



## Research on Comprehensive Quality Evaluation System of Engineering Undergraduates Based on Developmental Evaluation: Taking X University as an Example

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# **Research on Comprehensive Quality Evaluation System of Engineering**

## **Undergraduates Based on Developmental Evaluation**

### **——Taking X University as an Example**

#### Abstract

This research relates to a comprehensive quality evaluation system of engineering undergraduates based on developmental evaluation. “Quality education”, proposed in the 1980s, represents the practice of China’s education reform. Quality-oriented education aims to solve the long-standing problems facing China in its higher education, such as “narrow major span”, “less humanistic education”, and “strong utilitarianism tendency”, promoting students’ rounded development and enhancing the quality of personnel training. Evaluation of education constitutes an indispensable part of education itself, evaluation of students represents a significant part of education evaluation, and evaluation of students’ comprehensive quality plays an important part in quality education. Nevertheless, the dominant mode of evaluating students in most Chinese universities has long been summative evaluation centering on exam results, yet this is not limited and is contrary to the core of education. In this way, students are directed to pursue only the learned knowledge and ignore other essential qualities. Based on theories of rounded development of humans and developmental evaluation, a comprehensive quality evaluation system is put forward for engineering undergraduates using developmental evaluation in this research. In combination of numerous approaches, this paper aims to design an overall quality evaluation system for engineering undergraduates at X University based on studies of literature review, Chinese education policies, the survey data about the qualities valued most by employers in “White Paper on the Employment of Undergraduates at X University in 2011”, and questionnaires from teaching experts at X University. Meanwhile, based on the guidance, diagnosis and nurturing functions of developmental evaluation, we developed operation program, i.e., taking the first three years of undergraduate stage as an evaluation cycle, and conducting an assessment for each semester. After each stage evaluation, the head teacher and counselor will, according to the evaluation results, conduct an interview (at least once) with students to analyze the feedback and provide suggestions for the students’ comprehensive quality training at the next stage. This evaluation system lays more emphasis on quantitative analysis, and less on qualitative analysis. Process-monitoring feedback and operability also feature this system. Four years have passed when this system was adopted to undergraduates at X university, and the data of students assessed by the original evaluation system and those assessed by this comprehensive quality evaluation system is obviously different.

#### I. Introduction

“Quality education”, proposed in the 1980s, represents the practice of China’s education reform. “The ‘Outline of National Medium- and Long-term Education Reform and Development Plan (2010-2020)’ has identified ‘adhering to the people-centered approach and promoting quality-

oriented education' as the 'strategic theme' of China's educational reform and development [1].” “‘Quality’ refers to the relatively stable psychological quality gradually formed by internalization of knowledge through influences of education and social environment on the basis of human nature [2].” “Quality-oriented education is designed to promote students’ comprehensive development and improve China’s national educational level by enhancing the quality of each educated person, who would accept education in ideology, morality, culture, science, professional skills, as well as physical and mental quality [2].” Quality-oriented education aims to solve the long-standing problems facing China in its higher education, such as “narrow major span”, “less humanistic education”, and “strong utilitarianism tendency”, promoting students’ rounded development and enhancing the quality of personnel training. Evaluation of education constitutes an indispensable part of education itself, evaluation of students represents a significant part of education evaluation, and evaluation of students’ comprehensive quality is an important part of quality education. Nevertheless, the dominant mode of evaluating students in most Chinese universities has long been summative evaluation centering on exam results, yet this is not limited and is contrary to the core of education. In this way, students are directed to pursue only the learned knowledge and ignore other important things.

Based on theories of rounded development of humans and developmental evaluation, this paper puts forward a comprehensive quality evaluation system for engineering undergraduates using developmental evaluation, highlighting various functions including guidance, diagnosis, feedback, cultivation, and partial appraisal. Relevant experiment has been conducted at X University for four years, we hope that we can boost quality education and provide new perspectives and methods for evaluation of students.

## II. Literature review

“Acting as the basis and essence of education evaluation, student evaluation refers to a value judgment taking students as the object and is realized by means of certain techniques and approaches in accordance with several evaluation standards [3].”

From the perspective of domestic research, the phrase “student evaluation” was taken as the keyword for searching in CNKI (China National Knowledge Internet). Upon selecting the category of “higher education”, a total of 2641 journal articles and 601 postgraduate dissertations appeared. After careful reading, 110 journal papers and 18 postgraduate dissertations closely related to “college student evaluation” were finally screened out. In general, relevant domestic studies mainly focus on the following aspects: 1) Analysis of existing problems in student evaluation. “Wang Jin pointed out the major problems in current evaluation mechanism: concerning evaluation content, knowledge memory and test scores are too much more emphasized than students’ overall quality; regarding assessment function, appraisal and selection are taken more important than diagnosis, feedback and motivation; as for evaluation criteria, students are taken as a whole, ignoring their individual differences; evaluation subjects are biased towards teachers, ignoring the diversification of evaluation subjects; with regard to the evaluation process, conclusive nature is obvious while the process is ignored; for evaluation methods, written forms are dominant, neglecting other forms of

evaluation. Besides, quantified results are excessively employed, and adoption of evaluation methods reflecting the diversified quality of students required in higher education is a rare occurrence [4].” 2) Presentation of corresponding measures and methods. “Yu Chengjie presented some advice for improving the construction of the evaluation mechanism for college students: to strengthen process guidance and the incentive role of scholarships; to adhere to the combination of quantitative evaluation and fuzzy evaluation; and to take synthesis as basis and classification as emphasis [5].” 3) Discussion of the objective and effect of student evaluation. “Tang Yanjie mentioned that China highlights the developmental and educational effect in the evaluation of college students in theory, yet in practice, it has deviated from its essence to objectives of selection, management, task completion, and vicious competition out of various reasons [6].”

Afterwards, the phrase “comprehensive quality evaluation” was taken as the keyword for searching in CNKI. Upon selecting the category of “higher education”, a total of 269 journal articles and 110 postgraduate dissertations appeared, among which 148 journal papers and 42 postgraduate dissertations closely related to “comprehensive quality evaluation for college students” were finally screened out after careful reading. In general, relevant domestic studies mainly focus on the following aspects: 1) Investigation of the connotation of comprehensive quality evaluation. “Zhou Lu suggested that evaluation of college students’ comprehensive quality is a value judgment process concerning students’ ideological and morality, professional quality, innovation, humanistic quality, as well as physical and mental health. This evaluation is realized through combining qualitative and quantitative, dynamic and static methods [7].” 2) Research on the diversification of evaluation subjects. “Tang Renchun uncovered that theoretically, the evaluation subject should be pluralistic, including education administration departments, schools, the society, employers, and parents, but in practice, education administrative departments and schools are still dominant evaluation subjects for some reasons [8].” 3) Exploration of the methods and systems of comprehensive quality evaluation. “Jiang Na evaluated the overall quality of college students with the fuzzy comprehensive evaluation method, and stated that ideological quality, practice and innovation capability, physical and mental quality and learning ability should be considered for building an indicator system [9].”

From the perspective of foreign studies, “the history of college student evaluation abroad is so long that it can be traced back to the first half of the 19th century. During that process, numerous classic educational evaluation models have been produced, among which the most prominent ones are: Taylor’s behavioral goal model, Bloom’s theory on Taxonomy of Educational Objectives for the Cognitive Domain, Daniel Stufflebeam’s CIPP model, Scriven’s purpose-free evaluation model, and Stark’s responsive evaluation model. These evaluation models still have profound influences on the development of modern educational evaluation [8].” The keywords “college student assessment” and “college student evaluation system” were searched in a core database called “Web of Science”, and then 224 articles emerged, including 90 journal articles and 131 proceedings. Finally, 47 related articles were screened out. In summary, related literatures mainly involve the following aspects: 1) Investigation on evaluation of college students’ comprehensive quality. “Mohl.G. proposed the concept and method of innovative assessment of student quality. He emphasized the immanence of student quality and pointed

out the inadequacies of traditional assessment methods and the need for innovative assessment [10].” “McMorran noted in an article that a student evaluation system taking specific scores and certificates as the final competency evaluation result may hinder students’ overall development and burden students with greater pressures, potentially misleading students to pursue only scores [11].” “Giada presented a new evaluation method for college graduates. Based on the traditional evaluation systems encompassing America’s Grade Point Average (GPA) and Italy’s Measurement of the Performance (MEP), the new method first quantifies the credits and scores students received during course study, and then introduces reasonable parameter factors and calculation formulas to calculate a new evaluation indicator as a universal evaluation result for students [12].” 2) Study of the evaluation of college students’ learning ability. “E. Karagiannopoulou and P. Christodoulides collected learning-ability-related questionnaires from 180 Greek college students, adopted path analysis method to dig out their learning abilities for evaluation, and examined the impact of learning environment and learning methods on their learning abilities [13].” 3) Exploration of a specific field’s evaluation system for college students. The most typical one is in the field of nursing: 19 articles searched are about nursing. “Ali wrote that in addition to the traditional test evaluation, students’ self-feedback and self-evaluation during the nursing simulation internship should also serve as an important basis for examining student learning result [14].”

It can be observed from the above literature review that the existing literatures at home and abroad have, to some extent, studied the evaluation of college students’ comprehensive quality, and scored certain achievements. It can also be noted that foreign and domestic studies are quite different in study content concerning student evaluation and comprehensive quality evaluation. Specifically, foreign studies emphasize people-orientation, improvement of students through evaluation, combination of educational theory and practice, empirical research and diversified evaluation subject. As for evaluation indicators, foreign studies lay little emphasis on students’ moral education. Most domestic studies focus on theoretical aspects such as theory analysis, the status quo and solutions, and effects and objectives of college students’ comprehensive quality evaluation. While some scholars and universities have conducted multiple investigations on college students’ comprehensive quality evaluation, deficiencies are not excluded: inadequate implementation of people-orientation, fuzzy definition of comprehensive quality evaluation, unclear evaluation dimension, unconnected competence factors, less qualitative research on evaluation indicators, limited evaluation subject and poor practical operability of research results. Besides, the existing domestic articles merely explored a few aspects of how to improve college students’ comprehensive quality, i.e. a systematic research that can satisfy the requirements of colleges and universities to conduct evaluation of students’ comprehensive quality is currently absent. Therefore, it is imperative to refocus on the core of quality education by establishing a targeted and operable comprehensive quality evaluation system for college students.

### III. Research design

#### 1. Theory basis

This paper is based on theories of rounded development of humans and developmental evaluation.

“The theory of rounded development of humans refers to the rounded development of ‘human’s material and spiritual attributes’, the harmonious development of human’s intelligence and physical strength, and the coordinated and unified development of individuals and the society [15].” In ancient Greece, human was regarded as the object of philosophical research and the importance of the overall development of humans was initially realized; during the Renaissance, under the dominance of the humanists, rounded education was advocated; during the period of German classical philosophy, people began to be understood rationally. In the middle of the 19th century, through critical inheritance of predecessors’ theories, Marx and Engels created the theory of rounded development of humans and explained the general laws of the development of human society and the core of human’s comprehensive development.

“Developmental evaluation, developed in the 1980s, is an object-targeted education evaluation aimed to promote the development of evaluation objects. Developmental evaluation underlines the continuity of development, the studies of objects’ past learning status to promote their future development, the objects’ individual values, common discussions between evaluators and objects of the evaluation objectives, multifaceted abilities of students, learning process and timely feedback, and the role of formative evaluation [16].” “The developmental evaluation of college students refers to the process in which, based on the education objectives and values of higher education, evaluators and students establish a relation of mutual trust, share a common value orientation, jointly formulate development goals agreed upon by both parties, and apply appropriate evaluation techniques and methods to evaluate college students’ development, enabling students to continuously recognize and improve themselves through evaluation [15].”

## 2. Research strategy

This paper aims to design an overall quality evaluation system for engineering undergraduates at X University based on studies of literature review, Chinese education policies, the survey data about the qualities valued most by employers in “White Paper on the Employment of Undergraduates at X University in 2011”, and questionnaires from teaching experts at X University.

Through literature review, we can learn the academic community’s research on the connotation and evaluation indicators of the comprehensive quality evaluation for college students, that is, the needs of the academic community. “Xia Yixin et al. believe that the comprehensive quality of college students primarily involves six aspects: political ideology, intelligence, physical and mental health, aesthetic consciousness, innovation and practice ability, and personality development [17],” whereas “Li Bingkuan et al. consider that it refers to college students’ ideological and moral quality, professional quality, ability and physical and mental health [18].” “After a comprehensive survey of society, schools, families, and students, Xu Yan and others deem that the comprehensive quality of college students mainly includes four dimensions: thinking, body and mind, knowledge, and ability [19].”

By analyzing China’s education policies, we can understand the educational goals and values of China’s higher education, that is, the country’s needs. “In the “Outline of National Medium-

and Long-term Education Reform and Development Plan (2010-2020)” promulgated by China in 2010, it was mentioned that adherence to people-oriented theory and full implementation of quality education are the strategic themes of education reform and development. Quality Education deals with important issues such as what sort of talents we want to cultivate and how to do it. And the key is to face to all the students and promote their rounded development by improving their social responsibilities to serve the people, their innovative spirits to explore the unknowns and practice abilities to solve problems [1].” “Chinese President Xi Jinping proposed at the “National Conference on Ideological and Political Work in Colleges and Universities” to continuously improve students’ ideological level, political awareness, and moral and cultural quality, so that they can become talents with both ability and political integrity [20].”

Through analyzing the survey data about the qualities valued most by employers presented in the “White Paper on the Employment of Undergraduates at X University in 2011” published by the Office of Recruitment and Employment at X University, we are aware of the employers’ views on the overall quality of college students, that is, the needs of the employers. From Table 1, the most valued qualities by employers are communication, innovation, logic and teamwork, by order.

**Table 1 Evaluation dimension of the overall quality of students by employers**

	Innovation	Communication	Interpersonal relation	Teamwork	Logic	English	Time control	Personality	Others
Number	141	263	37	68	83	15	1	25	5
Ratio	22.45%	41.88%	5.89%	10.83%	11.62%	2.39%	0.16%	3.98%	0.80%

By studying relevant literatures, Chinese education policies, the survey data about the qualities valued most by employers presented in the “White Paper on the Employment of Undergraduates at X University in 2011”, and summarizing the related behaviors and issues involved in the training of students at X University, a 32-point questionnaire containing nine aspects involved in the daily education and training of students (i.e. ideological and moral qualities, learning ability, practice ability, innovation ability, physical and mental health, cultural quality, sense of social responsibility, hobbies and teamwork ability) was designed by means of literature review and target decomposition to identify the evaluation indicators that can reflect students’ comprehensive quality through a combination of closed and open questions. The respondents of this survey were all teaching experts at X University. In this study, 40 questionnaires were distributed, 36 were collected, so the recovery rate was 90%. Except for zero invalid questionnaires with incomplete answers and fixed answers, 36 valid questionnaires were recovered and the effective questionnaire recovery rate was 90%. The ratio in each column in Table 2 represents the ratio of the number of participants who selected this dimension to the total number of participants. Table 2 shows the dimensions teaching experts paid attention to, and the degrees of attention from high to low are: social responsibility, practice ability, culture, learning ability, ideological and moral quality, teamwork, innovation, physical and mental health, and nobody takes students’ hobbies as evaluation indicator.

**Table 2 Survey of the overall quality of students by teaching experts**

	Ideological and moral quality	Learning ability	Practice ability	Innovation	Physical and mental health	Culture	Social responsibility	Hobbies	Teamwork
Ratio	52%	64%	78%	50%	41%	75%	100%	0%	51%

In summary, based on theories of rounded development of humans and developmental evaluation, taking the needs of the academy community, the nation, teaching experts at X University and the employers into account, we identified the final evaluation system for comprehensive quality (see Table 3) using content analysis method according to the education objectives and values of China's higher education. The first-level indicators include four dimensions: ideological and moral quality, learning ability, practice ability and humanistic quality. The second-level indicators are more specific than that of the first, including 11 indicators. The third-level indicators are the most specific ones, including 16 indicators. Based on the guidance, diagnosis and nurturing functions of developmental evaluation, we developed an operation program, i.e., taking the first three years of undergraduate stage as an evaluation cycle, and conducting an assessment for each semester. After evaluating each stage, the head teacher and counselor will, according to the evaluation results, conduct an interview (at least once) with students to analyze the feedback and provide suggestions for the students' comprehensive quality training at the next stage. The operation program proposed lays more emphasis on quantitative analysis, and less on qualitative analysis. Process-monitoring feedback and operability also feature this program. Four years have passed when this system was adopted to undergraduates at X University.

#### IV. Construction of the evaluation system

The first-level indicators of the comprehensive quality evaluation system for college students (see Table 3) are divided into four dimensions: ideological and moral quality, learning ability, practice ability, and humanistic quality.

Four second-level indicators, i.e. ideal and faith, collective spirit, social work and campus activity, constitute the dimension of ideological and moral quality. "Zhao Fei signaled that ideological and moral qualities are mainly ideological, political, and moral qualities, in which ideological qualities mean values of life, ideals and beliefs, social responsibility, collectivism, and patriotism; political qualities entail political belief, political consciousness, and participation in social and political matters; and moral qualities imply social morality, honesty, and moral evaluation criteria [21]." "According to Luo Shuyang, ideals and beliefs present people's steadfast and persistent pursuit of future goals, and are highly reflective of people's world outlook, outlook on life, and values [22]." "In Zhang Liwei's view, volunteerism is an important carrier for colleges to carry out social responsibility education [23]." "It was written by Gao Fei that the volunteering is endowed with the core value of collectivism under the socialism with Chinese characteristics [24]. Moreover," "Xu Jilv defined that patriotism and collectivism are essentially consistent [25]." Therefore, the core of ideological quality is



relevant to idea, belief and collectivism. Ideals and beliefs can be evaluated through relevant training data of school-level party schools and student cadre schools as only those excellent students with solid ideals and beliefs can be admitted to these schools. Collectivism can be evaluated through students' collective honors received and participation in volunteer services. There are two definitions of college students' social works: broadly speaking, social work involves both students' obliged participation in student work services within school, and paid participation in part-time jobs outside the school; narrowly speaking, social work involves only students' obliged participation in student work services within school as student cadres, and this paper adopts the narrow one. Student cadres, both objects of education and subjects of student management, are an important force for colleges' ideological and political works. When student cadres are selected, Chinese universities frequently place the highest emphasis on their political quality. Therefore, social work is a trustworthy indicator for evaluation of student's political quality. "Huang Yuanming defined campus culture as an important cultural form, holding the key to formation of college students' moral personality [26]." Therefore, campus activity is listed as an evaluation indicator, due to its role in improving students' moral quality.

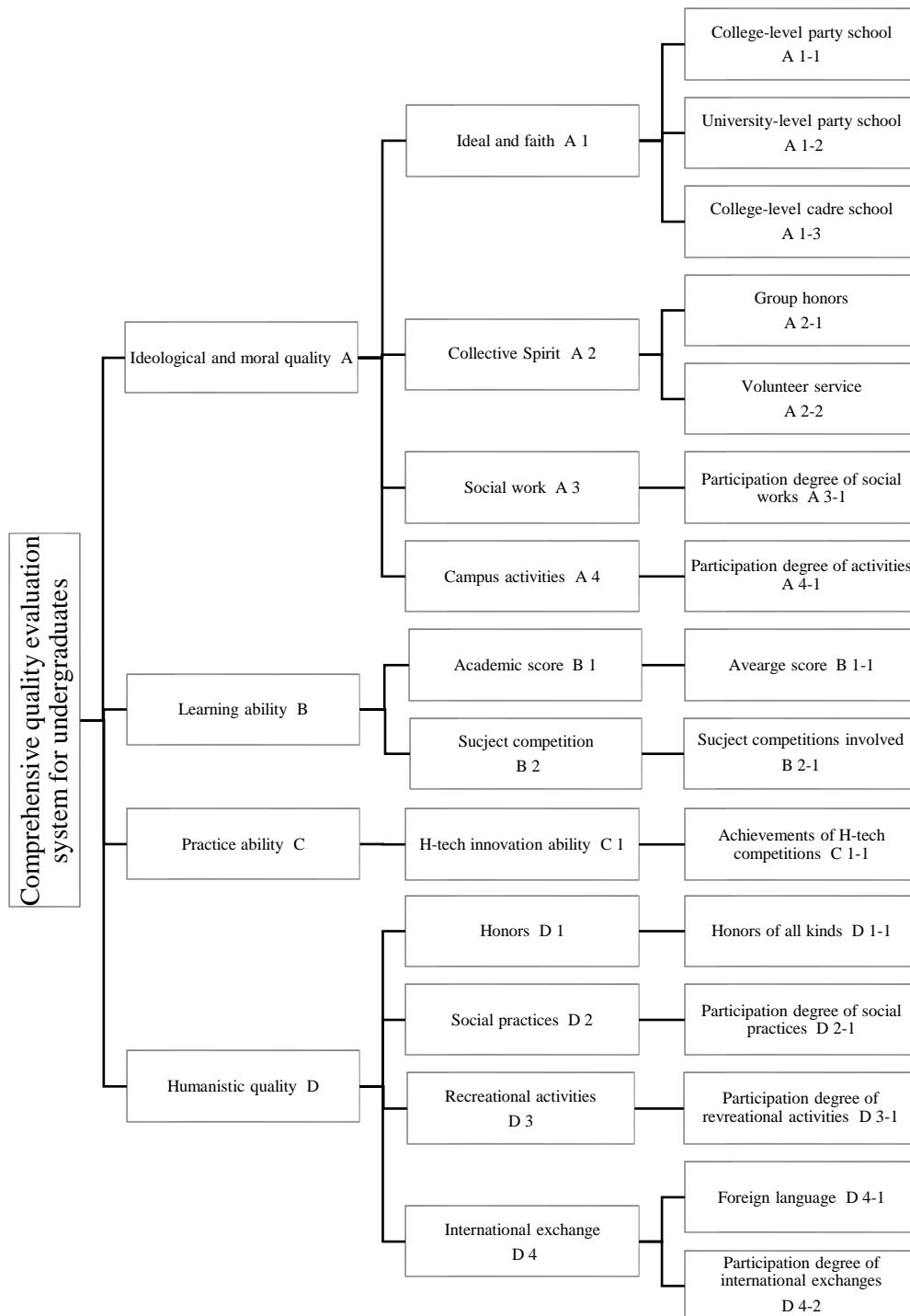
"Learning ability refers to the intrinsic qualities of an individual that can bring more sustained changes in one's behavior or thinking, and must also be formed and developed through certain learning practices [27]." "Learning ability, a personal characteristic formed and developed during learning activities, means students adopt scientific learning strategies to independently acquire, process, and apply information, and analyze and solve practical problems [28]." For Chinese college students, course learning and subject competition are their dominant learning activities. Thus, the results of their learning activities can be employed to evaluate students' learning ability.

Practice ability particularly refers to the ability of scientific and technological innovation herein. Innovation and entrepreneurship contests, science and technology competitions and the aims are the dominant ways to enhance students' ability of scientific and technological innovation. These contests are designed to train students on their practice ability and to cultivate their awareness of scientific and technological innovation.

In terms of humanistic quality, "Xie Dingguo proposed that the humanistic quality education in colleges and universities is mainly achieved by humanity courses and environment nurturing, through which students are encouraged to gradually form their own stable internal quality and value orientation by self-internalization and self-development, fostering high moral character, high-grade personality, creative thinking ability, and broadened knowledge vision [29]." "In the viewpoint of Zeng Keqiang, social practice has become a significant way for contemporary college students to comprehend the society and the national conditions, and to increase abilities, perseverance and social responsibility. Having an upbeat effect irreplaceable by classroom instructions, social practice is also of paramount importance for students' growth [30]." "Xu Guobin suggested to strengthen cross-cultural education among undergraduates and foster internationally oriented talents with global vision and innovation awareness [31]." Social practices, international exchanges, and cultural and recreational activities of various forms at differing environments are all implicit education for students to improve their cultural qualities,

thereby being used as evaluation indicators. Being an aspect of students' humanistic quality improvement, student honor can reflect external recognition for students' high-quality performances in campus activities, and is also accepted as an evaluation indicator.

**Table 3 Comprehensive quality evaluation system for undergraduates**



## V. Implementation of the system

The first three years of undergraduate stage is taken as an evaluation cycle, and a periodic

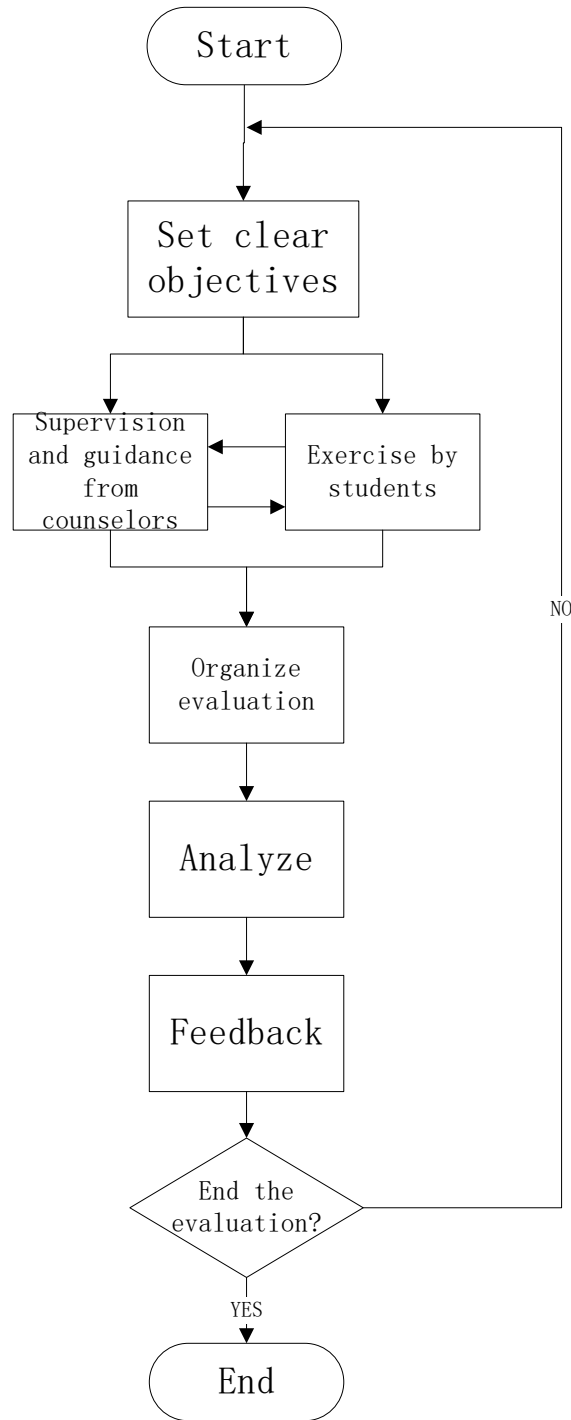
assessment is conducted at each semester. At each periodic assessment, the class teacher and counsellor conduct at least one evaluation feedback to the students (see Fig. 1).

1. Set clear objectives. At the beginning of each semester, counselors should introduce the comprehensive evaluation scheme to students for them to identify the evaluation purpose, become familiar with and master the contents and grading standards of the comprehensive evaluation, and understand the organizational form of the evaluation, paving the way for the formal comprehensive quality evaluation.

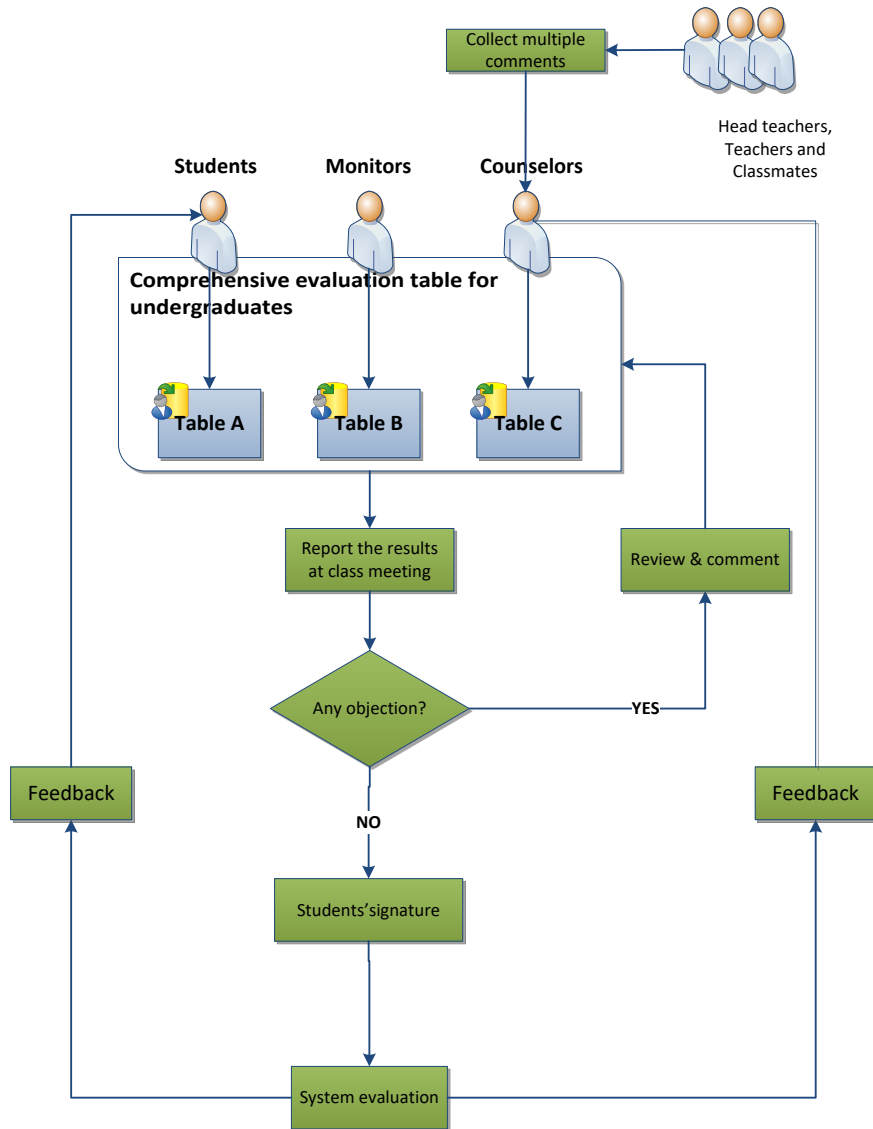
2. Students exercise and counselors supervise. Students should perform targeted exercise according to their individual characteristics and different growth stages, and the head teacher and counselor should supervise and guide them in the process, so as to help students achieve the goal of quality training.

3. Organize evaluation. At the end of each semester, the Steering Committee for Students' Comprehensive Evaluation of college level organizes the evaluation work, while the Executive Committee for Students' Comprehensive Evaluation of grade level implements the evaluation. The Steering Committee for Students' Comprehensive Evaluation of college level is responsible for revising the students' comprehensive evaluation program, supervising and guiding their routine works, as well as reviewing the evaluation results, and the Executive Committee for Students' Comprehensive Evaluation of grade level is responsible for the implementation of comprehensive evaluation program of its own grade. During the evaluation, students, based on their self-evaluation, fill in the "Comprehensive Evaluation Table—For Students" (Table A) as required, class monitors fill in the "Comprehensive Evaluation Table" (Table B) as required, and counselors Table C in consideration of comments of head teachers and classmates. Subsequently, the class workgroup integrates Tables A, B and C of each student into one "Comprehensive Evaluation Table", holds a class meeting to announce each student's specific bonus points, and signs the tables upon students' confirmation or reconsiders the evaluation if there is any objection. Finally, class teachers should fill in the "Summary of Comprehensive Quality Evaluation" and report it to the Steering Committee for Students' Comprehensive Evaluation of college level for approval. (See Fig. 2)

4. Analyze results and provide feedback. Head teachers and counselors then analyze students' growth according to their reports from the perspective of development, interview with students for feedback, and make comments and suggestions on students' comprehensive quality training in the next stage. Two dominant analytical methods are applied to draw the evaluation results: the first one is horizontal analysis, that is, to compare a particular student's score with those of other students in a class to present improvement advice in a group; the second one is vertical analysis, i.e. to analyze the variance of each evaluation indicator at each evaluation period during the three years, and present suggestions on how to achieve self-development during college years. In combination of horizontal and vertical comparisons, students can clearly recognize the gap between themselves and others so as to identify their own deficiencies and clarify their personal goals.



**Fig. 1 Flow chart of general implementation of comprehensive evaluation scheme for undergraduates**



**Fig. 2 Flow chart of specific implementation of comprehensive evaluation scheme for undergraduates**

## VI. Effectiveness of the system

1. The score of GPA and the comprehensive quality evaluation scores were significantly different in the same grade.

A paired T-test was performed to identify, for the same grade of students, if there was a significant difference between the score of GPA and the integrated mean value of comprehensive quality evaluation scores. The paired T-test result in Table 4 indicates that there was a significant difference between the score of GPA and the integrated mean value of comprehensive quality evaluation scores,  $t=-3.931$ ,  $df=221$  and  $P=0.000$ . Since  $p<0.05$ , the integrated mean value of comprehensive quality evaluation scores was better than that of GPA scores. Since the mean difference (MD) was 0.923, and the pooled standard deviation (Pooled SD) was approximately 3.497,  $d=0.29$ , “which according to Cohen (1988) was low effect size [32].”

**Table 4 Comparison of the integrated mean value of GPA and that of comprehensive quality evaluation scores**

Variable	M	SD	t	df	p
Comparison of integrated mean value for same-grade students			-3.931	221	.00*
GPA-based mean value	67.252	5.762			
Comprehensive-quality evaluation score-based mean value	68.174	4.646			

\*p<.05

2. The head teachers' evaluation scores and the comprehensive quality evaluation scores were significantly correlated.

In this study, Pearson coefficient method was applied to analyze the correlation between the head teachers' evaluation scores and the comprehensive quality evaluation scores. The results reveal that there was a statistically significant correlation between the head teachers' evaluation scores and the comprehensive quality evaluation scores,  $r(222) = 0.438$  and  $p < 0.01$ . The direction of the correlation was positive, which means that students obtaining high scores from head teachers tended to obtain high scores in the comprehensive quality evaluation. "According to Cohen's standard (1988) [32]," the effect size was medium and low. The r-squared Pearson coefficient ( $r^2$ ) further indicates that 19 % of the variance in students' comprehensive quality evaluation scores can be predicted from their head teachers' scores.

3. 64% of students improved their all-round capabilities due to the comprehensive quality evaluation system.

In this study, the arithmetic subtraction method was employed to analyze the mean value of students' three-year comprehensive quality evaluation scores and their first-year comprehensive quality evaluation scores. The results reveal that among 222 students, 141 students have a mean value of students' three-year comprehensive quality evaluation scores greater than or equal to the standard deviation of their first-year comprehensive quality evaluation scores, indicating that after three years of overall quality evaluation, 64% of students have promoted their comprehensive qualities.

## VII. Discussions and conclusions

### 1. Conclusions and expectations

This article studies the comprehensive evaluation of engineering undergraduates based on the developmental evaluation. After being practiced at X University for four years, the comprehensive quality evaluation system mentioned in this article provides a personalized plan and an effective reference for the evaluation of engineering undergraduates' comprehensive quality.

This evaluation system favorably played its role in guidance, diagnosis and education. Specifically, the system truly steered the direction of students' overall development; achieved the diagnosis and education functions by means of semester evaluation and the interview feedbacks of the head teachers and counselors; and fulfilled in part the appraisal function mainly for the selection of exempt postgraduate students, laying a solid and lasting basis for the implementation of the overall quality evaluation system. The indicators of this comprehensive quality evaluation system are mainly quantitative ones, and the qualitative evaluation mainly focuses on the implementation of evaluation. Students, monitors and counselors fill in different evaluation forms to realize multiple qualitative evaluation.

Despite of the favorable functions of this system, problems are inevitable. These evaluation indicators are more quantitative than qualitative; therefore, further investigations and revisions are required. We also need to further determine the connotation of developmental evaluation, probably by setting targeted indicator weights in different grade according to the growth characteristics and training objectives of different grades, guiding students towards appropriate training objectives. Besides, the feedback part is not perfect enough. Currently, feedback can only be presented during meeting of students and head teachers & counselors, and students' self-evaluations can still not be achieved through visual platforms. Therefore, an electronic portfolio might be created in the future to assist evaluation, on which students can perform self-evaluation at any time, save relevant growth data and instantly acquire evaluation reports based on scientific data analysis.

## 2. Inspirations

(1) Redefine the connotation of students' comprehensive quality evaluation. "Yu Juntai, from the functional point of view, regard the comprehensive quality evaluation for college students as an assessment and a means by which employers can understand the development of college students [33]." "Yin Wu, from the effect point of view, regard the comprehensive quality evaluation for college students as 'a judgment basis for student's all-kind performance at school, and a mechanism for students' comprehensive assessment and incentives' [34]." While in view of this paper, the evaluation of students' comprehensive quality should strictly abide by the concept of quality-oriented education. Evaluation indicators should be identified scientifically and effectively by screening comprehensive characterization information of students during daily training; and a personalized and practicable comprehensive quality evaluation system should be formulated for students of different majors and characteristics, realizing refined and classified evaluation. Based on the theory of developmental evaluation, we should underscore the continuous improvement of students' all-round quality, give play to the system's diagnosis, feedback and education (and part of appraisal function for incentives) functions during training, so as to ensure the sustainability and operability of the evaluation system. Furthermore, the diversity of evaluation subjects should also be underlined.

(2) Design basic principles for students' comprehensive quality evaluation. The first one is to combine qualitative research with quantitative research. Being intuitive and easy to operate, quantitative research adopts objective data to analyze and appraise the evaluation objects,

enhancing the fairness of the evaluation results. Qualitative research uses subjective descriptions to analyze difficult-to-quantify information such as thoughts and attitudes, enhancing the comprehensiveness and diversification of evaluation results. The second one is to combine formative evaluation with summative evaluation. Formative evaluation is mainly carried out during educational activities, taking feedback and improvement as dominant purposes, while summative evaluation is to conclude the educational activities for screening and appraisal, providing a reference for decision-making. The improvement of students' comprehensive quality is a step-by-step process. It requires teachers' procedural guidance, supervision, motivation and feedback. If too much attention was paid to the results, students would be utility-inclined and the training process would be absent. If too much attention was paid to development, students would easily become lazy without incentives, according to demand-driven behavioral theory and students' characteristics, leading to poor practice and unsustainable operation of the evaluation program.

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## Appendix 1 : Survey Questionnaire on the Training of Undergraduates' Comprehensive Quality in Engineering Majors

**Dear teachers :**

Nice to meet you!

The purpose of this questionnaire survey is to understand the factors and the importance of the ability of university teachers to improve the overall quality of engineering undergraduates. It is hoped that this study will provide a theoretical reference and reference for the evaluation of the overall quality of undergraduates majoring in engineering. Thank you!

The "score" in the survey questionnaire indicates the importance of the comprehensive qualities that you think a college student needs to develop. 1-5 represents "very unimportant," "not important," "indifferent," "important," and "very important." Please draw a "√" in the form corresponding to the selected score.

Do you think the following behaviors or events are important for the development of the overall quality of college students?	Very unimportant<--->Very important				
	1	2	3	4	5
Ideal and Faith Education					
Participate in Political Life					
Honest Education					
Social Ethics Education					
Student Party School Learning					
Student Cadre School Learning					
Participate in small class good study style classes, advanced class collective response activities					
Interpersonal communication					
Cultivate Critical Spirit					
Volunteering					
Student Cadres					
Participate in organizing campus activities					
Course learning					
Discipline Competition					
Professional Education					
Technological Innovation Activities					
Entrepreneurial Activities					
Technology Competition					
Social Practice					
Social Work					
Sports Activities					

Do you think the following behaviors or events are important for the development of the overall quality of college students?	Very unimportant<--->Very important				
	1	2	3	4	5
Cultural Activity					
International Exchange					
Obtaining related certificates such as computers and foreign languages					
Psychological Counseling					
Career Plan					
Development of interests and hobbies					
Literary Writing					
Develop Communication Skills					
Team Practice					
Focus on time management					
Other :					

**Appendix 2 : Forms for implementation of comprehensive evaluation system**

**Comprehensive Evaluation Table (Table A)**

For Students (No.     semester)

Name: \_\_\_\_\_ Student No.: \_\_\_\_\_ Filling Date: \_\_\_\_\_ Year \_\_\_\_\_ Month \_\_\_\_\_ Date

Item	Awarded Points	Reasons
A 1-1		
A 1-2		
A 1-3		
A 2-1		
A 2-2		
A 3-1		
A 4-1		
B 1-1		
B 2-1		
C 1-1		
D 1-1		
D 2-1		
D 3-1		
D 4-1		
D 4-2		
Total		

Note: Please carefully fill in the reasons for applying for points in accordance with the items listed in the table. If there are multiple items in the same group, they should be stated one by one for review. Application items not specified in detail will not be approved.

Item	Table A	Table B	Table C	Total Item
<b>Total Score</b>				

Reviewed by: \_\_\_\_\_

Filled by: \_\_\_\_\_

## Comprehensive Evaluation Table (Table B)

For Monitors (No.     semester)

Name: \_\_\_\_\_ Student No.: \_\_\_\_\_ Filling Date: \_\_\_\_\_ Year \_\_\_\_\_ Month \_\_\_\_\_ Date

Item	Awarded Points	Reasons	Awarded by
A 1-1			
A 1-2			
A 1-3			
A 2-1			
A 2-2			
A 3-1			
A 4-1			
B 1-1			
B 2-1			
C 1-1			
D 1-1			
D 2-1			
D 3-1			
D 4-1			
D 4-2			

Note: Please carefully fill in the reasons for applying for points in accordance with the items listed in the table. If there are multiple items in the same group, they should be stated one by one for review. Application items not specified in detail will not be approved.

Reviewed by: \_\_\_\_\_ Filled by: \_\_\_\_\_

## Comprehensive Evaluation Table (Table C)

For Counselors (No.     semester)

Filling Date: \_\_\_\_\_ Year \_\_\_\_\_ Month \_\_\_\_\_ Date

Item	Awarded Points	Reasons	Awarded by
A 1-1			
A 1-2			
A 1-3			
A 2-1			
A 2-2			
A 3-1			
A 4-1			
B 1-1			
B 2-1			
C 1-1			
D 1-1			
D 2-1			
D 3-1			
D 4-1			
D 4-2			

Note: Please carefully fill in the reasons for applying for points in accordance with the items listed in the table. If there are multiple items in the same group, they should be stated one by one for review. Application items not specified in detail will not be approved.

Reviewed by: \_\_\_\_\_

Filled by: \_\_\_\_\_