation. As we build this information structure, we form a better and better picture of the problem (Saaty, 2001)

2.7.3.2 Hierarchies in the AHP; An organized way to model the current decision is using an AHP hierarchy. A group of alternatives or possibilities for achieving the goal are included, as well as a number of elements or criteria that relate the alternatives to the overall goal. The number of levels at which the criteria can be further subdivided into subcriteria, sub-subcriteria, and so on depends on the complexity of the situation. If a criterion has graded distinctions, it may not apply consistently. For example, a little sweetness is pleasant, but too much sweetness might be detrimental. In that situation, the criterion is separated into subcriteria that represent various intensities of the criterion, such as: small, medium, and high, and these intensities are prioritized through comparisons under the parent criterion, sweetness. Published descriptions of

AHP applications often include diagrams and descriptions of their hierarchies; some simple ones are shown throughout this article. More complex AHP hierarchies have been collected and reprinted in at least one book(Saaty and Forman, 1992).More complex hierarchies can be found on a special talk page for this article. The design of any AHP hierarchy will depend not only on the nature of the problem at hand, but also on the knowledge, judgments, values, opinions, needs, wants, etc. of the participants in the decision-making process. Constructing a hierarchy typically involves significant discussion, research, and discovery by those involved. Even after its initial construction, it can be changed to accommodate newly-thought-of criteria or criteria not originally considered to be important; alternatives can also be added, deleted, or changed (Saaty, 2001). Consider a decision problem with a goal to be achieved, three potential paths to achieve the goal, and four standards by which the alternatives must be evaluated in order to better comprehend AHP hierarchies. A graphic similar to the one below can be used to represent this hierarchy, with the aim at the top, the three choices at the bottom, and the four criteria in the middle. The components of such diagrams can be described using the following terms: A node is the term for each box. A parent node is a node that has connections to one or more nodes that are lower in the hierarchy. The nodes that it is thusly connected to are referred to as its children. When these concepts are applied to the diagram below, it becomes clear that the goal is the parent of the four criteria and that the four criteria are the goal's offspring. Each of the three Alternatives has a parent criterion. Even though there are only three Alternatives, each one appears under each of its parents in the figure. It is typical to portray AHP hierarchies as shown in the picture below, with a single node for each alternative and numerous lines linking the alternatives and the applicable criteria, in order to minimize the size of the drawing needed. These lines may occasionally be removed or condensed in order to decrease clutter. Despite any such simplifications in the diagram, each criterion is connected to each possibility separately in the hierarchy. You can imagine the lines pointing downward from the parent at one level to its children at a lower level. AHP hierarchy is used to select leaders. There is one objective, three candidates, and four selection criteria.

2.7.3.3 Evaluate the hierarchy; The participants examine the hierarchy once it has been created using a series of pairwise comparisons that result in numerical

scales of measurement for the nodes. The purpose and the criteria are compared pairwise for importance. Each preference criterion is used to compare the alternatives pairwise. Priorities are established for each node based on the comparisons after they have been handled mathematically. Think about the previous "Choose a Leader" illustration. Determining the importance of being accorded to each element in the selection of a leader is a crucial responsibility for the decision-makers. Choosing how much weight to give each contender in relation to each of the criteria is another crucial challenge. They are also able to provide each of the four criteria a meaningful and objective numerical value thanks to the AHP. Unlike most surveys which adopt the five point Likert scale, AHP's questionnaire is 9 to 1 to 9.(Li and Chau et al., 2019)

2.8 The teaching evaluation index of engineering specialty in China

2.8.1 Research on Accreditation Organizations in American Engineering Education. The Accreditation Board for Engineering and Technology (ABET), originally known as ECPD, is currently the main accreditation body for engineering education in the United States. A professional association with autonomy, a focus on the commercial sector, and non-governmental status is ABET. There are two main categories in the ABET research literature: *First,* the ABET organization's internal research literature, which consists of: (1) Annual reports that are published. (2) Special Reports created by specialized committees that concentrate on important advancements or certain organizational themes. (3) Since 1934, the President's Reports have been released yearly. *Second,* scholarly works published by researchers from the organization as well as from outside it, in journals and conferences like the Frontiers in Education Conference, ASEE Annual Conference, Journal of Professional Issues in Engineering Education and Practice, International Journal of Engineering Education, and Journal of Engineering Education. According to a survey of the literature, academics have mostly concentrated on ABET accreditation standards and procedures in domestic research.

2.8.1.1 Research on ABET Accreditation Standards and Procedures

Wankat P. C., in his 2004 article 'A Decade of Analysis of the Journal of Engineering Education,' pointed out that while the most common keywords remained

computer, teaching, and design, there was a noticeable increase in research related to 'assessment' and 'ABET' from 1998 to 2002. This indicated a growing interest in the study of EC2000, the accreditation criteria introduced by ABET during that period (Wankat, 2004). In the 1980s, influenced by the rapid development of information technology, profound changes occurred in the U.S. economy, society, and labor market. ABET accreditation standards became increasingly standardized but hindered innovation in the field to adapt to evolving practical demands. As Froyd J. E. pointed out in "Five Major Shifts in 100 Years of Engineering Education," questions arose about whether accreditation was obstructing curriculum innovation and whether engineering graduates were adequately prepared for practice. Despite ABET's longstanding excellence and recognition in both industry and academia, during this period, the organization faced a severe organizational crisis (Froyd and Wankat et al., 2012). In response, in 1997, ABET officially introduced the renowned "Engineering Criteria 2000" (EC2000). According to Prados J. W., this marked a fundamental change in ABET's accreditation philosophy, standards, and processes. It shifted the focus from a compliance mindset to actively encouraging continuous improvement in education quality. The new accreditation standards emphasized what graduates could do rather than how much time they spent in classrooms. Additionally, it underscored the importance of selecting, training, and evaluating professional assessors effectively(Prados, 2004). To assess the effectiveness of EC2000 implementation, the Pennsylvania State University's Center for the Study of Higher Education conducted research from 2004 to 2006, resulting in two reports: "Sustaining Change: A Follow-Up Report on the Perspectives of Change" and "Change in Engineering: A Study of the Impact of EC2000 (Executive Summary)." These reports indicated that, overall, 2004 graduates performed better in nine assessment areas compared to a decade prior. ABET became a major force in promoting a shift in faculty culture and the use of assessment methods to enhance curricula (Volkwein and Lattuca et al., 2004; Lattuca, 2006). In China, scholars like Bi Jiaju introduced EC2000, emphasizing its key features, including a focus on output quality in professional education, advocacy for innovation and reform in engineering education, and requirements for schools to ensure that professional education meets public demands. It also mandated that schools establish their own quality assessment systems and outlined

11 requirements for graduates' practical abilities(Prados and Peterson et al., 2005) . Subsequent scholars elaborated on the specifics of EC2000. It consists of three parts: general criteria for bachelor's level, general criteria for master's level, and program-specific criteria. Wang Chuan-yi and Yi Cheng compared ABET's general criteria for bachelor's and master's levels in an international journal article (Wang and Cao, 2019) .

The research on bachelor's level criteria is more extensive. It includes eight criteria related to students, program educational objectives, student outcomes, continuous improvement, curriculum, faculty, facilities, institutional support, and 11 student outcome requirements are specifically introduced and analyzed by scholars. Regarding the ABET accreditation process, domestic scholars have provided various overviews. For instance, Qiao Weifeng compiled a special report on ABET's engineering program accreditation, outlining the basic procedures, including application submission, assessment preparation, self-assessment, on-site evaluation, and follow-up activities(Milligan and Collated et al., 2015).

2.8.1.2 Research on the Application of ABET Accreditation; With the implementation and promotion of EC2000, many scholars have reported their involvement in accreditation. On the other hand, several scholars have also introduced effective practices in curriculum development based on ABET principles and requirements. For instance, Shuman L. J. and others provided examples of how to cultivate skills such as communication and teamwork as required by EC2000 and conducted research on their assessment methods (Shuman and Besterfield-Sacre et al., 2005). EC2000 intentionally does not explicitly define 11 student learning outcomes, and Besterfield-Sacre M. and others developed a framework based on Bloom's taxonomy for assessment, but they also recognized that these definitions are dynamic and need continuous modification and updates (Besterfield-Sacre and Shuman et al., 2000).Al-Bahi A. and others proposed an assessment quantity-based approach to assess and continuously improve abilities required by ABET standards, such as teamwork, oral and written communication, and lifelong learning (Al-Bahi and Taha et al., 2013).

As engineering education program accreditation becomes an international trend, ABET's global influence continues to grow, leading other countries to seek ABET accreditation and sparking related research. At the 6th International Forum

on Engineering Education (IFEE 2012), Jibril Baba from the College of Engineering at Sudan's University of Khartoum shared their experience in developing necessary steps for continuous program improvement based on an introduction to ABET accreditation standards and procedures (Jibril and Houache, 2013).As the application of ABET accreditation deepens, scholars from various countries have shifted from simple introductions to innovative approaches that integrate their own national practices. For example, in Saudi Arabia, Al-Yahya Sulaiman A. and others published a paper in 2013 introducing the process of ABET accreditation for the electrical engineering program at Qassim University, serving as a reference for other schools seeking accreditation (Al-Yahya and Abdel-Halim, 2012). In 2019, Shafi Aamir and colleagues described how the computer science and computer information systems programs quantified ABET's requirements for student learning outcomes through a series of direct and indirect assessment methods (summative data analysis, formative data analysis, capstone exams, faculty surveys, and alumni surveys) (Shafi and Saeed et al., 2019).

2.8.2 Research on the Chinese Engineering Education Professional Accreditation Organization; Currently, there is no national standard for the evaluation system of engineering education in China. However, on June 2, 2016, China officially became a member of the Washington Accord, an international agreement for the mutual recognition of undergraduate engineering degrees. China subsequently initiated the process of engineering education accreditation. Engineering education accreditation refers to the process of conducting accreditation of engineering disciplines under the leadership of the Chinese Engineering Education Accreditation Association (referred to as the Accreditation Association)(Maoguo and Zhiying et al., 2005; Xiaoyan and Yantong, 2005). The Accreditation Association is a nationwide, nonprofit, membership-based organization formed voluntarily by enthusiastic Chinese organizations and individuals dedicated to engineering education(Bi, 2009).

The objectives of conducting engineering education accreditation are as follows:1. Establish a quality monitoring system for engineering education in China to promote reforms in Chinese engineering education and further enhance its quality.2. Establish an engineering education accreditation system that aligns with the engineering professional practice, fostering stronger connections between engineering education and

the industry. This will enhance the adaptability of engineering education in nurturing talent for industrial development.3. Facilitate international recognition of Chinese engineering education to enhance its global competitiveness (Sunyu and Ziqiang et al., 2014).

The basic procedure for engineering education accreditation consists of six stages:1. Application and Acceptance2. Self-assessment by the institution and submission of a self-assessment report3. Review of the self-assessment report4. On-site inspection5. Deliberation and issuance of accreditation conclusions6. Maintenance of accreditation status (Na, 2016). The establishment of specialized accreditation organizations for engineering education in China occurred relatively late, and there has been limited research in this area. The research has primarily focused on two aspects:

2.8.2.1 Early Research on the Construction of Accreditation Organizations for Engineering Education in China. Many scholars have proposed the need for China to establish its own accreditation organization for engineering education to align with the country's unique circumstances. For example, in 2005, Li Maoguo, the former Director of the Department of Higher Education of the Ministry of Education, suggested the creation of the "Higher Education Engineering Education Accreditation Committee" under the leadership of the Ministry of Education, in collaboration with relevant industry departments and associations. This proposal aimed to accelerate the establishment of an accreditation and evaluation system for engineering education (Maoguo and Zhiying et al., 2005). Unlike third-party or private accreditation systems in foreign countries, Chinese scholars considered the national context, suggesting that government departments should initially create authoritative accreditation bodies in collaboration with existing accreditation institutions and various stakeholders. These bodies would gradually transition to semi-official organizations, subject to government oversight and social supervision, while independently conducting assessments within their legal jurisdiction and representing China's engineering community in international exchanges and cooperation (Xiaoyan and Yantong, 2005).

2.8.2.2 Reflective Research on the Practical Work of Accreditation Organizations for Engineering Education in China. As China's accreditation organizations for engineering education were established and their work

progressed, some scholars conducted reflective research. Bijiaju analyzed the organizational structure of China's pilot work in engineering education accreditation and argued that, after several years of experimentation, China's engineering education accreditation had gradually embarked on a path of healthy development. However, to gain international recognition, build credibility, and seek membership in the Washington Accord, China's accreditation organizations needed to possess characteristics such as professionalism, authority, non-governmental status, and independence (Bi, 2009).. With China's formal membership in the Washington Accord, higher expectations were placed on the country's accreditation organizations. Wang Sunyu and others reflected on a decade of constructing an internationally equivalent accreditation system in China. They suggested the need to clarify the responsibilities of all parties involved, streamline the coordination mechanisms among external stakeholders, accelerate the development of detailed operational procedures, and establish comprehensive internal operational mechanisms within the associations. Additionally, they emphasized the importance of training and oversight to enhance the capabilities of accreditation institutions in various professional fields (Sunyu and Ziqiang et al., 2014). As accreditation organizations and mechanisms in engineering education in China matured, Sun Na suggested that these institutions should gradually transition towards more market-oriented operations (Na, 2016).

2.9 China Performance Excellence Education Criteria

2.9.1 Main Content of the "Education Criteria for Performance Excellence"(Le Yi, 2004)

It is divided into four main sections: The first section elucidates the core values and concepts of the "Criteria," its framework, key characteristics, integration of key educational themes, and major revision explanations. These contents form the theoretical foundation upon which the assessment standards and indicator system of the "Criteria" are based. They reflect contemporary quality management theory and organizational behavior thinking, embody advanced performance management concepts and systemic ideas. Therefore, whether for research or application of this award, one must first grasp

the fundamental concepts expressed in this section to understand the significance of the assessment standards in a holistic and fundamental way.

The second section provides a detailed description of the specific content of the seven major categories of standards and the breakdown of indicators at each level. The "Criteria" is divided into seven categories, and indicators are hierarchically divided into classifications, items, areas, and subparts. The third section discusses the scoring system and specific scoring guidelines of the "Criteria." The fourth section mainly covers specific matters related to applying for evaluation, including the application process, procedures, considerations, document requirements, preparation of application qualification materials, fees, etc. Applying organizations can learn about these aspects through various channels and may also hire experts in this field to serve as consultants.

2.9.2 Education Criteria for Performance Excellence" and School Self-Assessment Methods. School self-assessment is the foundation of external school evaluation and a manifestation of a school's autonomy. Using school self-assessment to identify shortcomings in self-reflection and promote continuous improvement in school development and quality is one of the quality assurance mechanisms and means adopted by countries around the world (Ming, 2016). The choice of assessment methods often depends on different evaluation schemes, content, types, and evaluators. The same applies to school self-assessment, which can be conducted using methods such as "grading assessment, textual assessment, primary issue assessment," and so on. These methods can be chosen for teacher evaluations, principal evaluations, and other aspects, serving as a way to assess individual work performance.

CHAPTER 3
METHODOLOGY

The research of objectives of the study are as follows (1) to synthesize teaching evaluation system on engineering for applied university in China; (2) to identify and develop a teaching evaluation system on engineering for applied university in China. This study describes the research methodology used in the Focus Group technique to collect data. The research used quantitative, qualitative, and analytic hierarchy process methods. The research instruments for data collection, the data collection procedures, and the statistical methods used for data analysis are explained as follows:

1.1 Theoretical Framework

1.2 Sampling Technique

1.3 Instrumentation

1.4 Procedure of the Data Collection

1.5 Data Processing and Analysis

1.6 Statistical analysis

3.1 Theoretical Framework

3.1.1 Developmental evaluation; a systematic evaluation model known as developmental evaluation assesses teachers and students in all areas. Through adaptable evaluation, teachers and students can accomplish their respective learning and teaching goals. The aims of both, however, are determined throughout the teaching process to support students' ongoing development, which reflects the idea of student-centered teaching assessment. Developmental evaluation now focuses on encouraging students' potential, reawakening their creativity, paying attention to each student's development, and promoting the long-term development of all students rather than assessing kids' good grades through tests of their accomplishments. While using a variety of evaluation techniques and tools across the entire instructional evaluation activities, developmental evaluation also places a strong emphasis on process assessment. Developmental evaluation aims at the all-round development of the appellant's quality, describes the development characteristics of the evaluator, identifies the development level and makes

necessary selection, etc. It pays more attention to individual differences and emphasizes the diversification of evaluation subjects (Liu, 2019).Through collaboration, communication, and consultation between the evaluation subjects and the evaluation objects, developmental evaluation establishes the development objectives and implementation strategies of the evaluation objects. After the development plans are finished, the evaluation contents are gathered, summarized, and summarized by the evaluation subjects and the evaluation subjects collectively. The value of the teaching activities is then assessed in accordance with the accomplishment of the development objectives of the evaluation objects. Finally, the evaluation subject and evaluation object re-formulate the development plan and execution steps for the following stage in light of the experience gained from the previous stage. The benefit of developmental evaluation is that because the evaluation object is a part of the entire assessment process, it can stimulate the evaluation object's subject consciousness and product polarity.

The developmental evaluation places more emphasis on the ability to carry out practical tasks and bases its conclusions on observations and records of the behavior of the evaluation object. With the aim of promoting the development of the evaluation object and significantly enhancing abilities, developmental evaluation is the evaluation of the evaluation object over time. The methodologies utilized are mostly formative evaluation and process evaluation.

The developmental evaluation confirms the accomplishments, diagnoses the issues, and identifies the new development starting point, the most recent development area, the development direction, and the development potential of the evaluation object by looking at the development of the evaluation object in the past. An educational activity to cultivate and enhance the ability of evaluation objects, developmental teaching evaluation is based on the building of the philosophical theory's central idea to point to the future. The developmental evaluation emphasizes the evaluation of the evaluation objects' creative thinking, communal consciousness, and practical ability; it also pays attention to differences between the evaluation objects and actual development needs; it supports a diverse concept of talent development; and it satisfies the social demand for skilled talents.

3.1.2 Stakeholder theory; There are many different theories on stakeholders, and Freeman stated that they include everybody who can, directly or indirectly, contribute to the achievement of organizational goals to some amount. On the other hand, Clarkson defines stakeholders as the people or businesses that put money into their businesses and incur certain risks.

Domestic scholars comprehensively believe that stakeholder theory refers to those individuals and groups who have made certain specific investments and taken certain risks in production activities, and their activities can influence or change the goals, or are affected by the process of realizing their goals. In the context of quality management, stakeholders are those who have a special interest in the quality of education provision and the standards of outcomes, and who participate in and benefit from the provision of education(Wang and Bao et al., 2023). Through stakeholder analysis and understanding of education quality, the vivid "subject image" behind the quality is highlighted. Through each stakeholder expressing their own interest demands, the value concepts and demands of important quality stakeholders are touched, and the appropriate value expression of education quality is formed (Yun, 2019).

Teaching evaluation is a systematic project that requires multi-party participation, and its participants can be called stakeholders. The stakeholders of the school are divided into internal and external, and the internal stakeholders mainly include school leaders, administrators, students and teachers. External stakeholders include the government, enterprises, institutions and society (Shuai, 2022). The government, school administrators, students, and teachers all have a significant influence on the quality of teaching evaluations, therefore they can also be referred to as direct stakeholders given the current state of education and teaching evaluation.

3.2 Sampling Technique

3.2.1 Phase I: To synthesize teaching evaluation system on engineering for applied university in China. The participants chosen for this study consisted of 9 experts who were all located in China. Each expert was chosen through the purposive sampling method. They all had a doctoral degree and had worked for over five years in least the position of Assistant Professor. Each participant was individually invited since Ludwig

(1997: 266) posits that the number of participants is less important than who the participants are. Inductive data analysis was used to interpret the data collected (Macmillan, 1971) as shown in Appendix A. Purposive sampling and maximum variation sampling strategy (Cobb and Steffe, 2011) are used to select participants.According to Creswell & Clark , the key issue or conundrum that researchers want to investigate can be thoroughly explored and understood using the purposive sampling methodology. Participants are chosen for the purposive sampling technique because they can actively inform the study's main phenomenon. According to Patton (2002), it is preferable to concentrate on a small group of well-chosen participants rather than gathering uniform data from a big and statistically significant sample. Because the researcher purposefully chose participants with sufficient and appropriate knowledge and expertise in teaching evaluation on engineering, this technique was therefore thought to be appropriate for this study. The participants chosen for this study consisted of 9 experts who were all located in China. Each expert was chosen through the purposive sampling method. All experts were qualified in evaluation, and they were from the same university. They all had worked for over five years, at least as Assistant Professors. The saturation criterion determines the number of interviewees in this study.

3.2.2 Phase II: To identify and develop teaching evaluation system on engineering for applied university in China. Sichuan University of Science & Engineering was selected as participant. The university is a national public university and a general full-time applied university. It included engineering, science, management, education, literature, history, art, law, economics and other nine disciplines. The university has 20 colleges, ten colleges of which are engineering colleges. Engineering is the main major of the university.

3.3 Instruments

3.3.1. Semi-structured interviews: Semi-structured interviews (Patton, 1990) were used for first round: brainstorming was related to the framework from developmental evaluation, stakeholder. There were four parts in the interviews, context evaluation, input evaluation, process evaluation and product evaluation. The characteristics of the semi-structured interviews focused on obtaining the opinions of

experts on each idea through questioning. The interview for creating the Question I conceptual framework had four parts. These were: context evaluation, input evaluation, process evaluation and product evaluation, and they are discussed below (also see appendix B).

3.3.1.1 there were questions about context evaluation; what do you think should be included in the context evaluation? For example, the positioning of the school, including the goal of running the school, the idea of running the school, the conditions of running the school; The development plan of the school, including the content of the plan, the implementation guarantee and the development effect; Training objectives, including personnel training objectives, curriculum standards; the construction of the ideological and political work system and the establishment of the "three full education" work pattern, including the full-time teachers and converted students of ideological and political courses, the proportion of the total number of full-time party and ideological and political staff and the number of teachers and students in the school, the special funds for ideological and political work and party work team construction per student, and the special funds for ideological and political work per student network.

3.3.1.2 there were questions about input evaluation; what do you think should be included in the input evaluation? For example: teacher conditions, including teacher structure, student-to-teacher ratio, vocational teaching; Teaching ability, including teachers' teaching ability, professional level, innovation ability, engineering experience, communication ability, career development ability, ability to carry out research on engineering practice problems, ability to participate in academic exchanges; Teaching conditions, including facilities and equipment, teaching management team, teaching management level, etc.

3.3.1.3 there were questions about process evaluation; what do you think should be included in the process evaluation? For example: Students' interest in learning,Students' learning habits,Students' learning methods,Students' consciousness of learning,Cooperation among students,Students' ability to apply knowledge and independently solve practical problems in production management and service,Students' international perspective,The participation of leading cadres and teachers in student work,The fit degree between teaching content and talent training objectives, the

integration of professional ideological and political education,The performance of teachers' ethics,the degree of teachers' teaching energy input,The implementation of the teaching plan,Systematic situation of teaching content,Control the level of teaching difficulty,Implementation of practical teaching,The rationality of the practical class proportion arrangement,The use of teaching methods,Scientific situation of curriculum arrangement, the effect of teacher's guidance to students,The establishment of quality assessment system,Teaching material quality,Teaching management situation, Etc.

3.1.1.4 there were questions about product evaluation; what do you think should be included in the product evaluation? For example: Mastery of theoretical knowledge,Practical operation ability,Construction cost thinking establishment situation,Cultivate students' ability of coordination and cooperation,Develop students' problem-solving ability,Training students' ability of independent innovation,Competition awards,The degree of improvement of teachers' professional competence,The degree of improvement of teachers' teaching ability, Construction of teachers' professional personality,The orderly operation of all aspects of the school's talent training,The continuous improvement and promotion of the school's talent training,Student satisfaction with learning and growth,Teachers' satisfaction with school education,Employer satisfaction,The achievement of the training objectives of each specialty of the school,The employment rate and structure of fresh graduates were stolen,Graduation rate of graduates, etc.

3.3.2. Questionnaire I: Questionnaire I was used for the second round: to evaluate the items of teaching evaluation system on engineering for applied universities in China built on the basis of CIPP model. In this study, content validity method was used to synthesize data from semi-structured interviews and construct questionnaire I. Questionnaire I consists of four parts: context evaluation, input evaluation, process evaluation and product evaluation. Through questionnaire I, 9 experts selected the indicators that they thought could most effectively evaluate the teaching evaluation system on engineering for applied university in China.

3.3.3. Questionnaire II: After questionnaire I had been returned, the responses were synthesized and developed through the results of the expert discussion (as shown in chapter 4 and box1-9) and then categorized into: similarities and differences. According to the discussion of experts to modify the items to form a questionnaire II.

3.3.4. Questionnaire III: After questionnaire II had been returned, the responses were identified, categorized and condensed into major themes and suggestions,the teaching evaluation system on engineering for applied university in China based on CIPP model has been basically established. The researcher constructs the judgment matrix according to the level of items, compare the judgment matrix in pairs and score according to the importance. Questionnaire III was used to analyzed the weight of each item by 9 experts . Questionnaire III is in chapter 4 and table and appendix E.

3.4 Procedure of the Data Collection

3.4.1 Literature data method

In the initial phase of this research, extensive efforts were devoted to gathering and organizing pertinent literature related to the teaching evaluation system within the context of applied universities in China. The primary focus was on engineering programs, a critical sector within higher education. This comprehensive literature review aimed to establish a solid foundation and gain a thorough understanding of the existing landscape of teaching quality evaluation within this specific academic domain. Through meticulous examination and synthesis of the available literature, the paper was able to offer a comprehensive review and summary of the prevailing practices and challenges faced by engineering education in applied universities in China.

Building upon the insights obtained from the extensive literature review, this paper laid the groundwork for its own research endeavors. By identifying gaps, trends, and areas requiring further exploration, it established the starting point and research direction for its unique contributions to the field. Additionally, the comprehensive review process facilitated the accumulation of essential theoretical knowledge, providing a robust theoretical underpinning for the subsequent sections of the paper. The research then transitioned into a more focused investigation of the current teaching evaluation

system in engineering education within China. This phase of the study aimed to lay the groundwork for the development of a preliminary set of evaluation indices within the teaching evaluation system, ultimately contributing to the enhancement of teaching quality in applied universities.

3.4.2 Focus group

Invited 9 experts to discuss and evaluate the evaluation system index and put forward suggestions for modification. According to the modification suggestions, researchers will delete useless indexes, optimize improperly expressed indexes, and add missing indexes in the teaching evaluation system. The revised teaching evaluation system will again invite experts to score and evaluate and put forward suggestions for modification. The final teaching evaluation system on engineering for applied university in China will be obtained after modification according to the opinions of the second round. Hierarchical structure model of the teaching evaluation system on engineering for applied university in China based on the CIPP model will be build.

3.4.3 Analytic hierarchy Process

In order to establish a robust teaching evaluation system tailored to the context of applied universities in China, a structured approach known as the Analytic Hierarchy Process (AHP) is employed (Siekelova and Podhorska et al., 2021). This method involves a systematic process to assign appropriate weights to various components of the teaching evaluation system. The first step in this process is the creation of a hierarchical model that represents the different indexes within the teaching evaluation system. Each index is carefully structured to fit within the broader framework (Stofkova and Krejnus et al., 2022).

Next, a pairwise comparison judgment matrix is constructed for these indexes. This matrix allows experts in the field to provide valuable input by comparing and scoring the relative importance of each index(Hong and Chee Keong et al., 2022). These experts bring their knowledge and experience to the table, contributing to the refinement of the evaluation system. Once the comparisons are completed, the researcher processes the scoring data through normalization and conducts a consistency test to ensure the reliability of the weights assigned (Sudaryono and Rahardja et al., 2020).

Upon successfully passing the consistency test, the final weights for all levels of the teaching evaluation system index are determined. These weights reflect the collective judgment of experts and provide a balanced and well-informed foundation for assessing and improving the quality of education in applied engineering programs at Chinese universities. This meticulous and data-driven approach enhances the objectivity and effectiveness of the teaching evaluation system, ultimately benefiting both students and educational institutions (Bernasconi and Choirat et al., 2010).

3.4.4 Case analysis; the CIPP model based teaching evaluation system on engineering for applied university in China was applied to Sichuan University of Technical & Engineering . Through observing, recording, analyzing, summarizing and reflecting on the teaching background, teaching input, teaching process and teaching results, the corresponding solutions were put forward. Further optimize and improve the teaching evaluation system on engineering for applied university in China.

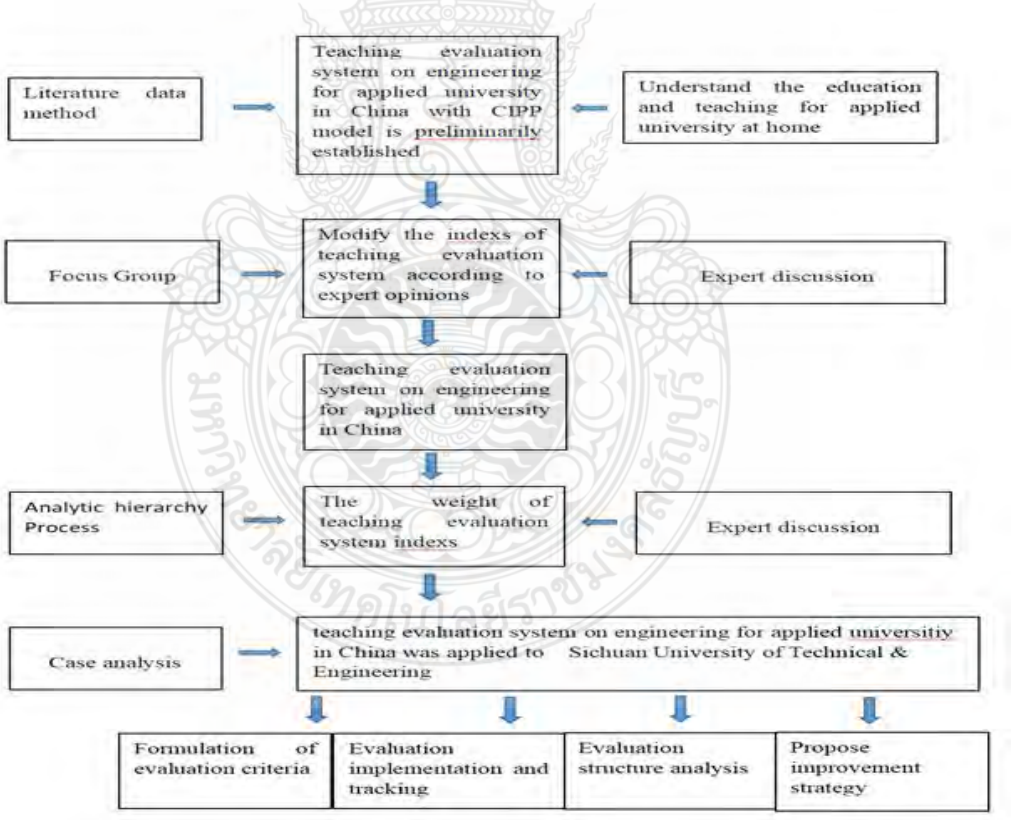

Figure3.1 Technology Road map

3.5 Data processing and analysis

3.5.1 Focus Group

First Round: In the brainstorming session, the researcher was related to the developmental evaluation and stakeholder theory focused on content evaluation, input evaluation,process evaluation, and product evaluation, the results from this analysis were used for the framework for the semi-structured interviews. The questionnaire was sent to 9 experts, who returned the first round of questions in the form of a meeting discussion. After receiving the responses, the answers were classified and integrated to form another questionnaire (Questionnaire I).

Second Round: This was the evaluation of the experts' ideas phase and consisted of the evaluation of the experts' responses. In round two evaluations, Questionnaire I was used for the experts' ideas on content evaluation, input evaluation,process evaluation, and product evaluation concerning teaching evaluation system on engineering for applied university in China.

Third Round: In this re-evaluation stage, the selected items from the results of questionnaire I concerning a teaching evaluation on engineering for applied university in China were pooled together as similarities or differences. The similarities meant that most of the 9 experts agreed, while the differences meant the reverse. The results of the synthesis were used to develop questionnaire II which was sent to the experts for the third round.

Fourth Round:Using analytic hierarchy process, the weights of teaching evaluation system on engineering for applied university in China are established. According to the hierarchical model of teaching evaluation system index, the pairwise comparison judgment matrix is constructed, and then experts are invited to compare and score the importance of the indexes. The researcher will carry out on the scoring data about normalized calculation and consistency test . After passing the consistency test, the final weights of all levels of the teaching evaluation system index are obtained.

By this round, the feasible ideas had been identified, resolved and reported. The experts acknowledged all the group's opinions with the ideas or strategies and details of implementation.

Table3.1 Categories of Experts

Categories	Experts
national-level assessment expert	2
University-Level Assessment Expert	5
Doctoral Degree	4
Professor	9
Engineering Experts.	7

3.5.2 Data Collection

3.5.2.1 Phase I: To synthesize teaching evaluation system on engineering for applied university in China.

The data were collected using the Focus Group technique. There were four rounds for the data collection as follows:

First Round: Brainstorming

The first round involved brainstorming the experts through semi-structured questionnaires focus on content evaluation, input evaluation,process evaluation, and product evaluation.The first round of data collection proceeded as follows:

1.The researcher connected with 9 qualified experts by phone to request their agreement to participate in the study using the Focus Group technique.

2.When all 9 qualified experts had agreed, the researcher issued official letters of invitation from Faculty of Technical Education , Rajamangala University of Technology Thanyaburi (RMUTT) as shown in appendix G.

3.Appointments were made with all qualified experts on the date and time preferred.

4.All of 9 experts groups meet at a meeting room to conduct the discussion in person.

5.Discussed questions and explained the purpose of the questionnaires.

6.The researcher separated the replies into similar and different categories to get a majority opinion.

7.The data from the interviews based on the semi-structured questionnaire were grouped and arranged to draft Questionnaire I concerning teaching evaluation system design based on content evaluation, input evaluation,process evaluation, and product evaluation. 9 experts modified the index by discussion.The researcher who prepared Questionnaire I get the index of teaching evaluation on engineering for applied university in China from experts.

Second Round: Evaluation of the Experts' Ideas

1.The second round evaluated the ideas using expert's discussion in questionnaire I.

2.The researcher connected with/contacted/called 9 qualified experts by phone to request their agreement to participate in the study using the Focus Group technique.

3.When all 9 qualified experts had agreed, the researcher issued official letters of invitation from Faculty of Technical Education , Rajamangala University of Technology Thanyaburi (RMUTT) to invite the experts.

4.Appointments were made with all qualified experts on the date and time the experts preferred.

5.All of 9 experts groups meet at a meeting room to conduct the discussion in person.

6.The researcher then processed the new idea from the first round open-end questionnaire to check for a consensus. The researcher selected the index from the results of the semi-structured interview questionnaire.

7.The results of synthesis of similarities and differences led to diagrams.

8.The data collection from 9 experts and was conducted through meeting.

9.Discuss each index

The data regarding the similarities and the differences based in content evaluation, input evaluation,process evaluation, and product evaluation. After that, the researcher created teaching evaluation system on engineering for applied university as shown in figures.

Third Round: Re-Evaluation

In the third round, the 9 experts were required to discuss every item of the questionnaire II.

1.Items were selected from the results of Questionnaire I. These included all content evaluation, input evaluation, process evaluation, and product evaluation.

2.The findings were pooled together as similarities or differences. The similarities meant that most of the 9 experts agreed while the differences meant the reverse. The results of the synthesis were used to develop Questionnaire II.

3.Appointments were made with all qualified experts on the date and time the experts preferred.

4.All of 9 experts groups meet at a meeting room to conduct the discussion in person.

5.A teaching evaluation system on engineering of applied university was created.

6.After the researcher concluded Questionnaire III, the framework for teaching evaluation system on engineering for applied university was developed.

Fourth Round: Solution-Report

In the fourth round, the experts came to a resolution and made a report since the feasible ideas had been identified. Furthermore, the experts acknowledged all the group's opinions with the ideas or strategies and details of implementation.

3.5.2.2 Phase II: To identify and develop teaching evaluation system on engineering for applied university in China.

Sichuan University of Science & Engineering was selected as participant. The university is a national public university and a general full-time applied university. It included engineering, science, management, education, literature, history, art, law, economics and other nine disciplines. The university has 20 colleges, ten colleges of which are engineering colleges. Engineering is the main major of the university.

The process of evaluation is mainly based on interview and observation. First, the teaching evaluation system on engineering for applied university is observed in

class by the observation method, and the teaching process including students' learning status, teaching and quality management is observed. After the observation, the grade is scored against the three indexs of the teaching evaluation system. The contents of the three indexs of teaching background, teaching input and teaching achievement are included by using the interview method. Students, teachers and relevant administrators are respectively interviewed and scored according to the interview results.

The evaluation process in applied universities heavily relies on interviews and observations as its primary assessment methods. Initially, the teaching evaluation system in engineering programs is meticulously scrutinized through classroom observations. During this phase, trained evaluators employ the observation method to gain insights into various facets of the teaching process. This includes a close examination of students' learning status, teaching methodologies employed by instructors, and the management of teaching quality. These observations serve as a foundational step in the assessment process, providing a firsthand view of the educational environment.

Following the observation phase, evaluators proceed to score the teaching quality based on a structured assessment framework composed of three crucial indices: teaching background, teaching input, and teaching achievement. These indices serve as critical benchmarks to evaluate the effectiveness of the engineering program. The teaching background index assesses instructors' qualifications and expertise, while the teaching input index gauges the resources and efforts dedicated to the teaching process. The teaching achievement index, on the other hand, measures the tangible outcomes of teaching, including student performance and the practical application of knowledge.

Complementing the observational aspect, the interview method is employed to delve deeper into the nuances of teaching quality. Through this approach, evaluators engage with key stakeholders, including students, teachers, and relevant administrators. Each group is interviewed separately to gather valuable insights into their perspectives on the teaching process. These interviews provide a more holistic understanding of the program's strengths and areas in need of improvement. Ultimately, the scores assigned following the interview phase are based on the feedback and

responses obtained from these diverse stakeholders, contributing to a comprehensive assessment of the teaching quality in engineering programs within applied universities.

The total score of each indicator is set to be ten, and the scoring grade is divided into five levels:

1.1≤ score ≤3 is too poor,

2.3 < score < 6 is poor,

3.6≤ score ≤7 is pass,

4.7 < score ≤8 is qualified,

5.8 < score ≤10 is excellent.

The score of the third-level index under the second-level index is multiplied by the corresponding weight and then summed to obtain the score of the second-level index; similarly, the score of the second-level index under the first-level index is multiplied by the corresponding weight and then summed to obtain the score of the first-level index; the score of the four first-level indexes is added to obtain the total score of the teaching evaluation of the engineering cost course in Sichuan University of Technology & Engineering.

3.6 Statistical Analysis

3.6.1Data collection was carried out and thought questionnaires were analyzed to determine the results as follows:

3.6.1.1 The value of the median should not be below 3.50.

3.6.1.2 The absolute value of the difference between median and mode should not be above 1.00.

3.6.1.3 The value of the interquartile range (IQ3 - IQ1) should not be above 1.5.

3.6.1.4 The IQR=Interquartile Range (IQR< 0.50 ≥ 1.00=Congruent; IQR>1.00=Incongruent). The meaning and level of experts' opinions of selected psychology theories. The meaning is shown in table 3.1 and was used to analyze the significant difference between respondent's opinions of selected psychology theories.

Table 3.2 Mean and level of expert opinions on selected psychology theories.

No.	*M*	Level of opinion
1.	1.00 – 1.49	Strongly disagree
2.	1.50 – 2.49	Disagree
3.	2.50 – 3.49	Neutral
4.	3.50 – 4.49	Moderately agree
5.	4.50 – 5.00	Strongly agree

Note: *M* = mean.

The level of the standard deviation. Measures of the dispersion of a collection of data from its *Mean* (Wongrattana, 2003) were as follows:

0.000-0.999 means less spread apart data.
More than 1.000 means more spread apart data.

The interviews and judgments were experts' opinions of selected psychology theories, qualification requirements, training approaches, and assessment. Some data were overcome in cases where there were similarities keyword analysis. (Miles and Huberman, 1994).

3.6.2 Data analysis, the researcher conducted the data analysis in the following steps:

3.6.2.1 Find the effectiveness of the machine game automatics for students following the criteria standard equal E1/E2 = 80/80.

3.6.2.2 The first 80 is the mean score obtained from the machine game automatics activities during the learning period of the students. The value of the test score after the instruction is no less than 80 percent.

3.6.2.3 The second 80 refers to the mean score in the percentage of the answer that the students were right. The value of the test score is no less than 80 percentage points.

3.6.3 Compare learning achievement between pretest and posttest scores with the machine game automatics in Thai Langue. The sample students used a *t-test* model-dependent sample. Analysis of students' feedback toward the machine game automatics in Thai Langue of the five-level Likert rating scale in the questionnaire. The analysis score was conducted as follows:

5 points mean Strongly Agree.

4 points mean Agree.

3 points mean Undecided.

2 points mean Disagree.

1 point means Strongly Disagree.

3.6.4 The result of the score was interpreted by collecting all the questionnaire answers and calculating them into Mean (*M*) and Standard Derivation (*SD*). The resulting score will be between 1.00 and 5.00. The meanings of the score were translated as the following:

4.51 to 5.00	means	indicates the highest level of opinion.
3.51 to 4.50	means	indicates the opinions are high.
2.51 to 3.50	means	indicates a moderate level of opinion.
1.51 - 2.50	means	indicates the opinions are low.
1.50 - 1.00	means	the comments are minimal.

The bare statistics in data analysis include:

3.6.4.1 The arithmetic mean formula Mean (*M*) in this study was:

$$\overline{X} = \frac{\sum X}{N}$$

$\overline{X}$	represent	Arithmetic Mean.
$\sum X$	represent	Sum of all score results.
N	represent	Number of students.

3.6.4.2The formula of Standard Derivation (*SD*.) in the study was:

$$SD = \sqrt{\frac{\sum\left(x-\bar{x}\right)^2}{N}}$$

SD	represents	Standard Derivation.
x	represent	Student Score.
$\overline{X}$	represent	Mean Score.
N	represent	Number of students.

3.6.4.3 The formula used for the percentage was:

$$P = \frac{f}{\mathrm{N}} \times 100$$

P	represent	Percentage.
f	represent	Frequency.
N	represent	Total frequency.

3.6.4.4 The statistics used to determine the quality of the instruments were: In finding content validity of the achievement test, we conducted the IOC formula (Item Objectives Congruence) by following the formula below:

$$\mathrm{IOC} = \frac{\sum \mathrm{R}}{\mathrm{N}}$$

IOC	represent	Index of correspondence between the test and the objective.
R	represent	Expert Rating.
$\sum \mathrm{R}$	represent	Sum of individual expert scores.
N	represent	Number of experts.

Configuration expert scores were:

+1 means The test measures are precisely the learning objective.

0 means The Uncertainty the test measures are precisely what the learning objective.

-1 means The test does not measure are precisely the learning objective.

3.6.5 AHP weight analysis; an initial study was conducted with the experts and instructors. The survey was on questionnaires.Data collection was done by questionnaires which were analyzed to determine the results. This part of the expert will systematically evaluate the scale to give weight values for the relative importance of each part, then establish a pair comparison matrix, and find the feature vector and eigenvalue, with the feature vector representing the priority of each part in each level. It can provide decision-makers with sufficient decision information and organize the selection conditions or criteria, weight and analysis of decisions, and reduce the risk of decision-making errors.

The evaluation scale of AHP is used as a pairwise comparison between indicator factors at each level, and the basic division includes five items, namely Equal Strong, slightly Weak Strong, quite Strong, Very Strong, and Absolution. The measurement values of nominal scales 1, 3, 5, 7 and 9 are assigned, and another four scales are set between the five basic scales, and the measurement values of 2, 4, 6 and 8 are assigned, totalling nine scales. The meanings represented by each scale are shown in the table below.

Table3.3 Scale table of Analytic Hierarchy Process

The value of relative importance is meaningful
1 indicates that horizontal indicators are more important than vertical indicators.
3 indicates that the horizontal indicator is a little more important than the vertical indicator.
5 indicates that the horizontal indicator is more important than the vertical indicator.
7 indicates that the horizontal indicator is much more important than the vertical indicator.
9 indicates that horizontal indicators are more important than vertical indicators.
The importance of 2, 4, 6 and 8 is between "1, 3, 5, 7 and 9".

CHAPTER 4 RESEARCH RESULTS

This chapter provides a descriptive analysis and meaning analysis of on teaching evaluation system on engineering for applied university in China. The categories summarize the results of the analysis of the interview and survey data. The tables summarize the results of the analysis of the Focus Group technique and Analytic Hierarchy Process (AHP) . The way the Focus Group technique and Analytic Hierarchy Process (AHP) was used in this research is outlined below.

4.1 Demographic data

4.2 Results and Analysis

4.3 Structural Equation Modeling Analysis

4.1 Demographic data

First Round: Brainstorming

The first round was brainstorming. As identified in objective 1, its purpose was to synthesize teaching evaluation system on engineering for applied university based on CIPP model.There were four parts in the interviews, context evaluation,input evaluation,process evaluation and product evaluation. The characteristics of the semi-structured interviews focused on obtaining the opinions of experts on each idea through questionnaire. The interview scheme and the semi-structured interview form (see appendix B) focus on context evaluation,input evaluation,process evaluation and product evaluation. Then, the results of the interviews or the first round or brainstorming was provided in the framework based on the theories.

The next step was the creation of Questionnaire I as shown in box1-6. (see appendix C).

Second Round: Evaluation of the Experts' Ideas

The second round was the evaluation of the ideas in Objective 1 so as to synthesize the index of teaching evaluation system on engineering for applied university in China. The evaluation focused on the two theories developmental evaluation and stakeholder theory, and there was also a focus on context evaluation,input evaluation,process evaluation and product evaluation. In the second round the experts'

responses were evaluated using questionnaire I (see appendix C). The responses were pooled together as similarities or differences. The similarities meant that most of the 9 experts agreed while the differences meant the opposite. The results of the synthesis of similarities and differences lead to the diagrams(Strawbridge and Wallhagen et al., 2007) shown in box7,8.

Third Round: Re-Evaluation

The third round involved a re-evaluation of Objective 1: to synthesize teaching evaluation system on engineering for applied university in China that selected index from the results of questionnaire I. It included the context evaluation,input evaluation,process evaluation and product evaluation that are based on the two theories, namely developmental evaluation and stakeholder theory. The 9 experts were required to discuss the questionnaire II as shown in box9.

Fourth Round: Analytic Hierarchy Process

By the fourth round, the constructed judgment matrix and corresponding values were input into the SPSSPRO software, and the weight value of each index was calculated and the consistency test was carried out through the software. Among them, the second-level index of the first-level index "teaching background", the third-level index of the second-level index "effectiveness" and the third-level index of the second-level index "satisfaction" are all second-level matrices. In the consistency test, the RI value of the second-level matrix is 0, and the second-level matrix itself is consistent, so it is not necessary to carry out the consistency test. Only calculate the weights corresponding to the indicators.

The feasible ideas had been identified, resolved and reported. These are provided in Questionnaire III and shown in appendix E and table 4.1. The experts acknowledged all the group's opinions with their ideas or strategies and details of implementation.

4.2 Results

4.2.1 Objective 1: To Synthesize Teaching Evaluation System on Engineering for Applied University in China.

First Round: Brainstorming

In total 9 expects attended focus groups. The results reflect views held by the majority. In the thematic analysis we placed greater emphasis on repeated themes, initially raised themes, strong feelings, or themes of long discussions. We have included discordant views to highlight differing experiences or perceptions of individuals and groups.

By reading a lot of literature and combining the current situation of engineering teaching evaluation in China, CIPP model is used as the basis for the framework of teaching evaluation system on engineering for applied university. Teaching background, teaching input, teaching process and teaching achievements are determined as the First-level index.

Box1:About the structure of the evaluation system

Expert 1: When it comes to designing a teaching evaluation system, there are several key considerations that need to be taken into account. Firstly, the system should be fair and impartial, providing an accurate assessment of the teaching quality. It should include multiple evaluation criteria, such as student feedback, peer evaluations, and self-assessment by the instructors themselves.

Expert 2: I completely agree. It's important to have a well-rounded approach to evaluation. In addition to the criteria you mentioned, I believe incorporating learning outcomes assessment is crucial. It helps determine whether students are actually achieving the desired learning outcomes and if the teaching methods are effective.

Expert 3:The semi-structured interviews is divided into four parts. I think a complete system is hierarchical system. It is recommended that these indexes be divided into three levels with reference to other evaluation systems.

Expert 4:The four descriptions of content evaluation, input evaluation, process evaluation and result evaluation are not accurate .they can be changed to teaching background, teaching input, teaching process and teaching achievements.

The consensus among the experts in the focus group was unanimous. They concurred with the outcomes of the discussion, unanimously recognizing content evaluation, input evaluation, process evaluation, and outcome evaluation as primary-level indices. These categories were collectively deemed to be better characterized as transitioning into teaching background, teaching input, teaching process, and teaching achievements. This consensus reflects the group's belief that such refinements more accurately represent the comprehensive assessment of the educational process, encompassing not only content but also the contextual, resource, procedural, and outcome dimensions, thereby providing a holistic framework for evaluating teaching effectiveness.(box1）.

Box2:About the composition of the second-level index of teaching evaluation system

Expert 1: The composition of second-level index in a teaching evaluation system can vary depending on the specific goals and priorities of the institution or organization implementing the system. However, I can provide you with a general overview of some commonly considered factors and criteria in designing second-level index for teaching evaluation systems.

Expert 2: Learning Environment should be included,it focuses on creating a positive and inclusive learning environment. It may assess factors such as classroom climate, respect for diversity, promotion of student well-being, and the creation of an atmosphere conducive to learning.

Expert 3: Assessment and Feedback is important .This index focuses on evaluating the effectiveness of assessments and feedback provided by the teacher. It may include criteria such as the fairness of assessments, the timeliness and quality of feedback, and the use of assessment results to inform instruction and support student learning. .....

In the process of comprehensive evaluation, experts play a crucial role by meticulously analyzing and summarizing nine second-level indexes. These indices serve as key pillars in assessing the effectiveness and quality of the educational ecosystem within applied universities. 1.Talent Cultivation Goal: This index scrutinizes the alignment of educational objectives with industry needs, ensuring that graduates are well-equipped for the job market.2. Teaching Goal: It assesses the clarity and effectiveness of teaching objectives, ensuring that they are student-centric and outcome-driven.3. Teaching Resources: The availability and adequacy of resources, including technology, textbooks, and facilities, are evaluated to facilitate optimal learning experiences.4. Teacher Status: This index delves into the qualifications, expertise, and professional development opportunities for faculty members, ensuring they are well-prepared to deliver quality education.5. Student Activities: It evaluates extracurricular activities and student engagement, fostering holistic development beyond the classroom.6. Teaching Activities: This index assesses the effectiveness of teaching methods, pedagogical innovations, and interactive learning approaches employed by instructors.7. Student Ability Cultivation: It gauges the success of educational programs in nurturing students' critical thinking, problem-solving skills, and practical application of knowledge.8. Teacher Development: Continuous professional development for instructors is emphasized, ensuring they stay current with evolving teaching methodologies.9. Satisfaction Survey: Feedback from students, faculty, and stakeholders is collected through surveys, providing valuable insights for program enhancement.

These second-level indexes collectively offer a comprehensive framework for evaluating and continuously improving the educational quality and outcomes of applied universities, promoting excellence in both teaching and learning.（box2).

Box 3: Teaching background
Expert 1:Teaching background is content evaluation, which as a first-level index should include two aspects: talent cultivation goal and teaching goal.
Expert 2:The goal of talent cultivation should conform to the orientation of the school and meet the needs of social and economic development. .....

All the experts agree that talent cultivation and teaching objectives should be regarded as the second-level index of teaching background.So,Teaching background includes two Second-level indexes: talent cultivation and teaching goalIn the realm of educational assessment and program development, it's widely acknowledged by experts that the concept of teaching background can be thought of as a multi-faceted construct. This multifaceted perspective incorporates two critical second-level indices: talent cultivation and teaching goals. These components hold paramount importance in shaping the educational landscape of institutions.

Firstly, talent cultivation encompasses the intricate process of nurturing and harnessing the potential of learners. It delves into how well educational programs prepare students with the skills, knowledge, and abilities they need to excel in their chosen fields, essentially addressing the core purpose of education — the development of capable and proficient individuals.

On the other hand, teaching goals delineate the specific objectives and outcomes that educators aim to achieve through their instructional efforts. These objectives serve as the guiding principles for curriculum design, pedagogical strategies, and assessment methodologies, ensuring that the teaching process aligns with the overarching mission of the educational institution.

In essence, these second-level indices, talent cultivation, and teaching goals, are integral components of the broader teaching background framework, collectively shaping the educational journey and defining the success of educational programs in preparing students for the challenges of the future.（box3).

Box4:About teaching input

Expert 1: When it comes to teaching the input we provide to students plays a crucial role in their learning process. As educators, we need to carefully consider the quality and relevance of the information we present to students. The input should be engaging, thought-provoking, and tailored to the students' needs and abilities.

Expert 2: Absolutely. It's important to remember that teaching is not just about delivering information but also about fostering a deeper understanding and critical thinking skills in students. The input we provide should go beyond rote memorization and encourage students to analyze, question, and connect ideas.

Expert 3: I completely agree. It's essential to make the input meaningful and relatable to students' lives and experiences. By incorporating real-life examples, practical applications, and problem-solving activities, we can enhance their engagement and help them see the relevance of what they're learning. .....

After discussion, most of all experts agree that teaching resources and the status of teachers should be a Second-level index of teaching input. However, some individual experts disagree and believe that some indexes can be added.Following extensive discussions, the consensus among the majority of experts centers on categorizing teaching resources and the status of teachers as Second-level indices within the teaching input category. This agreement reflects the pivotal role these factors play in shaping the quality of education. Nevertheless, it is worth noting that there are dissenting opinions among a minority of experts. They argue that additional indices could further enrich the evaluation process, fostering a more comprehensive understanding of teaching input. This diversity of perspectives underscores the complexity of assessing teaching quality and the need for ongoing dialogue to refine evaluation criteria and methods.（box4).

Box5:teaching process

Expert 1:Teaching is a complex and multifaceted process that requires expertise and thoughtful consideration. Let's dive into some key points that experts often discuss when it comes to the teaching process.

Expert 2:Such as Teaching Effectiveness: This index focuses on evaluating the overall effectiveness of a teacher in delivering instruction. It may include sub-indices such as student learning outcomes, classroom management, and pedagogical strategies employed by the teacher.

Expert 3:Student Engagement: This index assesses the level of student involvement and participation in the learning process. It may consider factors such as student motivation, interaction with the teacher and peers, and the use of innovative teaching methods to enhance engagement. ....

Be regarded as Second-level index of teaching process. However, some experts disagreed, saying that more indexes or more accurate descriptions could be added.While there's general consensus among experts that student activities and teaching activities are crucial second-level indices in assessing the teaching process, there's room for debate. Some dissenting experts argue that the evaluation framework could benefit from additional indices or more precise descriptors. They emphasize the need for a more nuanced approach to capture the multifaceted nature of education. By expanding the set of evaluation criteria, they believe we can obtain a richer understanding of teaching quality, enabling educators to tailor their methods more effectively and adapt to the diverse needs of students. This ongoing discourse highlights the dynamic nature of educational assessment and the quest for continuous improvement in pedagogy.（box5).

Box6:teaching achievements
Expert 1: Today, let's discuss the importance of focusing on teaching achievements rather than just the process itself. While the process of teaching is undoubtedly crucial, ultimately, it is the results that demonstrate the effectiveness of our teaching methods and strategies.
Expert 2: Absolutely, teaching is all about achieving desired learning outcomes. We need to constantly evaluate and assess the results to ensure that our students are actually acquiring the knowledge and skills we intend to impart. Otherwise, we may end up with a gap between what we teach and what students actually learn.
Expert 3: I agree. When we prioritize teaching achievements, we can make data-informed decisions about our instructional practices. By analyzing the outcomes, we can identify areas where students are struggling or excelling, and then adjust our teaching strategies accordingly to meet their needs. .....

Most of all experts agree that student ability cultivation, teacher development and satisfaction should be regarded as the second-level index of teaching achievements. However, Some experts disagreed, they suggested more indexes or more accurate descriptions could be added.While the consensus among experts leans towards considering student ability cultivation, teacher development, and satisfaction as key second-level indices for measuring teaching achievements, there exists a divergence of opinion. Some experts advocate for a broader array of indices or more precise descriptions to offer a more comprehensive assessment. They argue that the multifaceted nature of education warrants a more nuanced evaluation framework, which might include factors like classroom dynamics, student engagement, or curriculum adaptability. This discourse highlights the ongoing quest for an ever-improving and more encompassing evaluation system in education to ensure that it accurately reflects the complex dynamics of the teaching and learning process.（box6).

After the discussion of experts, the preliminary teaching evaluation system on engineering for applied university in China are obtained, as shown in the table4.1.

Table 4.1 The index of teaching evaluation system on engineering for applied university in China

First-level index	Second-level index	Third-level index
A1. Teaching background	B1. Talent training objectives	C1. Construction of quality standards for engineering talents training
		C2. Development orientation of engineering talents
		C3. Talent training reflects the characteristics of running a school
		C4. Linkage between talent training objectives and local economic development
	B2. Teaching objectives	C5. Clarity of teaching objectives
		C6. Coincidence with regional economic development
		C7. Matching degree with students' career development
		C8. The effect of students' quality development
A2. Teaching input	B3. Teaching resources	C9. Quality of teaching materials
		C10. Effectiveness of school-enterprise cooperation
		C11. Input and use of teaching equipment
		C12. Construction and utilization of training room
		C13. Construction of teaching staff
		C14. Investment and expenditure of funds
	B4. Teacher status	C15. Age structure of teachers
		C16. The proportion of teachers with attachment experience in enterprises is 3.
		C17. Proportion of full-time and part-time teachers
		C18. Teacher training opportunities
		C19. Academic level of teachers
		C20. Teachers' teaching achievements
A3. Teaching process	B5. Student activities	C21. Students' learning attitude
		C22. Students' interest in learning
		C23. Students' study habits
		C24. Students' learning methods
		C25. Students' learning consciousness
		C26. Learning schedule
		C27. Degree of cooperation among students

Table 4.1 The index of teaching evaluation system on engineering for applied university in China(Cont.)

Second Round: Evaluation of the Experts' Ideas

First-level index	Second-level index	Third-level index
A3. Teaching process	B6. Teaching activities	C28. Fit between teaching content and objectives C29. Degree of implementation of teaching plan C30. Systematic situation of teaching content C31. Cross-disciplinary organization level C32. Teaching difficulty C33. Practical situation of teaching C34. Rationality of proportion arrangement of practical courses C35. Diversification of teaching methods C36. Proper arrangement of class hours C37. Accuracy of classroom time control C38. Progressiveness of teaching steps C39. Teachers' Guidance Effect on Students
A4. Teaching achievements	B7. Students' ability training	C40. Degree of theoretical knowledge mastery C41. Practical operation ability C42. Establishment of engineering thinking C43. Ability of coordination and cooperation

The preliminary teaching evaluation system on engineering for applied university in China is obtained from the semi-structured interviews, and the experts are meaningless to the First-level indexes. But there is still controversy about Second-level index and Third-level index(box7,8).

Box7:About Second-level index
Expert 1:I think that there is overlap between student activities and teaching activities, I suggest that the two should be edit.
Expert 2:I think that it is more appropriate to change the "satisfaction survey" to "satisfaction".
Expert 3:It is necessary to clarify the object of evaluation, to clarify whether the body is the evaluation of professional or professional courses, in addition, the curriculum includes public basic courses, professional basic courses and professional courses.
Expert 4:It is necessary to refine the Second-level index "teaching resources", which can be divided into tangible sources and intangible resources.
Expert 5:The first-level indicator "teaching process" not only includes student activities and teaching and learning activities, but also quality management.It should be included under the indexes, and the secondary indexes "teaching results" needs to be further improved.

From box7,The researcher summaries the experts' modification suggestions on the

Second-level indexes,As follows:

1. Change the second-level index "teaching objective" to "professional teaching objective".

2. Add two second-level indexes of "facility conditions" and "resource construction" under the first-level index of "teaching input".

3. Change "Student activities" to "Student Learning Status".

4. Change "Teacher activity" to "Teacher teaching status".

5. Add a second-level index of "Quality management status" under the first-level index of "teaching process".

6. Add the second-level index of "effectiveness" under the first-level index of "teaching achievement".

Box8:About Third-level index

Expert 1: Consistent with regional economic development ", "age structure of teachers", "level of interdisciplinary organization", "accuracy of classroom time control", "degree of scientific research ability improvement", "number of graduates" and "student enrollment rate"

The indexes are inappropriate and can not accurately evaluate the quality of engineering teaching. It is suggested to delete these seven indexes directly.

Expert 2: The two indexes of "consistency between teaching goals and regional economic development" and "connection between talent training goals and local economic development" overlap, one of them needs to be deleted.

Expert 3: The index "age structure of teachers" does not have a great impact on the strength of teachers, suggested to delete. Engineering teaching requires students to carry out practical operations on specific engineering projects, so students need to cooperate with each other. We should change "degree of cooperation among students" to "cooperation among students".

Expert 4: The meaning of "student quality development" is broad ,it should be described in detail; The index "academic level of teachers" is not particularly important for the inspection of teachers' status, so delete it. As for the "proportion of teachers with enterprise temporary job experience", it is need to add time, such as "half a year enterprise temporary job experience";

Expert 5: "Learning consciousness" belongs to "learning attitude", "learning time arrangement is reasonable" belongs to "learning habits", so delete it; The "accuracy of classroom time control" indicator is too trivial and should be deleted; "Progressive teaching steps" belongs to the rationality of the curriculum arrangement, it should be reclassify. The description of "teaching practice" is not accurate, so re-describe it; In the course of teaching, it is necessary to investigate the teachers' ethics, energy and dedication.

Expert 6: The integration of students' professional ideological and political education is not reflected. Remove the "number of graduates", "student enrollment rate", "student employment rate", "employer satisfaction" and "social satisfaction", which are not easy to statistical three indexes.

From box8,The researcher summaries the experts' modification suggestions on the Third-level index,As follows:

1. Change "The connection between talent training objectives and local economic development" to "the compatibility between talent training objectives and local economic development".

2. Delete the indicator "consistency between teaching objectives and regional economic development".

3. Change "clarity of teaching objectives" to "accuracy of professional teaching objectives".

4. Change "degree of conformity with regional economic development" to "degree of conformity between professional teaching objectives and regional economic development".

5. Change "Degree of matching with students' career development" to "degree of matching between professional teaching objectives and students' career development".

6. Change "the development of students' quality" to "the compatibility of professional teaching objectives with the promotion of students' all-round development of morality, intelligence, physical fitness, the United States and labor".

7. Under the second-level index "Facility conditions", add three indexes: "Investment in teaching funds", "investment and use of teaching equipment" and "construction and utilization of training room".

8. Under the second-level index "Resource construction", four three-level indexes are added: "Construction of application-oriented teaching materials", "construction and sharing of high-quality teaching resources", "resource sharing of real project cases of industry enterprises" and "school-enterprise cooperation".

9. Add two third-level indexes of "teacher title" and "teacher education" under the second-level index of "teacher status".

10. Delete the third-level index of "teachers' academic level".

11. Change "Proportion of teachers with temporary job experience in enterprises" to "proportion of teachers with more than half a year of temporary job experience in enterprises".

12. Remove the indicators of "students' learning attitude" and "students' learning time arrangement".

13. Change "the degree of fit between teaching content and goal" to "the degree of fit between teaching content and talent training goal".

14. Add three third-level indexes of "integration of professional ideological and political education", "performance of teachers' ethics" and "level of teachers' teaching energy investment" under the second-level index of "teachers' teaching status".

15. Change "Implementation degree of teaching plan" to "Implementation Status of teaching Plan".

16. Change "the practical situation of teaching" to "the implementation of practical teaching".

17. Change the "appropriateness of class arrangement" to "scientific arrangement of course".

18. Delete the two third-level indexes of "Accuracy of classroom time control" and "progressiveness of teaching steps".

19. Add three third-level indexes of "Establishment of quality assessment system", "quality of teaching materials" and "teaching management" under the second-level index of "quality management".

20.Delete the "number of graduates", "student enrollment rate" and "student employment rate", "employer satisfaction" and "social satisfaction" five third-level indexes.

21. Under the second-level index "Effectiveness", add "orderly operation of all links of school talent training" and"The continuous improvement and promotion of the school talent training work".

22. Change "Student satisfaction" to "Student satisfaction with learning and growth".

23. Add a third-level index of "teachers' satisfaction with school education" under the second-level index of "satisfaction".

After the experts discussion, the corresponding indexes were modified and improved to form teaching evaluation system on engineering for applied university in China and questionnaire II.

Third Round: Re-Evaluation

In this round, the experts discussed each index again.Most of the experts agreed with the indexes in Questionnaire II. But some of them suggestions to modify the description of individual indexes.The researcher changed "The fit between curriculum teaching objectives and the promotion of students' all-round development of morality, intelligence, physical fitness, the United States and labor" to "the fit between curriculum teaching objectives and the formation of students' theoretical knowledge and practical ability"(box9).

Box9:
Expert 1: I think the current indicators should be able to achieve the results we expect, and there is no need to modify them.
Expert 2: The content of the third-level index of "The fit between curriculum teaching objectives and the promotion of students' all-round development of morality, intelligence, physical fitness, the United States and labor" should be changed. the description of objectives is too much.It can be changed to "the fit between curriculum teaching objectives and the formation of students' theoretical knowledge and practical ability.

After three rounds of focus group discussions with nine experts, the researchers adjusted and modified the indexes at all levels by integrating the experts' suggestions, At last,the researcher established the teaching evaluation system on engineering for applied university in China.The index system is shown in Table 4-2.

Table 4.2 The teaching evaluation system on engineering for applied university in China

First-level index	Second-level index	Third-level index
A1. Teaching background	B1. Talent training objectives	C1. Construction of quality standards for engineering talents training
		C2. Development orientation of engineering talents
		C3. Talent training reflects the characteristics of running a school
		C4. Synchronization of professional construction and industry development
	B2. Course teaching objectives	C5. Accuracy of course teaching objectives
		C6. Matching degree between course teaching objectives and students' career development
		C7. The degree of fit between the teaching objectives of the course and the formation of students' theoretical knowledge and practical ability
A2. Teaching input	B3. Facility conditions	C8. Investment in teaching funds
		C9. Input and use of teaching equipment
		C10. Construction and utilization of training room
	B4. Resource construction	C11. Construction of applied teaching materials

		C12. Construction and sharing of high-quality teaching resources
		C13. Real project case resource sharing of industrial enterprises
		C14. School-enterprise cooperation
	B5. Teacher status	C15. Teachers' professional titles
		C16. Teacher education
		C17. The proportion of teachers with more than half a year's attachment experience in enterprises
		C18. Proportion of full-time and part-time teachers
		C19. Teacher training opportunities
A3. Teaching process	B6. Students' learning situation	C20. Students' interest in learning
		C21. Students' study habits
		C22. Students' learning methods
		C23. Students' learning consciousness
		C24. Cooperation among students
	B7. Teaching resources	C25. Fit between teaching content and talent training objectives

Table 4.2 The teaching evaluation system on engineering for applied university in China(Cont.)

First-level index	Second-level index	Third-level index
A3. Teaching process	B7. Teaching resources	C26. Integration of professional ideological and political education
		C27. Teachers' moral performance
		C28. The degree of teachers' teaching energy input
		C29. Implementation of teaching plan
		C30. Systematic situation of teaching content
		C31. Control of teaching difficulty
		C32. Implementation of practical teaching
		C33. Rationality of proportion arrangement of practical courses
		C34. Usage of teaching methods
		C35. Scientific situation of curriculum arrangement
		C36. Teachers' Guidance Effect on Students
	B8. Quality management	C37. Establishment of quality evaluation system
		C38. Quality of teaching materials
		C39. Teaching management
		C40. Degree of theoretical knowledge mastery

A4. Teaching achievement	B9. Student ability cultivation	C41. Practical operation ability C42. Ability to solve complex engineering problem C43. Training students' ability of coordination and cooperation C44. Possess good teamwork spirit C45. Training students' independent innovation ability C46. Participation in competition awards
	B10. Teacher development	C47. The improvement of teachers' professional ability C48. The improvement of teachers' teaching ability
	B11. Effectiveness	C49. Orderly operation of all aspects of school personnel training C50. Continuous improvement and promotion of personnel training in schools
	B12. Satisfaction	C51. Students' satisfaction with learning and growth C52. Teachers' satisfaction with school education

The Teaching Evaluation System study is clear, rigorous, and adaptive to China's engineering education demands. The findings could advise educational policymakers, university administrators, and faculty about the system's strengths and weaknesses in improving engineering education in applied universities. (a) Quantitative Analysis: Statistical software can provide descriptive statistics like mean, standard deviation, and frequency distribution from survey data. T-tests and ANOVA can reveal group perceptual differences. (b) Qualitative Analysis: The interviews can be transcribed and analyzed for Teaching Evaluation System themes and patterns. Response coding and categorization aid conclusion drawing.

Table 4.3 The Analysis result of teaching background

Third-level index	M	Opinion of experts	SD	CV%	IQR	Consensus
C1.Construction of quality standards for engineering talents training	4.56	Strongly agree	0.53	11.57	1	Congruence
C2.Development orientation of engineering talents	4.67	Strongly agree	0.50	10.71	1	Congruence
C3.Talent training reflects the characteristics of running a school	4.44	Moderately agree	0.53	11.86	1	Congruence
C4.Synchronization of professional construction and industry development	4.56	Strongly agree	0.53	11.57	1	Congruence
C5.Accuracy of course teaching objectives	4.78	Strongly agree	0.44	9.23	1	Congruence
C6.Matching degree between course teaching objectives and students' career development	4.78	Strongly agree	0.44	9.23	1	Congruence
C7.The degree of fit between the teaching objectives of the course and the formation of students' theoretical knowledge and practical ability	4.67	Strongly agree	0.50	10.71	1	Congruence

From table 4.3, the result of the report was 9 experts' opinions strongly agreed at 4.67, SD.=0.47, IQR=1, and the consensus of experts was congruence.The mean scores indicate the average response of experts for each aspect. In this case, the mean scores range from 4.44 to 4.78, which generally suggests a high level of agreement or positive assessment across all aspects.The fact that most opinions are "Strongly agree" indicates a high level of consensus among the experts.Smaller standard deviation values (such as 0.44 to 0.53 in this table) suggest that the experts' responses are clustered closely around the mean, indicating a relatively high level of agreement.The table shows that experts strongly agree on various aspects related to engineering talents training, indicating a high level of consensus in their opinions. The data suggests a positive assessment of these aspects, with minimal variation among the expert responses. This information could be valuable for decision-making and quality improvement in engineering education.

Table 4.4 The Analysis result of teaching input

Third-level index	M	Opinion of experts	SD	CV%	IQR	Consensus
C8.Investment in teaching funds	4.89	Strongly agree	0.33	6.82	1	Congruence
C9.Input and use of teaching equipment	4.67	Strongly agree	0.50	10.71	1	Congruence
C10.Construction and utilization of training room	4.89	Strongly agree	0.33	6.82	1	Congruence
C11.Construction of applied teaching materials	4.78	Strongly agree	0.44	9.23	1	Congruence
C12.Construction and sharing of high-quality teaching resources	4.89	Strongly agree	0.33	6.82	1	Congruence
C13.Real project case resource sharing of industrial enterprises	4.78	Strongly agree	0.44	9.23	1	Congruence
C14.School-enterprise cooperation	4.78	Strongly agree	0.44	9.23	1	Congruence
C15.Teachers' professional titles	4.56	Strongly agree	0.53	11.57	1	Congruence
C16.Teacher education	4.67	Strongly agree	0.50	10.71	1	Congruence
C17.The proportion of teachers with more than half a year's attachment experience in enterprises	4.78	Strongly agree	0.44	9.23	1	Congruence
C18.Proportion of full-time and part-time teachers	4.67	Strongly agree	0.50	10.71	1	Congruence
C19.Teacher training opportunities	4.78	Strongly agree	0.44	9.23	1	Congruence

From table 4.4, the result of the report was 9 experts' opinions strongly agreed at 4.69, SD.=0.44, CV=9.48%,IQR=1, and the consensus of experts was congruence.In this table, the experts strongly agree with each of the listed criteria.The standard deviation values are relatively low, suggesting that there is not much variation in the opinions of the experts for each criterion.the table suggests that experts strongly agree on various aspects related to teaching input, and there is a high level of consensus among them. The data shows relatively low variability (low standard deviation) but relatively high relative variability (high coefficient of variation) for these criteria. The interquartile range indicates that the data points are closely clustered around the mean. This analysis could

be useful for evaluating the effectiveness and consensus among experts regarding teaching input in the educational context.

Table 4.5 The Analysis result of teaching process

Third-level index	M	Opinion of experts	SD	CV%	IQR	Consensus
C20. Students' interest in learning	4.44	Strongly agree	0.53	11.86	1	Congruence
C21. Students' study habits	4.67	Strongly agree	0.50	10.71	1	Congruence
C22. Students' learning methods	4.44	Strongly agree	0.53	11.86	1	Congruence
C23. Students' learning consciousness	4.67	Strongly agree	0.50	10.71	1	Congruence
C24. Cooperation among students	4.44	Moderately agree	0.53	11.86	1	Congruence
C25. Fit between teaching content and talent training objectives	4.78	Strongly agree	0.44	9.23	1	Congruence
C26. Integration of professional ideological and political education	4.89	Strongly agree	0.33	6.82	1	Congruence
C27. Teachers' moral performance	4.78	Strongly agree	0.44	9.23	1	Congruence
C28. The degree of teachers' teaching energy input	4.56	Strongly agree	0.53	11.57	1	Congruence
C29. Implementation of teaching plan	4.78	Strongly agree	0.44	9.23	1	Congruence
C30. Systematic situation of teaching content	4.67	Strongly agree	0.50	10.71	1	Congruence
C31. Control of teaching difficulty	4.89	Strongly agree	0.33	6.82	1	Congruence
C32. Implementation of practical teaching	4.67	Strongly agree	0.71	15.15	1	Congruence

Table 4.5 The Analysis result of teaching process(Cont.)

Third-level index	M	Opinion of experts	SD	CV%	IQR	Consensus
C33. Rationality of proportion arrangement of practical courses	4.78	Strongly agree	0.44	9.23	1	Congruence
C34. Usage of teaching methods	4.67	Strongly agree	0.50	10.71	1	Congruence
C35. Scientific situation of curriculum arrangement	4.78	Strongly agree	0.44	9.23	1	Congruence
C36. Teachers' Guidance Effect on Students	4.78	Strongly agree	0.44	9.23	1	Congruence
C37. Establishment of quality evaluation system	4.67	Strongly agree	0.50	10.71	1	Congruence
C38. Quality of teaching materials	4.56	Strongly agree	0.53	11.57	1	Congruence
C39. Teaching management	4.56	Strongly agree	0.53	11.57	1	Congruence

From table 4.5, the result of the report was 9 experts' opinions strongly agreed at 4.61, SD.=0.48,CV=10.44% IQR=1, and the consensus of experts was congruence.The mean scores indicate the average response of experts for each aspect. In this case, the mean scores range from 4.44 to 4.89.Lower standard deviation values (e.g., 0.33 to 0.71) indicate that the experts' ratings are relatively close to the mean, suggesting a high level of agreement among the experts.Lower CV% values (e.g., 6.82% to 15.15%) suggest that the ratings are relatively consistent and have low variability.it appears that the teaching process is highly rated and there is a strong consensus among experts that the various aspects of teaching, such as students' interest in learning, study habits, teaching methods, and others, are performing well. The low standard deviation, coefficient of variation, and consistent interquartile range values support this conclusion, suggesting a high level of agreement among the experts in their assessments.

Table 4.6 The Analysis result of teaching achievement

Third-level index	M	Opinion of experts	SD	CV%	IQR	Consensus
C40. Degree of theoretical knowledge mastery	4.67	Strongly agree	0.71	15.15	1	Congruence
C41. Practical operation ability	4.67	Strongly agree	0.50	10.71	1	Congruence
C42. Ability to solve complex engineering problem	4.89	Strongly agree	0.33	6.82	1	Congruence
C43. Training students' ability of coordination and cooperation	4.67	Strongly agree	0.50	10.71	1	Congruence
C44. Possess good teamwork spirit	4.78	Strongly agree	0.44	9.23	1	Congruence
C45. Training students' independent innovation ability	4.56	Strongly agree	0.53	11.57	1	Congruence
C46. Participation in competition awards	4.67	Strongly agree	0.50	10.71	1	Congruence
C47. The improvement of teachers' professional ability	4.56	Strongly agree	0.73	15.95	1	Congruence
C48. The improvement of teachers' teaching ability	4.78	Strongly agree	0.44	9.23	1	Congruence
C49. Orderly operation of all aspects of school personnel training	4.78	Strongly agree	0.44	9.23	1	Congruence
C50. Continuous improvement and promotion of personnel training in schools	4.78	Strongly agree	0.44	9.23	1	Congruence
C51. Students' satisfaction with learning and growth	4.89	Strongly agree	0.33	6.82	1	Congruence
C52. Teachers' satisfaction with school education	4.78	Strongly agree	0.44	9.23	1	Congruence

From table 4.6, the result of the report was 9 experts' opinions strongly agreed at 4.58, SD.=0.46, CV=10.09%,IQR=1, and the consensus of experts was congruence.According to the experts' ratings, there is a high degree of agreement and consensus that teaching achievement is strong across all the assessed criteria. The low standard deviations, low coefficient of variation values, and narrow interquartile ranges all support this conclusion. This is reflected in the "Strongly agree" ratings for each criterion, indicating a positive assessment of teaching achievement.

Table 4.7 The Analysis result of teaching evaluation system on engineering for applied university in China

	Item	M	SD	F	CV	Cronbach's α
A1.Teaching background	7	4.6670	0.4792	0.2341	0.1031	0.838
A2.Teaching input	12	4.6853	0.4416	0.2013	0.0948	0.812
A3Tteaching process	20	4.6112	0.4798	0.2333	0.1044	0.911
A4.Teaching achievement	13	4.5798	0.4614	0.2184	0.1009	0.856
Total	52	4.6358	0.4655	0.2217	0.1008	0.823

To analyze the table 4.7 ,we can observe and interpret the information provided for each item (Teaching background, Teaching input, Teaching process, Teaching achievement) based on the given metrics (M, SD, F, CV). From the analysis, we can infer the following about the teaching evaluation system for engineering at the applied university in China:The overall mean scores for each item are quite close to each other, indicating a relatively balanced perception of the teaching quality in all areas (teaching background, teaching input, teaching process, and teaching achievement).The standard deviations are relatively small, which suggests that the scores are not highly dispersed from their respective means. This indicates a certain level of agreement or consistency among the evaluators.The coefficient of variation (CV) values are all relatively low (around 0.10), indicating that the data's relative dispersion is relatively low compared to the mean. This implies that the data points are not widely spread, and the evaluations are

somewhat consistent.Overall, the analysis suggests that the teaching evaluation system is providing relatively consistent and balanced feedback on different aspects of teaching at the applied university in China. However, further interpretation and decision-making should consider additional factors, such as the specific evaluation criteria, the context of the evaluations, and any qualitative aspects not captured in this table.

When Cronbaha 's α >0.7, the reliability of the questionnaire is in the normal range; when Cronbaha's α >0.8, the questionnaire's reliability is excellent. From table the overall reliability of the questionnaire is 0.823, showing reliability coefficients for four first-level indexes. The credibility of these indexes is high, and they are reasonable and credible.

Fourth Round: Resolved and Reported

A judgment matrix is constructed for the first-level index, the second-level index of the first-level index and the third-level index of the second-level index. Nine experts are invited to make pairwise comparison of the judgment matrix and score according to the importance degree. Then the average of the scores of each item of the nine experts is obtained, that is the value of the final judgment matrix. The meaning of expert scores is shown in the table:

Table 4.8 Scale table of Analytic Hierarchy Process

The value of relative importance is meaningful
1 indicates that horizontal indicators are more important than vertical indicators.
3 indicates that the horizontal indicator is a little more important than the vertical indicator.
5 indicates that the horizontal indicator is more important than the vertical indicator.
7 indicates that the horizontal indicator is much more important than the vertical indicator.
9 indicates that horizontal indicators are more important than vertical indicators.
The importance of 2, 4, 6 and 8 is between "1, 3, 5, 7 and 9".

The constructed judgment matrix and corresponding values were input into the SPSSPRO software, and the weight value of each index was calculated and the consistency test was carried out through the software. Among them, the second-level index of the first-level index "teaching background", the third-level index of the second-level index "effectiveness" and the third-level index of the second-level index "satisfaction" are all second-level matrices. In the consistency test, the RI value of the second-level matrix is 0, and the second-level matrix itself is consistent, so it is not necessary to carry out the consistency test. Only calculate the weights corresponding to the indicators.In addition, the SPSSPRO software cannot calculate second-order matrices, so the calculation steps are listed separately. The results are shown in Table 4.9 to Table 4.56

Table 4.9 First-level index judgment matrix

First-level index	Teaching background	Teaching input	Teaching process	Teaching achievement
A1.Teaching background	1	0.5	0.111	0.5
A2.Teaching input	2	1	0.125	2
A3Tteaching process	9	8	1	8
A4.Teaching achievement	2	0.5	0.125	1

Table 4.10 Analytic Hierarchy Process Results of First-level index judgment matrix

First-level index	Feature vector	Weight	Maximum characteristic root	CI
A1.Teaching background	0.247	0.06163	4.102	0.034
A2.Teaching input	0.509	0.12715		
A3Tteaching process	2.873	0.7183		
A4.Teaching achievement	0.372	0.09291		

Table 4.11 Consistency Test Results of the First-level index judgment matrix

Maximum characteristic root	CI	RI	CR	Consistency inspection results
4.102	0.034	0.882	0.039	adopt

Table 4.12 Judgement matrix of second-level index under "teaching background" of first-level index

second-level index	Talent training objectives	Course teaching objectives
B1.Talent training objectives	1	4
B2.Course teaching objectives	1/4	1

Table 4.13 Weights of second-level index under the first-level index "teaching background"

second-level index	Weight
B1.Talent training objectives	0.800000
B2.Course teaching objectives	0.200000

Table 4.14 Judgment Matrix of second-level index under "Teaching Input" of first-level index

Second-level index	Facility conditions	Resources Construction	Teacher status
B3.Facility conditions	1	3	1/6
B4.Resources Construction	1/3	1	1/7
B5.Teacher status	6	7	1

Table 4.15 Analytic hierarchy process results of Second-level index judgment matrix under first-level index "teaching input"

Second-level index	Feature vector	Weight	Maximum characteristic root	CI
B3.Facility conditions	0.536	0.17879	3.1	0.05
B4.Resources Construction	0.245	0.08182		
B5.Teacher status	2.218	0.73939		

Table 4.16 Consistency test results of the second-level index judgment matrix under the first-level index "teaching input"

Maximum characteristic root	CI	RI	CR	Consistency inspection results
3.1	0.05	0.525	0.095	adopt

Table 4.17 The judgment matrix of second-level index under the first-level index "teaching process"

Second-level index	Students' learning situation	Teaching resources	Quality management
B6.Students' learning situation	1	6	4
B7.Teaching resources	1/6	1	1
B8.Quality management	1/4	1	1

Table 4.18 Analytic hierarchy process results of the judgment matrix for second-level under the first-level "teaching process"

Second-level index	Feature vector	Weight	Maximum characteristic root	CI
B6.Students' learning situation	2.123	0.70752	3.018	0.009
B7.Teaching resources	0.409	0.13644		
B8.Quality management	0.468	0.15605		

Table 4.19 Consistency test results of the second-level index judgment matrix under the first-level index"teaching process"

Maximum characteristic root	CI	RI	CR	Consistency inspection results
3.018	0.009	0.525	0.017	adopt

Table 4.20 Judgment Matrix of Secondary Indicators under the First-level Index "Teaching Achievements"

Second-level index	Students' ability training	Teacher development	Effectiveness	Satisfaction
B9.Students' ability training	1	2	2	3
B10.Teacher development	0.5	1	1	2
B11.Effectiveness	0.5	1	1	2
B12.Satisfaction	1/3	0.5	0.5	1

Table 4.21 Analytic hierarchy process results of the judgment matrix for second-level index under the First-level "teaching achievements"

Second-level index	Feature vector	Weight	Maximum characteristic root	CI
B9.Students' ability training	1.692	0.42312	4.01	0.003
B10.Teacher development	0.909	0.22718		
B11.Effectiveness	0.909	0.22718		
B12.Satisfaction	0.49	0.12252		

Table 4.22 Consistency test results of the second level indicator judgment matrix under the first level indicator "teaching achievements"

Maximum characteristic root	CI	RI	CR	Consistency inspection results
4.01	0.003	0.882	0.004	adopt

Table 4.23 Judgement matrix of third-level index under the second-level index "Talent Training objectives"

Third-level index	Construction of quality standards for engineering talents training	Development orientation of engineering talents	Talent training reflects characteristics of running a school	Synchronization of professional construction and industry development
C1.Construction of quality standards for engineering talents training	1	1	2	2
C2.Development orientation of engineering talents	1	1	2	2
C3.Talent training reflects the characteristics of running a school	0.5	0.5	1	1
C4.Synchronization of professional construction and industry development	0.5	0.5	1	1

Table 4.24 Analytic hierarchy process results of the judgment matrix of the third-level index under the second-level index "talent training objectives"

Third-level index	Feature vector	Weight	Maximum characteristic root	CI
C1.Construction of quality standards for engineering talents training	1.333	0.33333	4	0
C2.Development orientation of engineering talents	1.333	0.33333		
C3.Talent training reflects the characteristics of running a school	0.667	0.16667		
C4.Synchronization of professional construction and industry development	0.667	0.16667		

Table 4.25 Consistency test results of the third-level index judgment matrix under the second-level index "talent training objectives"

Maximum characteristic root	CI	RI	CR	Consistency inspection results
4	0	0.882	0	adopt

Table 4.26 Third-level index judgment matrix under the second-level index "course teaching objectives"

Third-level index	Accuracy of course teaching objectives	Matching degree between course teaching objectives and students' career development	The degree of fit between the teaching objectives of the course and the formation of students' theoretical knowledge and practical ability
C5.Accuracy of course teaching objectives	1	1	1/8
C6.Matching degree between course teaching objectives and students' career development	1	1	1/8
C7.The degree of fit between the teaching objectives of the course and the formation of students' theoretical knowledge and practical ability	8	8	1

Table 4.27 Analytic hierarchy process results of the judgment matrix of the third-level index under the second-level index "course teaching objectives"

Third-level index	Feature vector	Weight	Maximum characteristic root	CI
C5.Accuracy of course teaching objectives	0.3	0.1		
C6.Matching degree between course teaching objectives and students' career development	0.3	0.1		
C7.The degree of fit between the teaching objectives of the course and the formation of students' theoretical knowledge and practical ability	2.4	0.8	3	0

Table 4.28 Consistency test results of the third-level index judgment matrix under the second- level index "course teaching objectives"

Maximum characteristic root	CI	RI	CR	Consistency inspection results
3	0	0.525	0	adopt

Table 4.29 Judgement Matrix of the third-level index under the second- level index "Facility Conditions"

Third-level index	Investment in teaching funds	Input and use of teaching equipment	Construction and utilization of training room
C8.Investment in teaching funds	1	0.5	0.2
C9.Input and use of teaching equipment	2	1	0.5
C10.Construction and utilization of training room	5	2	1

Table 4.30 Analytic hierarchy process results of the third-level index judgment matrix under the second-level index "facility conditions"

Third-level index	Feature vector	Weight	Maximum characteristic root	CI
C8.Investment in teaching funds	0.386	0.1285	3.006	0.003
C9.Input and use of teaching equipment	0.83	0.27661		
C10.Construction and utilization of training room	1.785	0.59489		

Table 4.31 Consistency test results of the third-level index judgment matrix under the second-level index "facility conditions"

Maximum characteristic root	CI	RI	CR	Consistency inspection results
3.006	0.003	0.525	0.005	adopt

Table 4.32 Judgement Matrix of the third-level index under the second- level index "Resource Construction"

Third-level index	Construction of applied teaching materials	Quality teaching resources Construction and sharing	Real project case resource sharing of industrial enterprises	School-enterprise cooperation
C11.Construction of applied teaching materials	1	1	0.25	1/9
C12.Construction and sharing of high-quality teaching resources	1	1	0.25	1/9
C13.Real project case resource sharing of industrial enterprises	4	4	1	1/6
C14.School-enterprise cooperation	9	9	6	1

Table 4.33 Analytic hierarchy process results of the third-level index judgment matrix under the second-level index "resource construction"

Third-level index	Feature vector	Weight	Maximum characteristic root	CI
C11.Construction of applied teaching materials	0.247	0.06167		
C12.Construction and sharing of high-quality teaching resources	0.247	0.06167		
C13.Real project case resource sharing of industrial enterprises	0.787	0.19667	4.123	0.041
C14.School-enterprise cooperation	2.72	0.68		

Table 4.34 Consistency test results of the third-level index judgment matrix under the second-level index "resource construction"

Maximum characteristic root	CI	RI	CR	Consistency inspection results
4.123	0.041	0.882	0.046	adopt

Table 4.35 Judgement matrix of third-level index under the second-level index "Teacher Status"

Third-level index	Teachers' professional titles	Teacher education	The proportion of teachers with more than half a year's attachment experience in enterprises	Proportion of full-time and part-time teachers	Teacher training opportunities
C15.Teachers' professional titles	1	0.5	1/6	1/6	1/6
C16.Teacher education	2	1	0.2	0.5	1/6
C17.The proportion of teachers with more than half a year's attachment experience in enterprises	6	5	1	2	0.5
C18.Proportion of full-time and part-time teachers	6	2	0.5	1	0.5
C19.Teacher training opportunities	6	6	2	2	1

Table 4.36 Analytic hierarchy process results of the judgment matrix for the third-level index under the second-level index "teacher status"

Third-level index	Feature vector	Weight	Maximum characteristic root	CI
C15.Teachers' professional titles	0.226	0.04521	5.134	0.033
C16.Teacher education	0.376	0.07512		
C17.The proportion of teachers with more than half a year's attachment experience in enterprises	1.456	0.29128		
C18.Proportion of full-time and part-time teachers	0.944	0.18874		
C19.Teacher training opportunities	1.998	0.39965		

Table 4.37 Consistency test results of the third-level index judgment matrix under the second- level index "teacher status"

Maximum characteristic root	CI	RI	CR	Consistency inspection results
5.134	0.033	1.11	0.03	adopt

Table 4.38 Judgement matrix of third-level index under the second-level index "Student learning situation"

Third-level index	Students' interest in learning	Students' study habits	Students' learning methods	Students' learning consciousness	Cooperation among students
C20.Students' interest in learning	1	1	0.25	4	4
C21.Students' study habits	1	1	0.25	5	4
C22.Students' learning methods	4	4	1	5	5
C23.Students' learning consciousness	0.25	0.2	0.2	1	3
C24.Cooperation among students	0.25	0.25	0.2	1/3	1

Table 4.39 Analytic hierarchy process results of the judgment matrix of the third-level index under the second-level index "student learning situation"

Third-level index	Feature vector	Weight	Maximum characteristic root	CI
C20.Students' interest in learning	0.937	0.18733		
C21.Students' study habits	1.002	0.20037		
C22.Students' learning methods	2.382	0.47641	5.423	0.106
C23.Students' learning consciousness	0.416	0.08328		
C24.Cooperation among students	0.263	0.05261		

Table 4.40 Consistency test results of the third-level index judgment matrix under the second-level index "student learning status"

Maximum characteristic root	CI	RI	CR	Consistency inspection results
5.423	0.106	1.11	0.095	adopt

Table 4.41 Judgement matrix of third-level index under the second-level index "Teaching resources "

Third-level index	C25	C26	C27	C28	C29	C30	C31	C32	C33	C34	C35	C36
C25	1	1/3	1/9	1/6	0.125	1/3	1/3	1/9	0.125	1/3	1	1/3
C26	3	1	1/7	1/3	0.25	1	0.5	1/7	1/6	1	1	0.5
C27	9	7	1	6	2	8	6	2	2	8	8	6
C28	6	3	1/6	1	1	7	3	2	2	6	6	4
C29	8	4	0.5	1	1	6	2	1	2	6	6	6
C30	3	1	0.125	1/7	1/6	1	0.25	1/7	1/6	1/3	1/3	1/3
C31	3	2	1/6	1/3	0.5	4	1	1/6	1/6	1	1	0.5
C32	9	7	0.5	0.5	1	7	6	1	6	3	6	3
C33	8	6	0.5	0.5	0.5	6	6	1/6	1	4	3	4
C34	3	1	0.125	1/6	1/6	3	1	1/3	0.25	1	1/3	1/4
C35	1	1	0.125	1/6	1/6	3	1	1/6	1/3	3	1	1
C36	3	2	1/6	0.25	1/6	3	2	1/3	0.25	4	1	1

Because there are many third-level indicators under the second-level indicator "Teaching resources ", it is not convenient for typesetting, so C25-C36 is used instead.

C25: Fit between teaching content and talent training objectives	C31. Control of teaching difficulty
C26. Integration of professional ideological and political education	C32. Implementation of practical teaching
C27. Teachers' moral performance	C33. Rationality of proportion arrangement of practical courses
C28. The degree of teachers' teaching energy input	C34. Usage of teaching methods
C29. Implementation of teaching plan	C35. Scientific situation of curriculum arrangement
C30. Systematic situation of teaching content	C36. Teachers' Guidance Effect on Students

Table 4.42 Analytic hierarchy process results of the judgment matrix of the third-level index under the second-level index "Teaching resources "

Third-level index	Feature vector	Weight	Maximum characteristic root	CI
C25	0.183	0.01523		
C26	0.329	0.02743		
C27	2.921	0.24342		
C28	1.602	0.13347		
C29	1.644	0.13702		
C30	0.243	0.02023	13.3	0.118
C31	0.481	0.04006		
C32	1.943	0.16189		
C33	1.327	0.11056		
C34	0.357	0.02974		
C35	0.406	0.03381		
C36	0.566	0.04714		

Table 4.43 Consistency test results of the third-level index judgment matrix under the second- level index "Teaching resources "

Maximum characteristic root	CI	RI	CR	Consistency inspection results
13.3	0.118	1.536	0.077	adopt

Table 4.44 Judgement Matrix of the third-level index under the second-level index "Quality Management"

Third-level index	Establishment of quality evaluation system	Quality of teaching materials	Teaching management situation
C37.Establishment of quality evaluation system	1	1	1/6
C38.Quality of teaching materials	1	1	1/6
C39.Teaching management situation	6	6	1

Table 4.45 Hierarchical analysis results of the third-level index judgment matrix under the second- level index "quality management"

Third-level index	Feature vector	Weight	Maximum characteristic root	CI
C37.Establishment of quality evaluation system	0.375	0.125		
C38.Quality of teaching materials	0.375	0.125	3	0
C39.Teaching management situation	2.25	0.75		

Table 4.46 Consistency test results of the third-level index judgment matrix under the second-level index "quality management"

Maximum characteristic root	CI	RI	CR	Consistency inspection results
3	0	0.525	0	adopt

Table 4.47 Judgment Matrix of Third-level Index under the Second-level Index "Student ability cultivation"

Third-level index	Degree of theoretical knowledge mastery	Practical operation ability	Ability to solve complex engineering problem	Training students' ability of coordination and cooperation	Possess good teamwork spirit	Training students' independent innovation ability	Participation in competition awards
C40.Degree of theoretical knowledge mastery	1	1/6	0.25	0.25	0.25	0.25	1
C41.Practical operation ability	6	1	4	4	2	4	6
C42.Ability to solve complex engineering problem	4	0.25	1	2	0.5	4	4
C43.Training students' ability of coordination and cooperation	4	0.25	0.5	1	0.5	1	4
C44.Possess good teamwork spirit	4	0.5	2	2	1	4	4
C45.Training students' independent innovation ability	4	0.25	0.25	1	0.25	1	2
C46.Participation in competition awards	1	1/6	0.25	0.25	0.25	0.5	1

Table 4.48 Analytic hierarchy process results of the judgment matrix of the third-level index under the second-level index "student ability cultivation"

Third-level index	Feature vector	Weight	Maximum characteristic root	CI
C40.Degree of theoretical knowledge mastery	0.275	0.03933		
C41.Practical operation ability	2.468	0.35255		
C42.Ability to solve complex engineering problem	1.133	0.16191		
C43.Training students' ability of coordination and cooperation	0.774	0.11059	7.389	0.065
C44.Possess good teamwork spirit	1.457	0.20809		
C45.Training students' independent innovation ability	0.6	0.08576		
C46.Participation in competition awards	0.292	0.04175		

Table 4.49 Consistency test results of the third-level index judgment matrix under the second-level index "student ability cultivation"

Maximum characteristic root	CI	RI	CR	Consistency inspection results
7.389	0.065	1.341	0.048	adopt

Table 4.50 Judgment Matrix of Third-level index under the Second-level Index "Teacher Development"

Third-level index	The improvement degree of teachers' professional ability	The improvement degree of teachers' teaching ability
C47.The improvement degree of teachers' professional ability	1	1/3
C48.The improvement degree of teachers' teaching ability	3	1

Table 4.51 Analytic hierarchy process results of the judgment matrix for the Third-level index under the Second-Level Index "Teacher Development"

Third-level index	Weight
C47.The improvement degree of teachers' professional ability	0.25
C48.The improvement degree of teachers' teaching ability	0.75

Table 4.52 Third-level index judgment matrix under the second-level indicator "effectiveness"

Third-level index	The orderly operation of all aspects of school personnel training	Continuous improvement and promotion of talent training in schools
C49.The orderly operation of all aspects of school personnel training	1	1/4
C50.Continuous improvement and promotion of talent training in schools	4	1

Table 4.53 Weights of Third-level index under the "validity" of Second-level index

Third-level index	Weight
C49.The orderly operation of all aspects of school personnel training	0.181818
C50.Continuous improvement and promotion of talent training in schools	0.818182

Table 4.54 Judgement Matrix of Third-level index under Second-level index "Satisfaction"

Third-level index	Students' Satisfaction with Learning and Growth	Teachers' Satisfaction with School Education
C51.Students' Satisfaction with Learning and Growth	1	4
C52.Teachers' Satisfaction with School Education	1/4	1

Table 4.55 Weights of Third-level index under Second-level index "satisfaction"

Third-level index	Weight
C51.Students' Satisfaction with Learning and Growth	0.80
C52.Teachers' Satisfaction with School Education	0.20

Table 4.56 Consistency test results and weight of the second-level index judgment matrix under the first-level index

First-level index	weights	Maximum characteristic root	CI	RI	CR	Consistency inspection results
A1	0.0616	/	/	/	/	/
A2	0.1272	3.1	0.05	0.525	0.017	adopt
A3	0.7183	3.018	0.009	0.525	0.095	adopt
A4	0.0929	4.01	0.003	0.882	0.004	adopt

Table 4.57 Consistency test results and weight of the third-level index judgment matrix under the second-level index

Second-level index	weights	Maximum characteristic root	CI	RI	CR	Consistency inspection results
B1	0.8000	4	0	0.882	0	adopt
B2	0.2000	3	0	0.525	0	adopt
B3	1.7879	3.006	0.003	0.525	0.005	adopt
B4	0.0818	4.123	0.041	0.882	0.046	adopt
B5	0.7393	5.134	0.033	1.11	0.03	adopt
B6	0.7075	5.423	0.106	1.11	0.095	adopt
B7	0.1364	13.3	0.118	1.536	0.077	adopt
B8	0.1561	3	0	0.525	0	adopt
B9	0.4231	7.389	0.065	1.341	0.048	adopt
B10	0.2272	/	/	/	/	/
B11	0.2272	/	/	/	/	/
B12	0.1225	/	/	/	/	/

Table 4.58 The Weights of Indexes at third-levels of the teaching evaluation system on engineering for applied university in China

Third-level index weights/Comprehensive weight	Third-level index weights/Comprehensive weight	Third-level index weights/Comprehensive weight	Third-level index weights/Comprehensive weight
C1	C14	C27	C40
0.333330/0.016435	0.680000/0.007074	0.243420/0.023856	0.039330/0.001546
C2	C15	C28	C41
0.333330/0.016435	0.045210/0.004250	0.133470/0.013081	0.352550/0.013859
C3	C16	C29	C42
0.166670/0.008217	0.075120/0.007062	0.137020/0.013429	0.161910/0.006365
C4	C17	C30	C43
0.166670/0.008217	0.291280/0.027384	0.020230/0.001983	0.110590/0.004348
C5	C18	C31	C44
0.100000/0.001233	0.188740/0.017744	0.040060/0.003926	0.208090/0.008180
C6	C19	C32	C45
0.100000/0.001233	0.399650/0.037572	0.161890/0.015866	0.085760/0.003371
C7	C20	C33	C46
0.800000/0.009861	0.187330/0.095203	0.110560/0.010835	0.041750/0.001641
C8	C21	C34	C47
0.128500/0.002921	0.200370/0.101830	0.029740/0.002915	0.250000/0.003518
C9	C22	C35	C48
0.276610/0.006288	0.476410/0.242117	0.033810/0.003314	0.750000/0.014228
C10	C23	C36	C49
0.594890/0.013524	0.083280/0.042324	0.047140/0.004620	0.181818/0.003838
C11	C24	C37	C50
0.061670/0.000642	0.052610/0.026737	0.125000/0.014011	0.818181/0.017270
C12	C25	C38	C51
0.061670/0.000642	0.015230/0.001493	0.125000/0.014011	0.800000/0.009107
C13	C26	C39	C52

0.196670/0.002046	0.027430/0.002688	0.750000/0.084068	0.200000/0.002277

The tables present the consistency test results and weights of the second-level and third-level index judgment matrices, respectively, under the first-level and second-level indexes in the teaching evaluation system on engineering for applied university in China. The consistency test results are used to assess the reliability and consistency of the judgments made by the evaluators.In the consistency test, the RI value of the second-level matrix is 0, and the second-level matrix itself already exhibits consistency. Therefore, consistency tests were not conducted for A1, B10, B11, and B12. Only the weights were calculated for these indexes.the table shows the results of a consistency test for a judgment matrix. The CR value being less than 0.1 suggests that the judgments made in the matrix are considered to be sufficiently consistent for use in decision-making. This is a positive result, as it indicates that the decision-makers' judgments align reasonably well with the principles of the Analytic Hierarchy Process or a similar decision-making methodology.The tables suggest that most of the judgments made by the evaluators in the teaching evaluation system are consistent and reliable. The consistency tests are crucial for ensuring the accuracy and validity of the evaluation system, and the adoption of most of the tests in both tables indicates that the system's structure is reliable and well-balanced.

In the process of evaluating and prioritizing indicators, a crucial step is to calculate the comprehensive weight values that reflect the relative importance of each indicator in the hierarchy. This ensures a well-balanced assessment and decision-making process. To achieve this, a hierarchical approach is employed. First, we calculate the weight values for the primary indicators, considering their overarching significance in the evaluation process. These primary weights are then multiplied by the weight values assigned to each secondary indicator. This multiplication yields the comprehensive weight values for each secondary indicator, indicating their relative importance within their respective primary categories. Furthermore, this hierarchical progression continues to the third level of indicators, where the weight values of each third-level indicator are multiplied by the comprehensive weight values of their corresponding second-level indicators. This step refines the granularity of our assessment, giving us comprehensive weights for the third-level indicators.Finally, with these comprehensive weight values in

place, the indicators are systematically sorted in descending order. This sorting process allows decision-makers to focus on the most crucial aspects first, ensuring that the highest-priority indicators are given the attention they deserve.

By employing this comprehensive weight calculation and hierarchical sorting method, organizations and evaluators can make informed decisions, allocate resources effectively, and prioritize actions based on a robust understanding of the relative importance of each indicator in the evaluation framework. This systematic approach enhances decision-making processes and helps achieve desired outcomes efficiently.

Table 4.59 Overall ranking of teaching evaluation system on engineering for applied in China

First-level index	Weight	Second-level index	Weight	Comprehensive weight	Third-level index	Weight	Comprehensive weight	Sort
A1. Teaching background	0.061630	B1. Talent training objectives	0.800000	0.049304	C1. Construction of quality standards for engineering talents training	0.33333	0.016435	12
					C2. Development orientation of engineering talents	0.33333	0.016435	13
					C3. Talent training reflects the characteristics of running a school	0.16667	0.008217	25
					C4. Synchronization of professional construction and industry	0.16667	0.008217	26
		B2. Course teaching objectives	0.200000	0.012326	C5. Accuracy of course teaching objectives	0.10000	0.001233	49
					C6. Matching degree between course teaching objectives and students' career development	0.10000	0.001233	50
					C7. The degree of fit between the teaching objectives of the course and the formation of students' theoretical knowledge and practical ability	0.80000	0.009861	23

A2. Teaching input	0.127150	B3. Facility conditions	0.178790	0.022733	C8. Investment in teaching funds	0.12850	0.002921	40
					C9. Input and use of teaching equipment	0.27661	0.006288	31
					C10. Construction and utilization of training room	0.59489	0.013524	19

Table 4.59 Overall ranking of teaching evaluation system on engineering for applied in China(Cont.)

First-level index	Weight	Second-level index	Weight	Comprehensive weight	Third-level index	Weight	Comprehensive weight	Sort
A2. Teaching input		B4. Resource construction	0.081820	0.010403	C11. Construction of applied teaching materials	0.06167	0.000642	51
					C12. Construction and sharing of high-quality teaching resources	0.06167	0.000642	52
					C13. Real project case resource sharing of industrial enterprises	0.19667	0.002046	44
					C14. School-enterprise cooperation	0.68000	0.007074	28
		B5. Teacher status	0.739390	0.094013	C15. Teachers' professional titles	0.04521	0.004250	34
					C16. Teacher education	0.07512	0.007062	29
					C17. The proportion of teachers with more than half a year's attachment experience in enterprises	0.29128	0.027384	7

					C18. Proportion of full-time and part-time teachers	0.18874	0.017744	10
					C19. Teacher training opportunities	0.39965	0.037572	6
A3. Teaching process	0.718300	B6. Students' learning situation	0.707520	0.508212	C20. Students' interest in learning	0.18733	0.095203	3
					C21. Students' study habits	0.20037	0.101830	2
					C22. Students' learning methods	0.47641	0.242117	1
					C23. Students' learning consciousness	0.08328	0.042324	5
					C24. Cooperation among students	0.05261	0.026737	8
		B7. Teaching resources	0.136440	0.098005	C25. Fit between teaching content and talent training objectives	0.01523	0.001493	48

Table 4.59 Overall ranking of teaching evaluation system on engineering for applied in China(Cont.)

First-level index	Weight	Second-level index	Weight	Comprehensive weight	Third-level index	Weight	Comprehensive weight	Sort
A3. Teaching process		B7. Teaching resources			C26. Integration of professional ideological and political education	0.02743	0.002688	42
					C27. Teachers' moral performance	0.24342	0.023856	9
					C28. The degree of teachers' teaching energy input	0.13347	0.013081	21
					C29. Implementation of teaching plan	0.13702	0.013429	20
					C30. Systematic situation of teaching content	0.02023	0.001983	45
					C31. Control of teaching difficulty	0.04006	0.003926	35

					C32. Implementation of practical teaching	0.16189	0.015866	14
					C33. Rationality of proportion arrangement of practical courses	0.11056	0.010835	22
					C34. Usage of teaching methods	0.02974	0.002915	41
					C35. Scientific situation of curriculum arrangement	0.03381	0.003314	39
					C36. Teachers' Guidance Effect on Students	0.04714	0.004620	32
		B8. Quality management	0.156050	0.112091	C37. Establishment of quality evaluation system	0.12500	0.014011	16
					C38. Quality of teaching materials	0.12500	0.014011	17
					C39. Teaching management	0.75000	0.084068	4
A4. Teaching achievements	0.092910	B9.Student ability cultivation	0.423120	0.039312	C40. Degree of theoretical knowledge mastery	0.03933	0.001546	47
					C41. Practical operation ability	0.35255	0.013859	18
					C42.Ability to solve complex engineering problem	0.16191	0.006365	30

Table 4.59 Overall ranking of teaching evaluation system on engineering for applied in China(Cont.)

First-level index	Weight	Second-level index	Weight	Comprehensive weight	Third-level index	Weight	Comprehensive weight	Sort
A4. Teaching achievements	0.092910	B9.Student ability cultivation	0.423120	0.039312	C43. Training students' ability of coordination and cooperation	0.11059	0.004348	33
					C44. Possess good teamwork spirit	0.20809	0.008180	27
					C45. Training students' independent innovation ability	0.08576	0.003371	38
					C46. Participation in competition awards	0.041750	0.001641	46
		B10. Teacher	0.227180	0.021107	C47. The improvement of	0.250000	0.003518	37

	development			teachers' professional ability			
				C48. The improvement of teachers' teaching ability	0.750000	0.014228	15
	B11. Effectiveness	0.227180	0.021107	C49. Orderly operation of all aspects of school personnel training	0.181818	0.003838	36
				C50. Continuous improvement and promotion of personnel training in schools	0.818182	0.017270	11
	B12. Satisfaction	0.122520	0.011383	C51. Students' satisfaction with learning and growth	0.800000	0.009107	24
				C52. Teachers' satisfaction with school education	0.200000	0.002277	43

The weightings presented in Table 4.59 provide valuable insights into the hierarchical importance of various factors within the teaching evaluation system. These weights offer a structured view of the criteria that carry the most significance in assessing the quality of teaching at an applied university.At the first level, "Teaching process" emerges as the most critical criterion, reflecting the overarching importance of how teaching is conducted in the evaluation process. This encompasses pedagogical methods, classroom dynamics, and the overall teaching approach.Following closely behind is "Teaching input," underscoring the significance of resources, curriculum design, and the tools available for effective instruction. It highlights the essential role of well-planned and adequately resourced teaching in achieving educational goals."Teaching achievement" comes next, acknowledging the outcome-oriented aspect of teaching. This index emphasizes the real impact of teaching on students, including their performance, learning outcomes, and practical application of knowledge.Lastly, "Teaching background" holds the lowest weight at the first level. While qualifications and expertise are important, this weight suggests that they are secondary to the actual teaching process, input, and achievement.Delving further into the second-level indices, it becomes evident that "Students' learning situation" holds the highest importance. This underscores the centrality of understanding and addressing students' needs and experiences in the learning

process."Quality management" follows closely, emphasizing the need for efficient and effective management practices within the educational context. This includes organizational aspects that contribute to the overall quality of teaching.

"Teaching resources," "Teacher status," and "Talent training objectives" complete the top five second-level indices, further emphasizing the multifaceted nature of effective teaching, which encompasses resources, instructor qualifications, and alignment with broader educational goals.Moving to the third-level indices, "Students' learning methods" assumes paramount importance, as it directly influences how students engage with course content and absorb knowledge. It is closely followed by "Students' study habits" and "Students' interest in learning," all of which center on student engagement and motivation."Teaching management situation" and "Students' learning consciousness" complete the top five third-level indices, highlighting the importance of effective classroom management and cultivating a positive learning mindset among students.Interestingly, the last three indices, "Matching degree between course teaching objectives and students' career development," "Construction of applied teaching materials," and "Construction and sharing of high-quality teaching resources," hold lower weights. While not negligible, these indices suggest that there is room for improvement in these areas to align them more closely with the overall teaching objectives and priorities.

In summary, these weightings provide a comprehensive framework for assessing and improving the quality of teaching at an applied university. They offer valuable guidance for educators and administrators seeking to enhance teaching processes, resources, and outcomes, ultimately benefiting both students and the institution as a whole.

4.2.2 To Identify and Develop a Teaching Evaluation System on Engineering for Applied University in China.

Sichuan University of Science & Engineering was selected as participant. The university is a national public university and a general full-time applied university. It included engineering, science, management, education, literature, history, art, law, economics and other nine disciplines. The university has 20 colleges, ten colleges of which are engineering colleges. Engineering is the main major of the university.

The process of evaluation is mainly based on interview and observation. First of all, the teaching evaluation system on engineering for applied university is observed in class by the observation method, and the teaching process including students' learning status, teaching and quality management is observed. After the observation, the grade is scored against the three indexes of the teaching evaluation system. The contents of the three indexes of teaching background, teaching input and teaching achievement are included by using the interview method. Students, teachers and relevant administrators are respectively interviewed and scored according to the interview results.

The total score of each indicator is set to be ten, and the scoring grade is divided into five levels:

1.1≤ score ≤3 is too poor,

2.3 < score < 6 is poor,

3.6≤ score ≤7 is pass,

4.7 < score ≤8 is qualified,

5.8 < score ≤10 is excellent.

The score of the third-level index under the second-level index is multiplied by the corresponding weight and then summed to obtain the score of the second-level index; similarly, the score of the second-level index under the first-level index is multiplied by the corresponding weight and then summed to obtain the score of the first-level index; the score of the four first-level index is added to obtain the total score of the teaching evaluation of the engineering cost course in Sichuan University of Science & Engineering.

Table 4.60 Sichuan University of Science & Engineering score table

First-level index	Weight	Score	Second-level index	Weight	Score	Third-level index	Weight	Score
A1. Teaching background	0.06163	8	B1. Talent training objectives	0.800000	8	C1. Construction of quality standards for engineering talents training	0.33333	8
						C2. Development orientation of engineering talents	0.33333	7

						C3. Talent training reflects the characteristics of running a school	0.16667	9
						C4.Synchronization of professional construction and industry	0.16667	9
			B2. Course teaching objectives	0.200000	8	C5. Accuracy of course teaching objectives	0.10000	8
						C6. Matching degree between course teaching objectives and students' career development	0.10000	8
						C7. The degree of fit between the teaching objectives of the course and the formation of students' theoretical knowledge and practical ability	0.80000	8
A2. Teaching input	0.127150	7.2432	B3. Facility conditions	0.178790	7.4051	C8. Investment in teaching funds	0.12850	8
						C9. Input and use of teaching equipment	0.27661	8
						C10. Construction and utilization of training room	0.59489	7

Table 4.60 Sichuan University of Science & Engineering score table（Cont.)

First-level index	Weight	Second-level index	Weight	Sort	Third-level index	Weight	Sort
A2. Teaching input		B4. Resource construction	0.081820	8	C11. Construction of applied teaching materials	0.06167	8
					C12. Construction and sharing of high-quality teaching resources	0.06167	8

					C13. Real project case resource sharing of industrial enterprises	0.19667	8
					C14. School-enterprise cooperation	0.68000	8
		B5. Teacher status	0.739390	7.1203	C15. Teachers' professional titles	0.04521	8
					C16. Teacher education	0.07512	8
					C17. The proportion of teachers with more than half a year's attachment experience in enterprises	0.29128	7
					C18. Proportion of full-time and part-time teachers	0.18874	7
					C19. Teacher training opportunities	0.39965	7
A3. Teaching process	0.718300	B6. Students' learning situation	0.707520	7.9682	C20. Students' interest in learning	0.18733	9
					C21. Students' study habits	0.20037	8
					C22. Students' learning methods	0.47641	8
					C23. Students' learning consciousness	0.08328	6
					C24. Cooperation among students	0.05261	7
		B7. Teaching resources	0.136440	7.8255	C25. Fit between teaching content and talent training objectives	0.01523	7
					C26. Integration of professional ideological and political education	0.02743	9
					C27. Teachers' moral performance	0.24342	9

Table 4.60 Sichuan University of Science & Engineering score table（Cont.)

First-level index	Weight	Second-level index	Weight	Sort	Third-level index	Weight	Sort
A3. Teaching process		B7. Teaching resources		7.8255	C28. The degree of teachers' teaching energy input	0.13347	8
					C29. Implementation of teaching plan	0.13702	8

					C30. Systematic situation of teaching content	0.02023	7
					C31. Control of teaching difficulty	0.04006	7
					C32. Implementation of practical teaching	0.16189	7
					C33. Rationality of proportion arrangement of practical courses	0.11056	7
					C34. Usage of teaching methods	0.02974	7
					C35. Scientific situation of curriculum arrangement	0.03381	6
					C36. Teachers' Guidance Effect on Students	0.04714	8
		B8. Quality management	0.156050	8	C37. Establishment of quality evaluation system	0.12500	8
					C38. Quality of teaching materials	0.12500	8
					C39. Teaching management	0.75000	8
A4. Teaching achievements	0.092910	B9.Student ability cultivation	0.423120		C40. Degree of theoretical knowledge mastery	0.03933	8
				7.9583	C41. Practical operation ability	0.35255	8
					C42.Ability to solve complex engineering problem	0.16191	8
					C43. Training students' ability of coordination and cooperation	0.11059	8
					C44. Possess good teamwork spirit	0.20809	8
					C45. Training students' independent innovation ability	0.08576	8

Table 4.60 Sichuan University of Science & Engineering score table（Cont.)

First-level index	Weight	Second-level index	Weight	Sort	Third-level index	Weight	Sort
					C46. Participation in competition awards	0.04175	7

A4. Teaching achievements	0.092910	B10. Teacher development	0.227180	7.6667	C47. The improvement of teachers' professional ability	0.16667	7
					C48. The improvement of teachers' teaching ability	0.16667	7
		B11. Effectiveness	0.227180	7.3636	C49. Orderly operation of all aspects of school personnel training	0.18182	9
					C50. Continuous improvement and promotion of personnel training in schools	0.81818	7
		B12. Satisfaction	0.122520	8	C51. Students' satisfaction with learning and growth	0.80000	8
					C52. Teachers' satisfaction with school education	0.20000	8

The total score (A) of the teaching evaluation system on engineering for applied university in China of Sichuan University of Science & Engineering is:

A=A1*0.06163+A2*0.12715+A3*0.71830+A4*0.09291=8*0.06163+7.2432 *0.12715+7.9538*0.71830+7.7621*0.09291=7.8484

4.3 Structural Equation Modeling Analysis

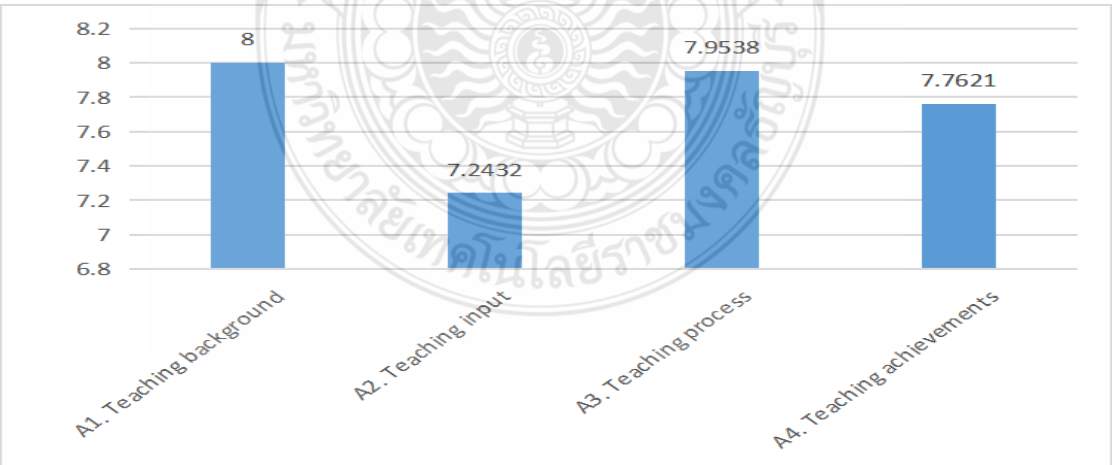

Figure 4.1 First-level index score

Figure 4.1 provides valuable insights into the engineering teaching evaluation at Sichuan University of Science & Engineering. The overall score of 7.8484 falls within the qualified range, indicating a respectable level of teaching quality across various dimensions. When delving into the first-level indices, a few noteworthy observations emerge.The highest score, 8, in the teaching background index highlights the institution's commendable efforts in ensuring that instructors possess the necessary qualifications and expertise in the field of engineering. This is a crucial foundation for effective teaching and academic excellence.On the other hand, the teaching input index, with a score of 7.2432, appears to be the lowest among the first-level indices. While it is lower in comparison, it's important to note that this score still falls within the qualified range. This suggests that there may be opportunities to further enhance the resources, curriculum, and teaching materials to optimize the learning experience for students.What's particularly reassuring is the minimal difference in scores among the four first-level indices. This consistency suggests a balanced approach to teaching quality across multiple dimensions, with all areas meeting the qualified standards.

In summary, Sichuan University of Science & Engineering has achieved a commendable overall score in its engineering teaching evaluation. The institution excels in teaching background while recognizing the potential for improvement in teaching input. The consistency in scores across various indices reflects a well-rounded and qualified educational environment, providing a strong foundation for ongoing enhancements in engineering education.

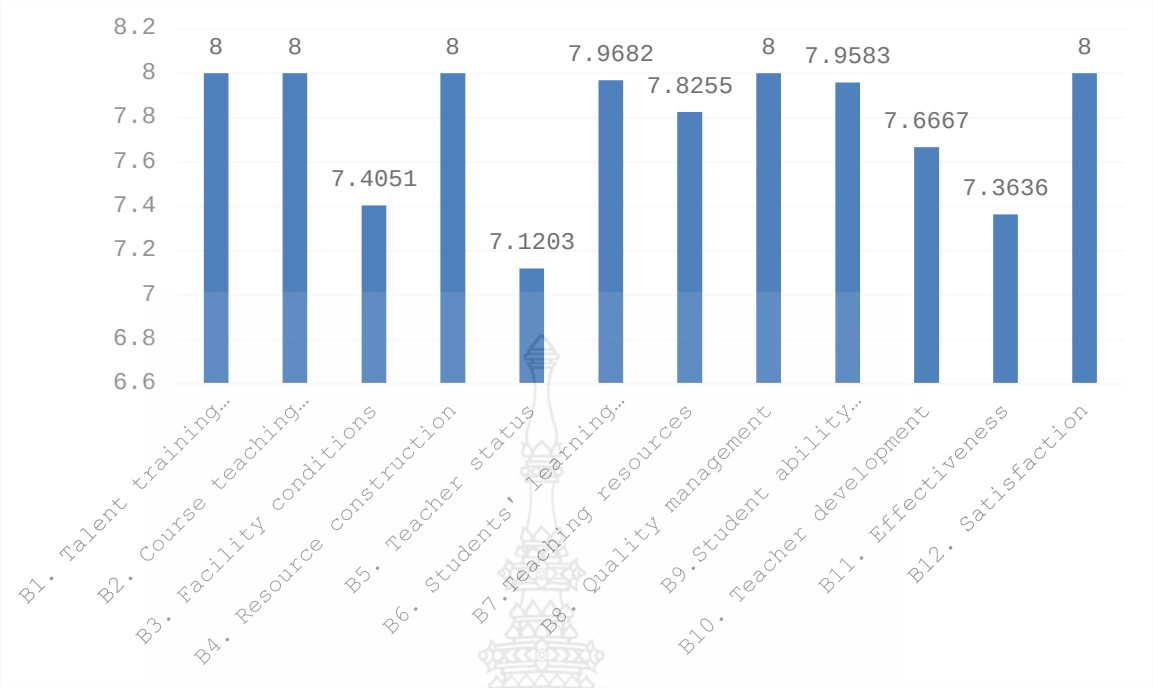

Figure 4.2 Second-level index score

In Figure 4.2, a detailed analysis of the second-level indices reveals valuable insights into the overall performance of Sichuan University of Science & Engineering's educational system. Notably, the teacher status, with a score of 7.1203, stands out as an area that requires attention and improvement. This lower score indicates that there may be room for enhancing the qualifications and professional development of faculty members, which can significantly impact the quality of education.Additionally, the effectiveness score, which is the second lowest at 7.3636, signifies a need to strengthen the teaching methods and strategies employed within the institution. Enhancing instructional techniques, adopting innovative pedagogical approaches, and fostering more engaging learning environments can contribute to improved educational outcomes.On a positive note, the five second-level indices related to talent training objectives, teaching course objectives, resource construction, quality management, and satisfaction all score an impressive 8 points. This suggests that the institution has effectively positioned its course and talent training objectives, demonstrating a clear sense of direction. Furthermore, resource allocation and quality management efforts are commendable, resulting in a well-rounded educational environment. The high

satisfaction ratings across the board indicate that students and stakeholders are generally content with various aspects of the university's educational services.

In conclusion, while there is room for improvement in teacher status and effectiveness, Sichuan University of Science & Engineering has achieved notable success in several critical areas, positioning itself as an institution with a strong commitment to providing quality education and fostering student satisfaction.

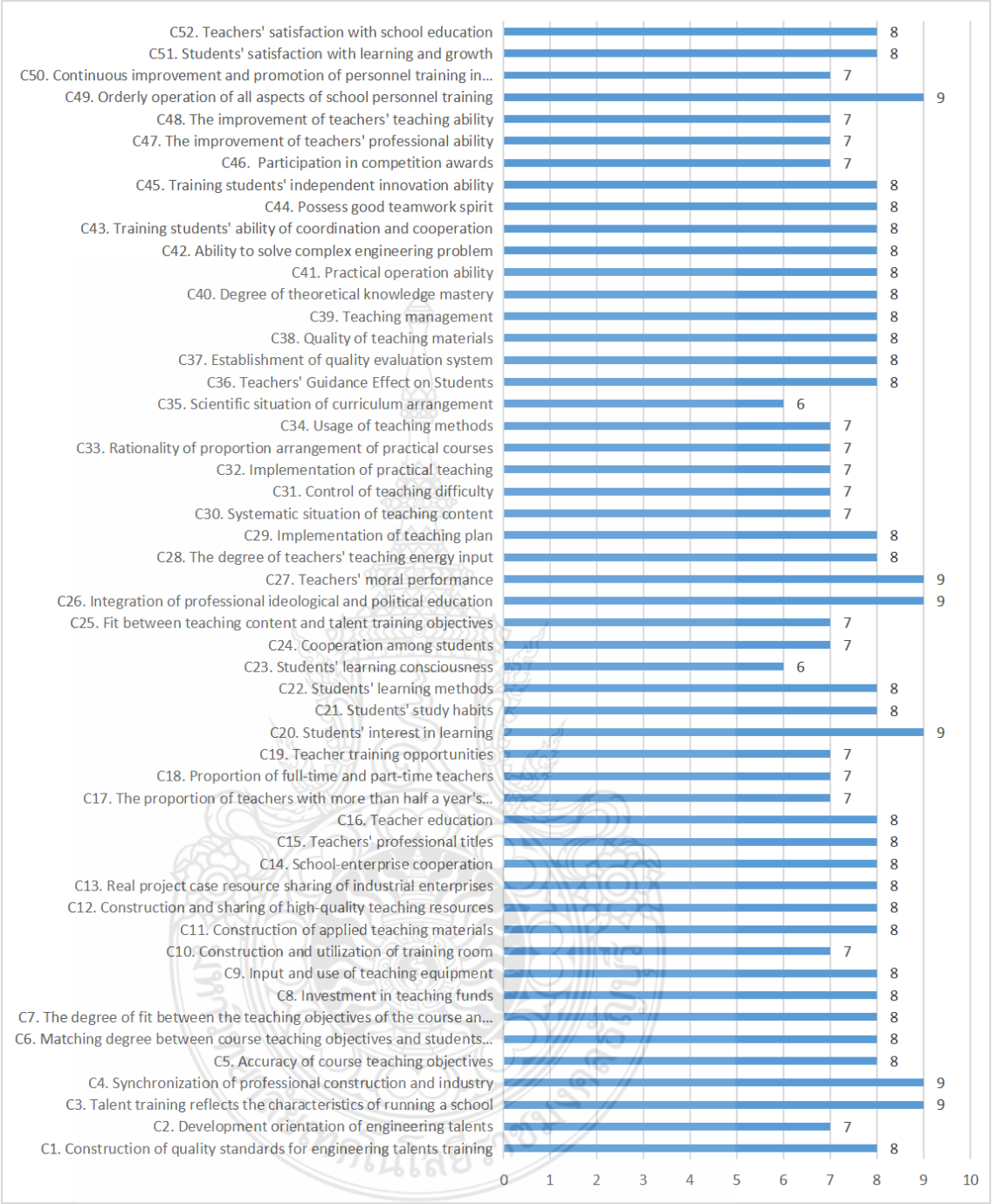

Figure 4.3 Third-level index score

In Figure 4.3, when we examine the third-level indices, we gain valuable insights into the strengths and areas for improvement within the educational framework. Notably, the lowest-scoring factor, with a rating of 6, pertains to the diversity of students' learning habits and teaching methods. This highlights a potential need for enhancing the

variety of instructional approaches and promoting a more flexible learning environment to cater to the diverse needs and preferences of students.On the positive side, several aspects within the evaluation framework shine with excellence. The highest scores are achieved in areas such as the alignment of talent training with the school's distinct characteristics and its relevance to local economic development. Furthermore, the high levels of student engagement and interest in learning, the integration of professional and ideological education, the exemplary conduct of teachers in upholding ethical standards, and the overall smooth functioning of various facets of talent training all reflect outstanding performance.

These results provide valuable guidance for further refining our educational practices. While we celebrate our strengths, they also underscore the importance of continuous improvement, particularly in fostering a dynamic and adaptable learning environment that caters to the evolving needs of our diverse student body. As we build upon our achievements, we remain committed to delivering exceptional education and nurturing the talents of our students.

CHAPTER 5 DISCUSSION AND RECOMMENDATION

The Teaching Evaluation System on Engineering for Applied Universities in China is a powerful tool to ensure the quality of engineering education. By employing clear evaluation criteria, diverse data collection methods, 1effective feedback mechanisms, and a strong focus on faculty development, the system promotes teaching excellence, enriches the learning experiences of engineering students, and contributes to the overall advancement of engineering education in applied universities in China. Continuous refinement and adaptation of the system will be essential to meet the evolving needs of engineering education and maintain high teaching standards in the dynamic engineering field.

5.1 Discussion and Recommendation

5.2 Implication for Practice and Future Research

5.1 Discussion and Recommendation

5.1.1Teaching Evaluation System for Chinese Applied Universities Based on the CIPP Model

Based on the CIPP model, this paper constructs a teaching evaluation system on engineering for applied university in China.And it was applied to the engineering courses at Sichuan University of Science & Engineering. The purpose is to verify the feasibility and operability of the evaluation index system.The result provide guidance and assistance for the engineering courses at Sichuan University of Science & Engineering. Additionally, the reseacher get improvement strategies, are proposed to address the issues identified in the teaching process.

The purpose, process, and effectiveness of the CIPP model are applicable to the teaching evaluation of engineering courses at Sichuan University of Science & Engineering. The purpose of the CIPP model is to improve teaching and focuses on developmental evaluation rather than just obtaining evaluation results. The content evaluation, input evaluation, process evaluation, and product evaluation of the CIPP model provide a comprehensive assessment of the preparatory work, mid-term work, and final outcomes of engineering teaching. Engineering courses often involve practical

components, but the traditional teaching evaluation methods are relatively limited. However, the CIPP model encompasses four stages of evaluation, allowing for comprehensive tracking, recording, and evaluation of the objectives, resource allocation, teaching process, and teaching effectiveness of practical teaching. This model enhances the importance placed on practical teaching in engineering courses.

The final perfect evaluation index system includes 4 first-level indexes, 12 second-level indexes and 52 third-level indexes. The author applies the teaching evaluation system on engineering for applied university in China based on CIPP model to the evaluation of Sichuan University of Science & Engineering. By making a score table for the teaching evaluation of the engineering cost course in Sichuan University of Science & Engineering, the classroom teaching observation and interviews with teachers, students and staff of relevant departments are scored against the score table. According to the analysis of the evaluation results, Such as, Schools do not pay enough attention to teachers, personal development and follow-up training; The orderly management and sustainable development plan of the school education work are not enough.

The teaching evaluation system on engineering for applied university in China is shown in the table5.1

Table5.1teaching evaluation system on engineering for applied university in China

First-level index	Second-level index	Third-level index
A1. Teaching background	B1. Talent training objectives	C1. Construction of quality standards for engineering talents training
		C2. Development orientation of engineering talents
		C3. Talent training reflects the characteristics of running a school
		C4. Synchronization of professional construction and industry development
	B2. Course teaching objectives	C5. Accuracy of course teaching objectives
		C6. Matching degree between course teaching objectives and students' career development
		C7. The degree of fit between the teaching objectives of the course and the formation of students' theoretical knowledge and practical ability
A2. Teaching input	B3. Facility conditions	C8. Investment in teaching funds
		C9. Input and use of teaching equipment
		C10. Construction and utilization of training room
		C11. Construction of applied teaching materials

	B4. Resource construction	C12. Construction and sharing of high-quality teaching resources
		C13. Real project case resource sharing of industrial enterprises
		C14. School-enterprise cooperation
	B5. Teacher status	C15. Teachers' professional titles
		C16. Teacher education
		C17. The proportion of teachers with more than half a year's attachment experience in enterprises
		C18. Proportion of full-time and part-time teachers
		C19. Teacher training opportunities
A3. Teaching process	B6. Students' learning situation	C20. Students' interest in learning
		C21. Students' study habits
		C22. Students' learning methods
		C23. Students' learning consciousness
		C24. Cooperation among students
	B7. Teaching resources	C25. Fit between teaching content and talent training objectives
		C26. Integration of professional ideological and political education
		C27. Teachers' moral performance
		C28. The degree of teachers' teaching energy input
		C29. Implementation of teaching plan
		C30. Systematic situation of teaching content
		C31. Control of teaching difficulty
		C32. Implementation of practical teaching

Table5.1teaching evaluation system on engineering for applied university in China(Cont.)

First-level index	Second-level index	Third-level index
		C33. Rationality of proportion arrangement of practical courses
		C34. Usage of teaching methods
		C35. Scientific situation of curriculum arrangement
		C36. Teachers' Guidance Effect on Students
	B8. Quality management	C37. Establishment of quality evaluation system
		C38. Quality of teaching materials
		C39. Teaching management
A4. Teaching achievement	B9. Student ability cultivation	C40. Degree of theoretical knowledge mastery
		C41. Practical operation ability
		C42. Ability to solve complex engineering problem
		C43. Training students' ability of coordination and cooperation
		C44. Possess good teamwork spirit
		C45. Training students' independent innovation ability

	C46. Participation in competition awards
B10. Teacher development	C47. The improvement of teachers' professional ability
	C48. The improvement of teachers' teaching ability
B11. Effectiveness	C49. Orderly operation of all aspects of school personnel training
	C50. Continuous improvement and promotion of personnel training in schools
B12. Satisfaction	C51. Students' satisfaction with learning and growth
	C52. Teachers' satisfaction with school education

5.1.2 EdPEx for teaching evaluation for engineering in china.

Engineering education evaluation can benefit significantly from the adoption of the Excellence in Performance Education Standards (EdPEx). EdPEx provides a robust framework for assessing engineering education in a way that aligns with modern educational goals and industry expectations. Here are several reasons why implementing EdPEx in engineering education evaluation is advantageous:

1. Alignment with Industry Standards:EdPEx is designed to align educational practices with industry standards and expectations. In engineering, where graduates often transition directly into the workforce, this alignment is crucial to ensure that students are adequately prepared for their careers. EdPEx can help identify areas where engineering programs can better meet industry needs.2.Focus on Continuous Improvement:EdPEx places a strong emphasis on continuous improvement. In engineering education, this means that programs can continually refine their curriculum, teaching methods, and assessment practices to stay current with evolving industry trends and emerging technologies.3. Holistic Evaluation:EdPEx considers various aspects of education, including curriculum design, teaching methods, student outcomes, and overall program effectiveness. This holistic approach allows engineering programs to evaluate their performance comprehensively and make data-driven decisions for improvement.4. Stakeholder Involvement: EdPEx encourages the involvement of multiple stakeholders, including students, faculty, employers, and industry professionals, in the evaluation process. This ensures that the assessment is well-rounded and takes into account different perspectives on educational quality.5. Student-Centered Approach:EdPEx prioritizes student success and the achievement of learning outcomes. This focus on student-centered education aligns with the goals of engineering programs to produce graduates

who are not only technically proficient but also critical thinkers, problem solvers, and effective communicators.6. Adaptability:EdPEx is adaptable to different educational contexts, allowing engineering programs to tailor their assessments to their unique missions, goals, and student populations. This flexibility is essential in the diverse landscape of engineering education.7. Global Benchmarking: EdPEx provides a framework for benchmarking engineering programs globally. This allows institutions to assess their performance in comparison to international standards, facilitating international collaboration and exchange of best practices.

In conclusion, adopting EdPEx for engineering education evaluation enhances the quality and relevance of engineering programs. It supports continuous improvement, aligns education with industry needs, and ensures that graduates are well-prepared for their engineering careers. By embracing EdPEx, engineering institutions can better meet the challenges and opportunities of modern engineering education.

5.2 Implication for Practice and Future Research

The construction of a comprehensive teaching evaluation index system for applied universities is a complex and multifaceted endeavor. This system is not something that can be adequately developed by individual efforts alone. It requires collective expertise and input to ensure its completeness and scientific validity.

Firstly, the process of building the evaluation index system demands collaboration among educators, administrators, and industry experts. Each stakeholder brings a unique perspective to the table, contributing to a well-rounded set of criteria that accurately reflects the goals and needs of applied university programs.

Secondly, the challenge of data collection and interpretation in teaching evaluation is acknowledged. Education is a highly nuanced field, and the subjectivity of assessment is inherent. Different individuals may interpret teaching quality differently, leading to variations in evaluation criteria. This inherent subjectivity underscores the importance of a holistic approach to evaluation that considers various perspectives.

Furthermore, determining the effectiveness of teaching evaluation can be elusive. Teaching effectiveness extends beyond mere numerical scores. It involves assessing long-term outcomes, such as the employability of graduates, their contributions

to society, and their ability to adapt to evolving industry demands. These factors are not easily quantifiable and require a more qualitative approach to evaluation.

Finally, the challenge of using evaluation results for continuous improvement is recognized. Applied universities often prioritize employability as a key outcome, potentially overshadowing other aspects of education. Striking a balance between employment-focused training and broader educational objectives is essential to ensure continuous improvement in all dimensions of the curriculum.

The CIPP model-based teaching evaluation system for engineering programs in Chinese applied universities, as developed through literature research and focus group discussions, presents a valuable starting point. However, it is important to note that the results are influenced by the limited number of participants, primarily experts located in China. This limitation may introduce bias into the index system.

To enhance the effectiveness and applicability of this evaluation system, several steps are essential. Firstly, the index system should undergo further refinement, incorporating diverse perspectives and experiences. This could involve engaging a broader international pool of experts to ensure a more comprehensive and globally relevant framework.

Secondly, the practicality and feasibility of the system need to be rigorously tested through additional case studies in different applied universities, both within China and abroad. This real-world testing will provide valuable insights into the system's functionality and adaptability.

In conclusion, while the CIPP model-based teaching evaluation system for engineering programs in Chinese applied universities represents a promising development, it is imperative to recognize its limitations and work towards refining and validating it through a collaborative, international, and evidence-based approach. By doing so, applied universities can ensure that their teaching evaluation processes lead to continuous improvement and better serve their educational goals.

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AppendixA.
List of Experts

The experts were:

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6. Prof. Dr.Liang Dong , Deputy Director of Science Park Management Office, Sichuan University of Science& EngineeringDoctor of Biomedical , Engineering,China.

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15 July, 2023

Dear Prof.Hu Yang, Director of Evaluation Center of Sichuan University of Science & Engineering, Expert in Undergraduate Education and Teaching Evaluation of Chinese institutions of Higher learning, China.

Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

I am writing to request your assistance as an honorary external research reviewer in evaluating the research instruments of Mrs. Luo Mingming, Doctor of Science Program in Technical Education (Vocational Education) Rajamangala University of Technology Thanyaburi, who has been working on the dissertation titled "Teaching Evaluation System on Engineering for Applied University in China". under the supervision of Assistant Professor Dr. Thosporn Sangsawang. In this regard, I would like to request your valuable time to evaluate the research instruments as I strongly believe that your expertise will be of great value in improving the research instruments.

If you have any questions or need further information, please feel free to contact Mrs. Luo Mingming, on the e-mail: mingming_l@mail.rmutt.ac.th

Yours sincerely,

(Assistant Professor Arnon Niyomphol)
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15 July, 2023

Dear Prof.Shan Sun , Director of the Academic Affairs Office of Sichuan University of Science & Engineering, Expert in Undergraduate Education and Teaching Evaluation of Chinese institutions of Higher learning,China.

Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

I am writing to request your assistance as an honorary external research reviewer in evaluating the research instruments of Mrs. Luo Mingming, Doctor of Science Program in Technical Education (Vocational Education) Rajamangala University of Technology Thanyaburi, who has been working on the dissertation titled "Teaching Evaluation System on Engineering for Applied University in China". under the supervision of Assistant Professor Dr. Thosporn Sangsawang. In this regard, I would like to request your valuable time to evaluate the research instruments as I strongly believe that your expertise will be of great value in improving the research instruments.

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15 July, 2023

Dear Prof.Fengying Mao, Teaching Supervision Expert of Evaluation Center, Sichuan University of Science & Engineering, China.

Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

I am writing to request your assistance as an honorary external research reviewer in evaluating the research instruments of Mrs. Luo Mingming, Doctor of Science Program in Technical Education (Vocational Education) Rajamangala University of Technology Thanyaburi, who has been working on the dissertation titled "Teaching Evaluation System on Engineering for Applied University in China", under the supervision of Assistant Professor Dr. Thosporn Sangsawang. In this regard, I would like to request your valuable time to evaluate the research instruments as I strongly believe that your expertise will be of great value in improving the research instruments.

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15 July, 2023

Dear Prof.Lianjun Hu, Teaching Supervision Expert of Evaluation Center, Sichuan University of Science & Engineering, China.

Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

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15 July, 2023

Dear Prof.Shikuan Wang , Teaching Supervision Expert of Evaluation Center, Sichuan University of Science & Engineering, China.

Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

I am writing to request your assistance as an honorary external research reviewer in evaluating the research instruments of Mrs. Luo Mingming, Doctor of Science Program in Technical Education (Vocational Education) Rajamangala University of Technology Thanyaburi, who has been working on the dissertation titled "Teaching Evaluation System on Engineering for Applied University in China". under the supervision of Assistant Professor Dr. Thosporn Sangsawang. In this regard, I would like to request your valuable time to evaluate the research instruments as I strongly believe that your expertise will be of great value in improving the research instruments.

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15 July, 2023

Dear Prof.Liang Dong , Deputy Director of Science Park Management Office, Sichuan University of Science & Engineering, China.

Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

I am writing to request your assistance as an honorary external research reviewer in evaluating the research instruments of Mrs. Luo Mingming, Doctor of Science Program in Technical Education (Vocational Education) Rajamangala University of Technology Thanyaburi, who has been working on the dissertation titled "Teaching Evaluation System on Engineering for Applied University in China". under the supervision of Assistant Professor Dr. Thosporn Sangsawang. In this regard, I would like to request your valuable time to evaluate the research instruments as I strongly believe that your expertise will be of great value in improving the research instruments.

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15 July, 2023

Dear Prof.Hao Wu , Deputy Director of University Science Park Management Office, Sichuan University of Science & Engineering; Deputy Director of Sichuan Province Key Laboratory of Artificial Intelligence, China.

Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

I am writing to request your assistance as an honorary external research reviewer in evaluating the research instruments of Mrs. Luo Mingming, Doctor of Science Program in Technical Education (Vocational Education) Rajamangala University of Technology Thanyaburi, who has been working on the dissertation titled "Teaching Evaluation System on Engineering for Applied University in China". under the supervision of Assistant Professor Dr. Thosporn Sangsawang. In this regard, I would like to request your valuable time to evaluate the research instruments as I strongly believe that your expertise will be of great value in improving the research instruments.

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15 July, 2023

Dear Prof.Guangzhong Hu, Dean of School of Mechanical Engineering, Sichuan University of Science & Engineering, China.

Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

I am writing to request your assistance as an honorary external research reviewer in evaluating the research instruments of Mrs. Luo Mingming, Doctor of Science Program in Technical Education (Vocational Education) Rajamangala University of Technology Thanyaburi, who has been working on the dissertation titled "Teaching Evaluation System on Engineering for Applied University in China", under the supervision of Assistant Professor Dr. Thosporn Sangsawang. In this regard, I would like to request your valuable time to evaluate the research instruments as I strongly believe that your expertise will be of great value in improving the research instruments.

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Yours sincerely,

(Assistant Professor Arnon Niyomphol)
Dean of Faculty of Technical Education

MHESI 0908.25/2023

Office of the Dean, Faculty of Technical Education
Rajamangala University of Technology Thanyaburi
Klong Luang, Pathum Thani 12110 Thailand
Tel:+66-2-549-4710 Fax:+66-2-577-5049

15 July, 2023

Dear Prof.Wei Hu , Teaching Supervision Expert of Evaluation Center, Sichuan University of Science & Engineering, China.

Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

I am writing to request your assistance as an honorary external research reviewer in evaluating the research instruments of Mrs. Luo Mingming, Doctor of Science Program in Technical Education (Vocational Education) Rajamangala University of Technology Thanyaburi, who has been working on the dissertation titled "Teaching Evaluation System on Engineering for Applied University in China". under the supervision of Assistant Professor Dr. Thosporn Sangsawang. In this regard, I would like to request your valuable time to evaluate the research instruments as I strongly believe that your expertise will be of great value in improving the research instruments.

If you have any questions or need further information, please feel free to contact Mrs. Luo Mingming, on the e-mail: mingming_l@mail.rmutt.ac.th

Yours sincerely,

(Assistant Professor Arnon Niyomphol)
Dean of Faculty of Technical Education

Appendix B

Instruments: I First Round: Brainstorming

Semi-Structured Interviews

Semi-Structured Interviews Question

Semi-Structured interviews question is associate with conceptual framework. There are four parts as in: (1) context evaluation, (2) input evaluation, (3) process evaluation, and (4)product evaluation. In this regard, experts will comment on the frame or by responding to ideas. “Please writes your specify any suggestion”

1. context evaluation	
	What do you think should be included in the context evaluation? For example :
Please selects your specify any suggestion in blank.	
….....	1)The goal of running a school
…….	2)The idea of running a school
…….	3) The conditions of running a school.
…….	4) School development planning content
…….	5) Implementation guarantee
….....	6) The goal of talent training.
…….	7) Development effect.
…….	8) Culture program.
…….	9) Curriculum standard.
…….	10) The construction of ideological and political work system and the establishment of the work pattern of "three full educations".
…….	11) Ideological and political courses full-time teachers and converted students.
…….	12) The proportion of the total number of full-time party affairs staff and ideological and political staff to the number of teachers and students in the school.
…….	13)Each student has a special fund for ideological and political work and the construction of party affairs staff.
…….	14) Per capita network ideological and political work special funds..

…….	15) How the establishment and construction of the major fit with the national needs, regional economic and social development and industrial development to the needs of applied talents.
…….	16) Teaching fund.
…….	17)Teaching resource condition.
…….	18)Teacher energy engagement..
…….	19)The degree of matching with students' career developmentInstructors use instructional media to create situations of nine reasons.
Please writes your specify any suggestion.	
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2. Input evaluation	
	What do you think should be included in the input evaluation? For example:
Please selects your specify any suggestion in blank	
……..	1) Teaching staff structure.
……..	2) Student-teacher ratio..
……..	3) Teacher's teaching ability.

……..	4) Teacher professional level.
……..	5)Teacher innovation ability..
……..	6) Teacher engineering experience.
……..	7) Teacher communication ability.
……..	8) Ability to carry out research on practical engineering problems.
……..	9) Ability to participate in academic exchanges.
……..	10) Facilities and equipment.
……..	11) Teaching management team.
……..	12) Teaching management level.
……..	13) The input and use of teaching equipment.
……..	14) Construction and utilization of the laboratory.
……..	15) Construction of applied teaching materials.
……..	16) Construction and sharing of high-quality teaching resources.
……..	17) Industry enterprises real project case resource sharing.
……..	18) School-enterprise cooperation.
……..	19)Teacher status.
……..	20)Teachers' professional titles.
……..	21) Educational background of teachers
……..	22) The proportion of teachers with temporary work experience in enterprises.
……..	23) Proportion of full-time and part-time teachers.
……..	24) Teacher training opportunities..
……..	29) Schools and enterprises and industry units to build practice training base.
……..	30) The topic of graduation thesis comes from the needs of the industry and enterprises, the implementation of the school-enterprise "double tutor" system and the quality of completion.
……..	31) The effect of the cultivation mode of outstanding talents integrating production and education.
……..	32) Results of innovation and entrepreneurship education.

Please writes your specify any suggestion.

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3. Process evaluation	
	What do you think should be included in the process evaluation? For example:
Please selects your specify any suggestion in blank.	
……..	1) Students' learning interests.
……..	2) Students' learning habits.
……..	3) Students' learning methods.
……..	4) Students' learning consciousness.
……..	5) Students' cooperation.
……..	6) Students' ability to apply knowledge comprehensively and solve practical problems in production, management and service independently students' international perspective.
……..	7) Leaders and teachers' participation in students' work.
……..	8) The degree of conformity between teaching content and talent training objectives.
……..	9) The integration of professional ideological and political education
……..	10) The performance of teachers' ethics.
……..	11) The degree of teachers' teaching energy input
……..	12)The implementation of teaching plan
……..	13)Systematic situation of teaching content.
……..	14)The implementation of the teaching plan.
……..	15)Control the level of teaching difficulty.
……..	16)Implementation of practical teaching.
……..	17)The rationality of the practical class proportion arrangement.
……..	18)The use of teaching methods.
……..	19)Scientific situation of curriculum arrangement.
……..	20)The effect of teacher's guidance to students.
……..	21)The establishment of quality assessment system.
……..	22)Teaching material quality.
……..	23)Teaching management situation.
Please writes your specify any suggestion.	

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4. Product evaluation	
	What do you think should be included in the product evaluation? For example:
Please selects your specify any suggestion in blank.	
……..	1) Mastery of theoretical knowledge.
……..	2) Construction cost thinking establishment situation.
……..	3) Cultivate students' ability of coordination and cooperation..
……..	4) Develop students' problem-solving ability.
……..	5) Competition awards.
……..	6)The degree of improvement of teachers' professional competence.
……..	7) The degree of improvement of teachers' teaching ability.
……..	8) Construction of teachers' professional personality.
……..	9) The orderly operation of all aspects of the school's talent training..
……..	10) The continuous improvement and promotion of the school's talent training.
……..	11) Student satisfaction with learning and growth.
……..	12)Teachers' satisfaction with school education.
……..	13) Employer satisfaction.
……..	14) The achievement of the training objectives of each specialty of the school.
……..	15) The employment rate and structure of fresh graduates were stolen.
……..	16) Graduation rate of graduates.
Please writes your specify any suggestion. …… …… …… ……	

Appendix C

Instruments: First Round: Brainstorming

Questionnaire I

Faculty of Technical Education
Rajamangala University of Technology Thanyaburi(RMUTT)
39 Moo 1,Rangsit-Nakhon Nayok Road
Klong Hok, Khlong Luang, Pathum Thani
Postal Code 12110, Thailand
Date:……
Dear …….

My name is Miss Mingming Luo. The researcher is a Ph.D. student in the Vocational Education Program in the Faculty of Technical Education of the Rajamangala University of Technology Thanyaburi, RMUTT. The research working on The dissertation entitled: *Teaching Evaluation System on Engineering for Applied University in China*. The research is in the process of developing the research tools and collecting the data. Nine experts will be interviewed 4 rounds to collect data by using Focus Group technique. First, the semi- structure interviews were employed and data were analyzed by using content analysis. Then the results were used to develop the rating scale questionnaires which will be used for collecting data in the second and the third rounds. The purpose of the second and the third rounds is to confirm the opinions and answers which were provided by those experts to explore the conclusions and the agreement among experts. These are essential for index design and development which teaching evaluation system will be used.

This questionnaire was constructed based on the content analysis of the first round. As a result, all experts are kindly asked to please answer the questionnaire. The data obtained will be analyzed by median, mode, and interquartile range. The opinions and answers will be kept secret, and the results will be reported as a whole group.

To respond appropriately to the questionnaire, you are asked to consider and provide the number *1, 2, 3, 4,* and *5* to each item for your approval; while 5 is highest and 1 is lowest.

Thank you very much for your kind co-operation.

Your sincerely,

Mrs. Luo Mingming

Questionnaire I on

Teaching Evaluation System on Engineering for Applied University in China.

Instructions:

This opinion form is divided into five grades according to the degree of recognition: very important (5 points), important (4 points), uncertain (3 points), unimportant (2 points) and very unimportant (1 point). Please tick "√" in the corresponding position according to the degree of importance. If you feel it is necessary to add, delete or modify the indicators of expression, you can directly write them in the blank at the end of the modified opinion column or opinion form.

Table 1 Table of First-level index for Teaching Evaluation of Engineering Specialty

First-level index	5	4	3	2	1	Revision opinion
Teaching background						
Teaching input						
teaching process						
Teaching achievement						

Table 2 Opinion Table of Second-level index for Teaching Evaluation of Engineering Specialty

Second-level index	5	4	3	2	1	Revision opinion
Talent training goal						
Teaching objectives						
teaching resource						
Teacher status						
Student activities						
teaching activities						
Cultivation of students' ability						
Teacher development						
Satisfaction survey						

Table 3 Opinion Table of Third-level index for Teaching Evaluation of Engineering Specialty

Third-level index	5	4	3	2	1	Revision opinion
Quality standard for training engineering cost professionals.						
Development orientation of engineering cost professionals						
Talent training embodies the characteristics of running a school.						
The relationship between talent training goal and local economic development						
Clarity of teaching objectives						
Coincidence with regional economic development						
Matching degree with students' career development						
Effect of students' quality development						
Teaching material quality						
Effectiveness of school-enterprise cooperation						
Input and use of teaching equipment						
Construction and utilization of training room						
Construction of teaching staff						
Investment and expenditure of funds						
Age structure of teachers						
Proportion of teachers with attachment experience in enterprises						
Proportion of full-time and part-time teachers						
Teacher training opportunities						

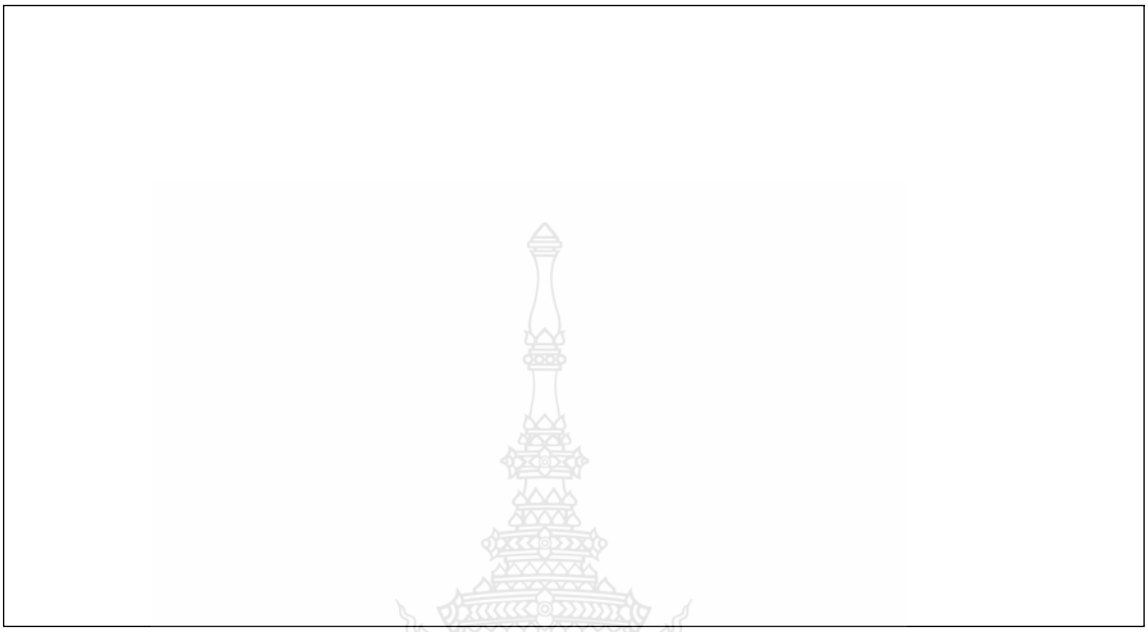
Table 3 Opinion Table of Third-level index for Teaching Evaluation of Engineering Specialty(Continued)

Third-level index	5	4	3	2	1	Revision opinion
Teachers' academic level						
Teachers' teaching achievements						
Students' learning attitude						
Are students interested in learning?						
Are students' study habits good?						
Whether students' learning methods are appropriate.						
Do students have the learning consciousness?						
Rationality of study schedule						
Degree of cooperation among students						
Fit between teaching content and objectives						
Degree of implementation of teaching plan						
Systematic teaching content						
Cross-disciplinary organization level						
Control of the difficulty of teaching						
Practicality of teaching						
Rationality of Proportion Arrangement of Practice Course						
Diversification of teaching methods						
Proper arrangement of class hours						
Accuracy of classroom time control						
Progressiveness of teaching steps						

Table 3 Opinion Table of Third-level index for Teaching Evaluation of Engineering Specialty(Continued)

Three-level index	5	4	3	2	1	Revision opinion
The Guidance Effect of Teachers on Students						
Degree of theoretical knowledge mastery						
Practical operation ability						
Establishment of engineering cost thinking						
Coordination and cooperation ability						
Problem solving ability						
Independent innovation ability						
Competition awards						
Professional competence degree of promotion						
Degree of improvement of teaching ability						
Degree of improvement of scientific research ability						
Construction of teachers' professional personality						
Number of graduates						
Student employment rate						
Student enrollment rate						
Student satisfaction						
Employer satisfaction						
Social satisfaction						

If you have other comments, you can write them directly in the blank column.



Appendix D

Instruments: Second Round: Evaluation Questionnaire II

Faculty of Technical Education
Rajamangala University of Technology Thanyaburi(RMUTT)
39 Moo 1,Rangsit-Nakhon Nayok Road
Klong Hok, Khlong Luang, Pathum Thani
Postal Code 12110, Thailand
Date:……
Dear …….

My name is Miss Mingming Luo. The researcher is a Ph.D. student in the Vocational Education Program in the Faculty of Technical Education of the Rajamangala University of Technology Thanyaburi, RMUTT. The research working on The dissertation entitled: *Teaching Evaluation System on Engineering for Applied University in China*. The research is in the process of developing the research tools and collecting the data. Nine experts will be interviewed 4 rounds to collect data by using Focus Group technique. First, the semi- structure interviews were employed and data were analyzed by using content analysis. Then the results were used to develop the rating scale questionnaires which will be used for collecting data in the second and the third rounds. The purpose of the second and the third rounds is to confirm the opinions and answers which were provided by those experts to explore the conclusions and the agreement among experts. These are essential for index design and development which teaching evaluation system will be used.

This questionnaire was constructed based on the content analysis of the first round. As a result, all experts are kindly asked to please answer the questionnaire. The data obtained will be analyzed by median, mode, and interquartile range. The opinions and answers will be kept secret, and the results will be reported as a whole group.

To respond appropriately to the questionnaire, you are asked to consider and provide the number *1, 2, 3, 4,* and *5* to each item for your approval; while 5 is highest and 1 is lowest.

Thank you very much for your kind co-operation.Your sincerely,

Mrs. Luo Mingming

Questionnaire II on

Teaching Evaluation System on Engineering for Applied University in China.

Instructions:

This opinion form is divided into five grades according to the degree of recognition: very important (5 points), important (4 points), uncertain (3 points), unimportant (2 points) and very unimportant (1 point). Please tick "√" in the corresponding position according to the degree of importance. If you feel it is necessary to add, delete or modify the indicators of expression, you can directly write them in the blank at the end of the modified opinion column or opinion form.

Table 1 Table of First-level index for Teaching Evaluation of Engineering Specialty

First-level index	5	4	3	2	1	Revision opinion
A1.Teaching background						
A2.Teaching input						
A3Tteaching process						
A4.Teaching achievement						

Table 2 Opinion Table of Second-level index for Teaching Evaluation of Engineering Specialty

Second-level index	5	4	3	2	1	Revision opinion
B1.Talent training objectives						
B2.Course teaching objectives						
B3.Facility conditions						
B4.Resources Construction						
B5.Teacher status						
B6.Students' learning situation						
B7.Teaching resources						
B8.Quality management						
B9.Students' ability training						
B10.Teacher development						
B11.Effectiveness						
B12.Satisfaction						

Table 3 Opinion Table of Third-level index for Teaching Evaluation of Engineering Specialty

Third-level index	5	4	3	2	1	Revision opinion
C1.Construction of quality standards for engineering talents training						
C2.Development orientation of engineering talents						
C3.Talent training reflects the characteristics of running a school						
C4.Synchronization of professional construction and industry development						
C5.Accuracy of course teaching objectives						
C6.Matching degree between course teaching objectives and students' career development						
C7.The degree of fit between the teaching objectives of the course and the formation of students' theoretical knowledge and practical ability						
C8.Investment in teaching funds						
C9.Input and use of teaching equipment						
C10.Construction and utilization of training room						
C11.Construction of applied teaching materials						
C12.Construction and sharing of high-quality teaching resources						
C13.Real project case resource sharing of industrial enterprises						
C14.School-enterprise cooperation						
C15.Teachers' professional titles						
C16.Teacher education						

Table 3 Opinion Table of Third-level index for Teaching Evaluation of Engineering Specialty(Continued)

Third-level index	5	4	3	2	1	Revision opinion
C17.The proportion of teachers with more than half a year's attachment experience in enterprises						
C18.Proportion of full-time and part-time teachers						
C19.Teacher training opportunities						
C20. Students' interest in learning						
C21. Students' study habits						
C22. Students' learning methods						
C23. Students' learning consciousness						
C24. Cooperation among students						
C25. Fit between teaching content and talent training objectives						
C26. Integration of professional ideological and political education						
C27. Teachers' moral performance						
C28. The degree of teachers' teaching energy input						
C29. Implementation of teaching plan						
C30. Systematic situation of teaching content						
C31. Control of teaching difficulty						
C32. Implementation of practical teaching						
C33. Rationality of proportion arrangement of practical courses						
C34. Usage of teaching methods						
C35. Scientific situation of curriculum arrangement						
C36. Teachers' Guidance Effect on Students						

Table 3 Opinion Table of Third-level index for Teaching Evaluation of Engineering Specialty(Continued)

Three-level index	5	4	3	2	1	Revision opinion
C37. Establishment of quality evaluation system						
C38. Quality of teaching materials						
C39. Teaching management						
C40. Degree of theoretical knowledge mastery						
C41. Practical operation ability						
C42. Ability to solve complex engineering problem						
C43. Training students' ability of coordination and cooperation						
C44. Possess good teamwork spirit						
C45. Training students' independent innovation ability						
C46. Participation in competition awards						
C47. The improvement of teachers' professional ability						
C48. The improvement of teachers' teaching ability						
C49. Orderly operation of all aspects of school personnel training						
C50. Continuous improvement and promotion of personnel training in schools						
C51. Students' satisfaction with learning and growth						
C52. Teachers' satisfaction with school education						

If you have other comments, you can write them directly in the blank column.

Appendix E

Instruments: Third Round:

Questionnaire III

Faculty of Technical Education
Rajamangala University of Technology Thanyaburi(RMUTT)
39 Moo 1,Rangsit-Nakhon Nayok Road
Klong Hok, Khlong Luang, Pathum Thani
Postal Code 12110, Thailand
Date:……
Dear …….

My name is Miss Mingming Luo. The researcher is a Ph.D. student in the Vocational Education Program in the Faculty of Technical Education of the Rajamangala University of Technology Thanyaburi, RMUTT. The research working on The dissertation entitled: *Teaching Evaluation System on Engineering for Applied University in China*. The research is in the process of developing the research tools and collecting the data. Nine experts will be interviewed 4 rounds to collect data by using Focus Group technique. First, the semi- structure interviews were employed and data were analyzed by using content analysis. Then the results were used to develop the rating scale questionnaires which will be used for collecting data in the second and the third rounds. The purpose of the second and the third rounds is to confirm the opinions and answers which were provided by those experts to explore the conclusions and the agreement among experts. These are essential for index design and development which teaching evaluation system will be used.

This questionnaire was constructed based on the content analysis of the first round. As a result, all experts are kindly asked to please answer the questionnaire. The data obtained will be analyzed by median, mode, and interquartile range. The opinions and answers will be kept secret, and the results will be reported as a whole group.

Thank you very much for your kind co-operation.

Your sincerely,

Mrs. Luo Mingming

After sorting out and revising the opinions of two rounds of experts, the teaching evaluation index of engineering specialty in China applied university based on CIPP mode has been basically established. The author constructs the judgment matrix according to the hierarchy of indicators, so please compare the judgment matrix with each other and score according to the importance. Therefore, the third and final expert opinion questionnaire was made. Thank you for your support and help!

Fill in the description: compare the horizontal indicators with the vertical indicators and judge their relative importance.

The value meaning is as follows:

The value of relative importance is meaningful
1 indicates that horizontal indicators are more important than vertical indicators.
3 indicates that the horizontal indicator is a little more important than the vertical indicator.
5 indicates that the horizontal indicator is more important than the vertical indicator.
7 indicates that the horizontal indicator is much more important than the vertical indicator.
9 indicates that horizontal indicators are more important than vertical indicators.
The importance of 2, 4, 6 and 8 is between "1, 3, 5, 7 and 9".

Table 1 First-level index judgment matrix

First-level index	Teaching background	Teaching input	teaching process	Teaching achievement
A1.Teaching background	1			
A2.Teaching input		1		
A3Tteaching process			1	
A4.Teaching achievement				1

Table 2 Judgement matrix of Second-level index under "teaching background" of First-level index

Second-level index	Talent training objectives	Course teaching objectives
B1.Talent training objectives	1	
B2.Course teaching objectives		1

Table 3 Judgment Matrix of Second-level index under "Teaching Input" of First-level index

Second-level index	Facility conditions	Resources Construction	Teacher status
B3.Facility conditions	1		
B4.Resources Construction		1	
B5.Teacher status			1

Table 4 The judgment matrix of Second-level index under the First-level index "teaching process"

Second-level index	Students' learning situation	Teaching resources	quality management
B6.Students' learning situation	1		
B7.Teaching resources		1	
B8.Quality management			1

Table 5 Judgment Matrix of Second-level index under the First-level index"Teaching Achievements"

Second-level index	Students' ability training	Teacher development	Effectiveness	satisfaction
B9.Students' ability training	1			
B10.Teacher development		1		
B11.Effectiveness			1	
B12.Satisfaction				1

Table 6 Judgement matrix of third-level index under the second-level index"Talent Training objectives"

Third-level index	Construction of quality standards for engineering talents training	Development orientation of engineering talents	Talent training reflects the characteristics of running a school	Synchronization of professional construction and industry development
C1.Construction of quality standards for engineering talents training	1			
C2.Development orientation of engineering talents		1		
C3.Talent training reflects the characteristics of running a school			1	
C4.Synchronization of professional construction and industry development				1

Table 7 Third-level indexr judgment matrix under the second-level index "course teaching objectives"

Third-level index	Accuracy of course teaching objectives	Matching degree between course teaching objectives and students' career development	The degree of fit between the teaching objectives of the course and the formation of students' theoretical knowledge mastery and practical ability
C5.Accuracy of course teaching objectives	1		
C6.Matching degree between course teaching objectives and students' career development		1	
C7.The degree of fit between the teaching objectives of the course and the formation of			1

students' theoretical knowledge and practical ability			

Table 8 Judgement Matrix of Third-level index under Second-level index "Facilities Conditions"

Third-level index	Investment in teaching funds	Input and use of teaching equipment	Construction and utilization of training room
C8.Investment in teaching funds	1		
C9.Input and use of teaching equipment		1	
C10.Construction and utilization of training room			1

Table 9 Judgement Matrix of Third-level index under Second-level index "Resource Construction"

Third-level index	Construction of applied teaching materials	Construction and sharing of high-quality teaching resources	Resource sharing of real project cases in industrial enterprises	School-enterprise cooperation
C11.Construction of applied teaching materials	1			
C12.Construction and sharing of high-quality teaching resources		1		

C13.Real project case resource sharing of industrial enterprises			1	
C14.School-enterprise cooperation				1

Table 10 Judgement matrix of Third-level index under the Second-level index "Teachers' Status"

Third-level index	Teacher titles	Teacher education	The proportion of teachers with more than half a year's attachment experience in enterprises	Proportion of full-time and part-time teachers	Teacher training opportunities
C15.Teachers' professional titles	1				
C16.Teacher education		1			
C17.The proportion of teachers with more than half a year's attachment experience in enterprises			1		
C18.Proportion of full-time and part-time teachers				1	
C19.Teacher training opportunities					1

Table 11 Judgement matrix of Third-level index under the Second-level index "Students' learning status"

Third-level index	Students' interest in learning	Students' study habits	Students' learning methods	Students' learning consciousness	Cooperation among students
C20.Students' interest in learning	1				
C21.Students' study habits		1			
C22.Students' learning methods			1		
C23.Students' learning consciousness				1	
C24.Cooperation among students					1

Table 12 Judgement matrix of Third-level index under the Second-level index "Teaching resources "

Third-level index	C25	C26	C27	C28	C29	C30	C31	C32	C33	C34	C35	C36
C25	1											
C26		1										
C27			1									
C28				1								
C29					1							
C30						1						
C31							1					
C32								1				
C33									1			
C34										1		

C35											1	
C36												1

Because there are many third-level indexes under the second-level index "Teaching resources , it is not convenient for typesetting, so C25-C36 is used instead.

C25: Fit between teaching content and talent training objectives
C26. Integration of professional ideological and political education
C27. Teachers' moral performance
C28. The degree of teachers' teaching energy input
C29. Implementation of teaching plan
C30. Systematic situation of teaching content
C31. Control of teaching difficulty
C32. Implementation of practical teaching
C33. Rationality of proportion arrangement of practical courses
C34. Usage of teaching methods
C35. Scientific situation of curriculum arrangement
C36. Teachers' Guidance Effect on Students

Table 13 Judgement Matrix of Third-level index under Second-level index "Quality Management"

Third-level index	Establishment of quality evaluation system	Quality of teaching materials	Teaching management situation
C37.Establishment of quality evaluation system	1		
C38.Quality of teaching materials		1	
C39.Teaching management situation			1

Table 14 Judgment Matrix of Third-level index under the Second-level index "Student ability cultivation"

Third-level index	Degree of theoretical knowledge mastery	Practical operation ability	Ability to solve complex engineering problem	Training students' ability of coordination and cooperation	Possess good teamwork spirit	Cultivation of students' independent innovation ability	Participation in competition
C40.Degree of theoretical knowledge mastery	1						
C41.Practical operation ability		1					
C42.Ability to solve complex engineering problem			1				
C43.Training students' ability of coordination and cooperation				1			
C44.Possess good teamwork spirit					1		
C45.Training students' independent innovation ability						1	
C46.Participation in competition awards							1

Table 15 Judgment Matrix of Third-level index under the Second-level index "Teacher Development"

Third-level index	The improvement degree of teachers' professional ability	The improvement degree of teachers' teaching ability
C47.The improvement degree of teachers' professional ability	1	
C48.The improvement degree of teachers' teaching ability		1

Table 16 Third-level index judgment matrix under the Second-level index "effectiveness"

Third-level index	The orderly operation of all aspects of school personnel training	Continuous improvement and promotion of talent training in schools
C49.The orderly operation of all aspects of school personnel training	1	
C50.Continuous improvement and promotion of talent training in schools		1

Table 17 Judgement Matrix of Third-level index under Second-level index "Satisfaction"

Third-level index	Students' Satisfaction with Learning and Growth	Teachers' Satisfaction with School Education
C51.Students' Satisfaction with Learning and Growth	1	
C52.Teachers' Satisfaction with School Education		1

Biography

Name-Surname	Mrs. Mingming Luo
Date of Birth	Oct 29, 1981
Address	No. 519 Huixing Road, Ziliujing District, Zigong City, Sichuan Province.China
Education	Education Master Degree in Belarusian State Academy of Arts(2012)
Work Experience	Sichuan University of Science and Engineering (2005-Present)
Telephone	+(86)13700959109
e-mail	mingming_l@mail.rmutt.ac.th