



Teaching Quality Evaluation Model Based on CNN-Framework with Entropy Weight Method

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Abstract. This paper focuses on the evaluation of teaching quality for higher education, particularly from the perspective of student teaching evaluation. As an important means to reflect the teaching quality and teachers' teaching abilities directly, student teaching evaluations hold immeasurable value in optimizing teaching methods and enhancing teaching standards. In this study, a teaching quality evaluation model utilizes CNN-framework with the entropy weight method proposed to comprehensively explore student evaluations in teaching assessment and their role in promoting teachers' teaching improvement. Firstly, through the "evaluation-feedback-improvement" cycle mechanism, an in-depth analysis of key information in the student evaluation data was conducted, such as course satisfaction and teacher recognition, and establishes a comprehensive and objective teaching quality evaluation system by integrating other evaluation indicators. Then, an in-depth analysis and study of the student evaluation data were given based on the teaching quality evaluation system. It was found that the student evaluation data can provide valuable teaching feedback to teachers, assist them in identifying problems and deficiencies in teaching, and subsequently formulate targeted improvement measures. Finally, this study proposes a series of specific improvement measures, including innovation of teaching methods, optimization of teaching content, and updating of teaching tools. These measures not only enrich the theoretical system of higher education teaching evaluation but also provide practical guidance for the improvement of teaching quality in universities.

Keywords: teaching evaluation; student evaluation; quality evaluation model

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1 INTRODUCTION

In the wave of globalization and the knowledge economy, higher education is directly related to a country's international competitiveness. A country with high-quality higher education can often cultivate more outstanding talents with an international perspective, innovative spirit, and practical abilities, providing a continuous driving force for the country's technological progress, economic development, and cultural prosperity. With the updating of educational concepts and the evolution of social needs, comprehensive development and overall quality cultivation have become the core objectives in today's higher education field. Against this backdrop, teaching quality has become a crucial indicator for evaluating the success of a school or a teacher. Teaching quality is not merely the one-way transmission of knowledge but also a comprehensive shaping process of students' individuality, character, social responsibility, and innovative abilities. It concerns not only the future of students but also the future of the country.

Therefore, how to scientifically, objectively, and comprehensively evaluate and enhance teaching quality has become a common focus for higher education administrators and teachers. Among various teaching evaluation methods, student evaluations of teaching are highly favored due to their direct, authentic, and timely characteristics. These evaluations take students as the main participants and provide an objective assessment of the teaching process and teachers' instructional abilities from a student's perspective. This evaluation method can directly reflect students' true feelings about teaching quality, providing valuable feedback for teaching improvement.

The value of student evaluations of teaching lies not only in their directness and authenticity but also in their rich informational content. These data encompass various aspects, including the teacher's teaching style, methodology, and attitude, as well as the difficulty level and practicality of the course content. Through in-depth analysis of these data, we can identify weaknesses and areas for improvement in teaching activities, providing scientific evidence and guidance for teaching enhancement. Furthermore, student evaluations of teaching can also reveal students' learning needs and expectations, assisting teachers in better meeting these needs and enhancing teaching effectiveness.

However, traditional teaching evaluation methods have revealed some limitations in practical application. Firstly, they tend to emphasize qualitative evaluation, lacking objectivity and scientific rigor. Traditional teaching evaluation often relies on experts' subjective judgments and experience summaries, which are prone to personal biases and subjective factors, making it difficult to comprehensively and accurately reflect the true state of teaching quality. Secondly, the feedback cycle of traditional evaluation methods is relatively long. As it requires organizing experts for review and discussion, the feedback cycle of traditional evaluation methods is lengthy, making it difficult to promptly identify and address issues in teaching activities. This, to a certain extent, affects the continuous improvement of teaching quality. Furthermore, traditional evaluation methods often only focus on teachers' teaching abilities while neglecting students' subjective feelings and feedback. Students are direct participants in teaching activities, and their feelings and feedback are crucial for enhancing teaching quality. However, traditional evaluation methods often overlook this aspect, making the evaluation results difficult to comprehensively reflect the actual situation of teaching activities.

To overcome the limitations of traditional evaluation methods, a teaching evaluation analysis based on student evaluations has emerged. This approach utilizes student evaluation data and modern data analysis techniques to conduct a comprehensive, objective, and in-depth analysis of teaching quality. Firstly, student evaluation data originates from students, making it highly objective and timely. As direct participants in teaching activities, students' feelings and evaluations can directly reflect the true state of teaching quality. Moreover, student evaluation data is characterized by strong timeliness, enabling timely identification and resolution of issues in teaching activities, thus providing prompt and effective feedback for teaching improvement.

Secondly, student evaluation data contains a wealth of information. These data not only cover evaluations of teachers' teaching styles, methods, and attitudes but also include information on the difficulty level and practicality of course content. Through in-depth analysis of these data, we can identify weaknesses and areas for improvement in teaching activities, providing scientific evidence and guidance for teaching enhancement. At the same time, these data can also reveal students' learning needs and expectations, assisting teachers in better satisfying them and enhancing teaching effectiveness.

Furthermore, teaching evaluation analysis based on student evaluation data offers several advantages. Firstly, it facilitates effective communication between teachers and students. Through analyzing student evaluation data, teachers can gain a deeper understanding of students' needs and expectations, enabling more effective communication that enhances students' learning motivation and interest. Simultaneously, students can express their opinions and suggestions through evaluations, enhancing their sense of participation and belonging. Secondly, it provides decision support for teaching administrators. Student evaluation data offers feedback on the overall situation and trends of teaching quality, helping administrators better grasp the current situation and formulate more scientific teaching management policies. Lastly, it drives teaching reform and innovation. Through analyzing student evaluation data, we can identify issues and deficiencies in teaching activities, thus promoting reform and innovation to enhance teaching quality continuously.

In conclusion, teaching evaluation analysis based on student evaluation data has vast application prospects and significant practical significance in the field of higher education. In future research and practice, we should further explore and improve this method, fully leveraging its role in enhancing teaching quality and achieving talent cultivation goals. At the same time, we should also focus on cultivating students' self-evaluation and reflection abilities, nurturing them into outstanding talents with autonomous learning abilities and innovative spirits.

2 RELATED WORK

As an essential means to improve educational quality and talent cultivation, teaching evaluation in universities has always attracted widespread attention from the educational community both domestically and internationally. Teaching evaluation, as an integral part of the educational process, speaks volumes of its significance. It not only provides feedback on teaching effectiveness for teachers but also points out the learning direction for students. Furthermore, it provides educational policymakers with information on educational quality. Since the introduction of teaching evaluation in universities in the United States, its advanced concepts and effective practices have quickly had a profound impact globally. In particular, in recent years, with the updating of educational concepts, technological advancements, and innovations in evaluation methods, research, and practice in teaching evaluation in universities have made significant progress.

After searching the topic of "teaching evaluation in universities" on CNKI, this study found a total of 4,174 results, including 3,773 Chinese literature pieces. The annual trend of publications is shown in Figure 1, and the distribution of major research topics is illustrated in Figure 2. As seen in Figure 1, the number of publications related to teaching evaluation peaked in 2014. Prior to that, the number of publications showed a year-on-year upward trend, with a relatively stable state between 2007 and 2011. The number of publications again showed an upward trend from 2011 to 2014. During the period from 2016 to 2022, the number of publications rose once again and remained stable with fluctuations. After 2022, the number of publications decreased somewhat, but the trend in Figure 1 indicates that there may be an increase in publications in 2024.

As shown in Figure 2, the main research focus of teaching evaluation in universities lies in teaching evaluation itself, with 711 publications. Besides, research topics such as teaching assessment, evaluation systems, and teaching quality also occupy a significant portion. Additionally, research topics specific to various disciplines, including physical education and ideological and political education, are also involved.

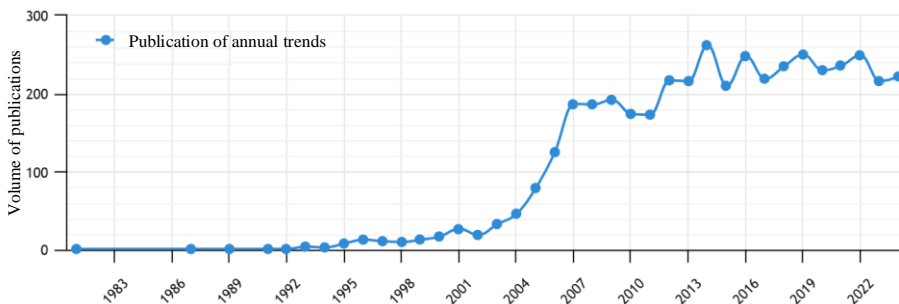


Figure 1: Annual trends in the number of articles issued.

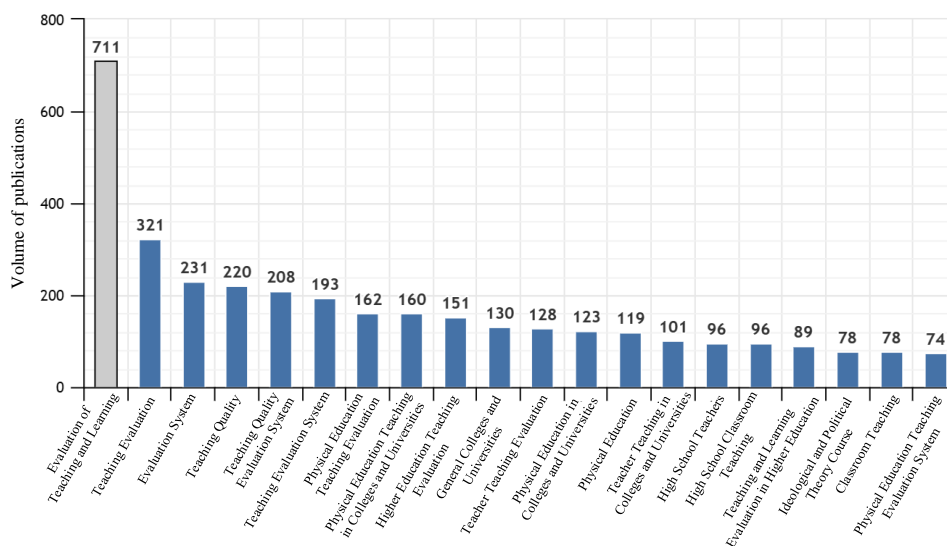


Figure 2: Distribution of main themes of research.

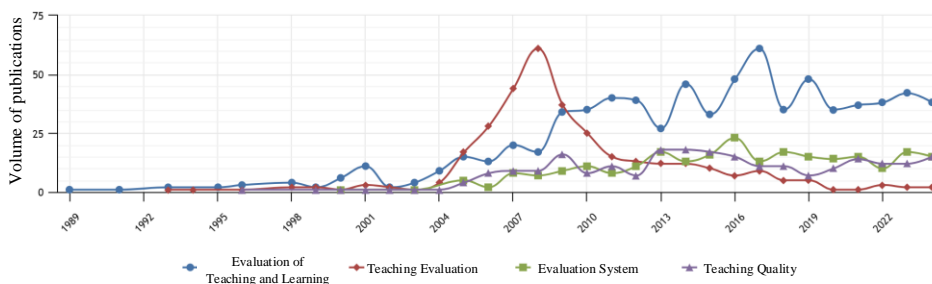


Figure 3: Comparison of the number of articles on selected major topics.

Figure 3 compares the number of publications on the four research topics: "teaching evaluation," "teaching assessment," "evaluation system," and "teaching quality." It can be observed from the figure that research on "teaching evaluation" started earlier than other topics. During the period

from 2005 to 2009, the number of publications on "teaching assessment" surpassed "teaching evaluation," but in other time periods, research on "teaching evaluation" significantly led to other topics, and the annual number of publications remains far higher than other topics at the present stage. This further demonstrates that research on the topic of "teaching evaluation" remains a hot issue.

As is well known, the origin of teaching evaluation in universities traces back to the United States. Its emergence and implementation have greatly promoted innovation and development in education and talent cultivation in American universities, enabling American higher education to achieve a leading position globally. Teaching evaluation in American universities mainly focuses on classroom teaching workload and teaching effectiveness, while emphasizing understanding students' opinions through interviews and other methods to continuously optimize teaching work. For example, the School of Public Health and Tropical Medicine at Tulane University has continuously improved its teaching evaluation system through this method. Hawaii University uses 15 evaluation indicators to evaluate teachers' classroom teaching effectiveness and provides specific suggestions for improving teaching work.

Based on the insight that student evaluation of teaching (SETs) plays a significant role as a key indicator for assessing teaching quality in higher education (HE), Steve et al. [1] have innovatively introduced a four-tier model. This model addresses biases related to SETs, delves into statistical anomalies and cognitive biases, and particularly emphasizes often overlooked hidden contextual and temporal factors.

Foreign universities tend to focus more on strategy design, implementation research, and students' interests and attitudes toward courses in their teaching evaluation studies. They collect data through various methods such as questionnaires, interviews, and observations, analyze students' learning experiences and outcomes, and provide targeted feedback and suggestions to teachers. However, there is relatively little research on students' learning outcomes, especially their mastery of knowledge itself, which may be related to their educational philosophy that emphasizes students' comprehensive development and personalized learning.

Since the 1990s, Chinese universities have also begun to pay attention to teaching evaluation issues. After years of exploration and practice, Chinese universities' teaching evaluation has shifted from theoretical research to practical exploration, achieving a series of achievements. During the rapid development phase of classroom teaching evaluation, a network of literature research emerged, encompassing multiple perspectives such as evaluation indicators, teaching quality, student evaluation of teaching, and evaluation subjects. These studies have not only enriched the theoretical system of teaching evaluation but also provided strong support for practical exploration. The teaching evaluation system established in Chinese universities is basically a top-down system constructed by administrators. With the deepening of the "student-centered" teaching philosophy, most universities have realized that students should be the subjects of teaching activities and teaching evaluation [2].

At present, the teaching evaluation in Chinese universities has shifted from theoretical research to practical exploration, achieving a series of achievements. During the rapid development stage of classroom teaching evaluation, literature research has formed a network comprising multiple perspectives such as evaluation indicators, teaching quality, student evaluation of teaching, and evaluation subjects. Xu et al. [3] drew on human resource management methodologies and analyzed knowledge teaching evaluation system characteristics in colleges and universities in a big data context to construct a "multiple evaluations, trinity, and four-step closed-loop" big data-based knowledge teaching evaluation system. "Trinity" represents evaluation from three performance dimensions: teaching effect, teaching behavior, and teaching ability. "Multiple evaluations" represent the design of teaching performance indicators based on teaching data, breaking the barriers between different evaluation subjects. "Four-step closed-loop" draws on performance management theory to standardize the teaching performance management process from four aspects: planning, implementation, evaluation, and feedback. This evaluation system provides a systematic

methodology for unifying the theory and practice of innovative knowledge teaching evaluation systems in universities in a big data context[4],[5].

Luis [6] utilized a mixed-methods design to explore college students' willingness to provide feedback through technical English during the teaching evaluation process. The results showed that students' positive perceptions of the evaluation process and their perceptions of useful evaluations increased their willingness to provide feedback while underlying student biases decreased their willingness to provide feedback[7]. By using qualitative methods to explore and describe student perceptions of the strongest aspects of instruction and areas for improvement in instructional coaching, David [8] aimed to describe the impact of teachers involved in classroom instruction. Based on the perspective of performance management, Li [9] used the 360 evaluation method to explore the process of improving the multiple evaluation subjects of teaching quality in colleges and universities from the single subject of leadership evaluation to the five evaluation subjects of student evaluation, expert evaluation, leadership evaluation, peer evaluation, and self-evaluation. Then, the introduction of third-party and long-term teaching quality evaluation systems, including mutual evaluation and social evaluation, is elaborated. Finally, it is proposed to emphasize the application of teaching quality evaluation results and the reform of the reward system for teaching quality evaluation, so as to make teaching quality evaluation truly meaningful[10].

In order to better improve students' academic performance and enhance their ability to accept knowledge, Xu [11] proposed an artificial intelligence algorithm for the development and evaluation of the teaching skills of college teachers. The analysis results show that the artificial neural network model has high numerical accuracy when using hierarchical analysis to evaluate teachers' classroom teaching skills [12]. Ma [13] described the multi-indicator evaluation method and listed the commonly used teaching quality evaluation methods, namely, the hierarchical analysis method, entropy weight method, and gray correlation analysis method. The basic principle of the hierarchical analysis method is given, and examples are given to illustrate the steps of calculating the initial weights of the hierarchical analysis method, and the initial weights of the hierarchical analysis method are combined and solved by the entropy weight method[14]. The evaluation principle of the gray correlation analysis method is given, and the combination weights of AHP-EWM evaluation are illustrated by the gray correlation analysis method. The teaching quality evaluation index system of applied talent cultivation in colleges and universities is constructed by using the AHPEWM evaluation method, and each index is mined and analyzed. It finally proves that the evaluation of teaching quality in colleges and universities is multifaceted, and colleges and universities can improve their teaching level according to different evaluation factors [15],[16]. Zhang [17] constructs an educational teaching evaluation model based on big data technology, which is centered on students' personality development. The established evaluation index system of education and teaching quality includes 5 first-level indicators and 22 second-level indicators. It provides an effective teaching model and evaluation method for colleges and universities to realize the development of quality education.

With the in-depth development of educational informatization and digitization, universities have adopted various methods for teaching evaluation. The acquisition and analysis of student evaluation data have become more convenient and efficient. A large amount of student evaluation data contains rich information, which can provide valuable references for teaching evaluation and improvement [18][7][20]. However, how to extract valuable information from the vast data has become an important topic in current educational research. Therefore, it is necessary to conduct in-depth research and analysis of student evaluation data to explore its application value and significance in teaching evaluation.

In summary, although teaching evaluation in universities has made significant progress both domestically and internationally, there are still some issues that need to be addressed urgently. Firstly, the weight setting of evaluation indicators is not reasonable enough. Many universities do not assign corresponding weights to indicators based on their importance and influence during teaching evaluation, resulting in inaccurate and objective evaluation results. Each evaluation indicator should be assigned a certain weight, and not all indicators should be treated equally.

Secondly, there is a lack of specific countermeasures for evaluation results. Many universities publish the results after teaching evaluation without providing specific improvement suggestions or countermeasures based on the evaluation results, making teaching evaluation unable to play its role truly. Specific countermeasures need to be given based on the results of teaching evaluation to achieve the purpose of "evaluation-feedback-improvement."

3 TEACHING EVALUATION RESEARCH METHODS

3.1 Evaluation Index System Construction

To comprehensively understand and improve teaching quality, we have constructed an evaluation system comprising ten student-based teaching assessment indicators. This system covers all aspects of teaching, aiming to provide students with a fair and comprehensive evaluation platform.

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(1) Teaching Objectives

Teaching objectives are the starting point and ultimate goal of teaching activities, explicitly stating the expected outcomes students should achieve through course study. We focus on whether teachers clearly and specifically articulate their teaching objectives and whether these objectives align with the curriculum outline and subject requirements.

(2) Teaching Content

Teaching content is the core of teaching activities, determining the breadth and depth of knowledge students learn. We value whether teachers select comprehensive and accurate content that keeps up with the forefront of the discipline. At the same time, we also pay attention to whether the teaching content is closely related to student's daily lives and future career development.

(3) Teaching Methods

Teaching methods are auxiliary tools for teaching activities, helping teachers better impart knowledge and stimulate students' interest in learning. Teachers can adopt diverse teaching methods, such as multimedia teaching, case analysis, experimental demonstrations, etc., to enhance teaching effectiveness and students' learning experience.

(4) Teaching Attitude

Teaching attitude refers to teachers' behavioral manifestations and psychological states during the teaching process, directly affecting students' learning outcomes. Teachers should possess a serious and responsible teaching attitude, respecting, caring for, and patiently guiding students. They should also maintain a positive mindset to inspire students' learning interests and motivation.

(5) Teaching Approach

The teaching approach is the specific method adopted by teachers in teaching activities, determining how knowledge is transmitted and how students learn. Teachers can adopt scientific and reasonable teaching approaches, such as heuristic teaching, discussion-based teaching, etc., to cultivate students' innovative thinking and practical abilities.

(6) Teaching Interaction

Teaching interaction is an essential part of teaching activities, facilitating communication and interaction between teachers and students. Teachers should actively engage in interaction with students, stimulating their interest and participation through questioning, discussions, and other methods. Simultaneously, teachers should focus on communication and cooperation with students to promote their comprehensive development.

(7) Learning Evaluation

Learning evaluation is a feedback loop in teaching activities, helping teachers understand students' learning progress and adjust teaching strategies. Teachers can establish a scientific and fair learning evaluation system, comprehensively understanding students' learning outcomes and performance through assignments, examinations, practical operations, etc. At the same time, teachers should also pay attention to the feedback and application of evaluation results to help students improve their learning methods and enhance learning outcomes.

(8) Moral Education

Moral education is one of the fundamental tasks of education, aiming to cultivate students' moral character and personality development. Teachers should emphasize moral education in the teaching process, guiding students to form correct values and life outlooks through words and deeds, as well as role modeling.

(9) Ability Cultivation

Ability cultivation is one of the core objectives of education, aiming to enhance students' comprehensive qualities and practical abilities. Teachers should focus on cultivating various abilities in students, such as problem-solving, analytical thinking, and creativity. Additionally, teachers should encourage students to actively participate in practical activities and project research to improve their practical abilities and comprehensive qualities.

(10) Degree of Satisfaction

The degree of satisfaction is students' overall evaluation of teachers' teaching work, reflecting their recognition of teaching quality and effectiveness. Students' feedback and suggestions are crucial for improving teaching work and enhancing teaching quality.

In this paper, the above ten indicators were adopted to accomplish the evaluation of teaching quality, and the schematic of the model is shown in Figure 4.

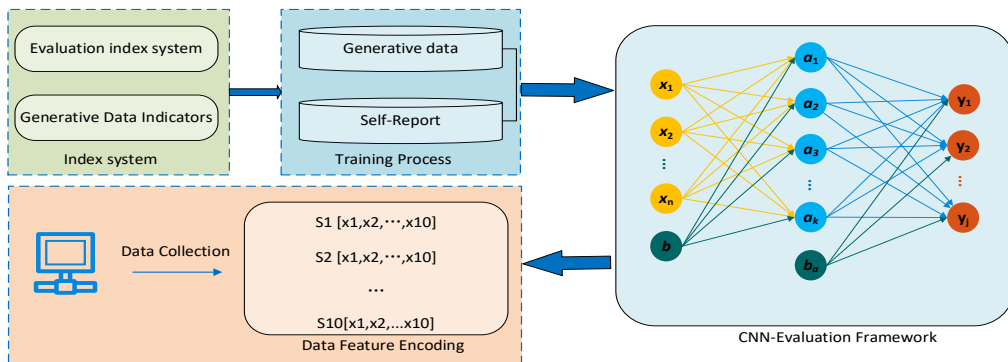


Figure 4: Evaluation model schematic.

3.2 CNN-Evaluation Framework Based on Entropy Weight Method

Entropy was first introduced by Shannon into information theory and has been widely applied in fields such as engineering technology, social economy, and others. In this paper, the entropy weight method is used with the CNN-Framework to determine the objective weight based on the size of the Evaluation index variability. Generally speaking, the smaller the information entropy of a certain index is, the greater the degree of variability of the index is, indicating that it provides more information and plays a more significant role in comprehensive evaluation. Thus, its weight is also greater. Conversely, the greater the information entropy of a certain index is, the smaller the degree of variability of the index is, indicating that it provides less information and plays a less significant

role in comprehensive evaluation. Thus, its weight is also smaller. The schematic diagram of the algorithm is shown in Figure 5.

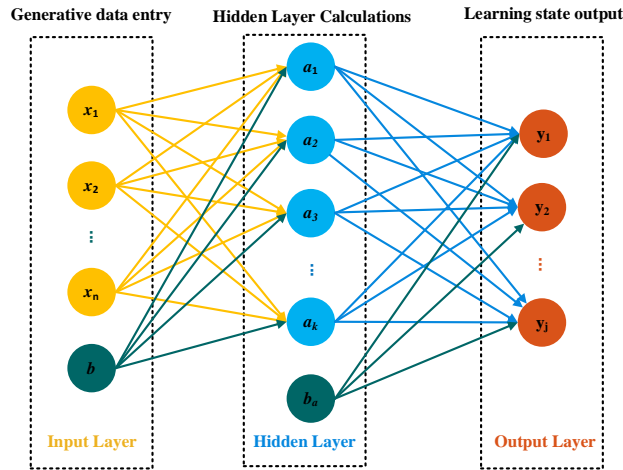


Figure 5: CNN-Evaluation Framework Based on Entropy Weight Method.

This article adopts the entropy weight method to assign weights to various index systems in the teaching evaluation process with CNN-Framework. The basic calculation steps are as follows:

(1) Data Standardization

First, each indicator is processed to remove the dimensional effect. Assuming the dataset contains n schemes, each scheme includes m indicators: $\{X_1, X_2, \dots, X_n\}$, where $X_i = \{x_1, x_2, \dots, x_m\}$. Assume that the value of the data standardization of each indicator is $\{Y_1, Y_2, \dots, Y_n\}$. Since some indicators are positive indicators and some are negative indicators, different standardization methods are used as shown in equations (1) and (2):

$$Y_{ij} = \frac{X_{ij} - \min(X_i)}{\max(X_i) - \min(X_i)} \quad (\text{positive indicators}) \quad (1)$$

$$Y_{ij} = \frac{\max(X_i) - X_{ij}}{\max(X_i) - \min(X_i)} \quad (\text{negative indicators}) \quad (2)$$

(2) Calculating the Ratio of Each Indicator in Each Scheme

The proportion of the i -th indicator in the j -th scheme relative to that indicator is used to calculate the degree of variation of the indicator, as shown in equation (3):

$$P_{ij} = \frac{Y_{ij}}{\sum_{i=1}^n Y_{ij}} \quad (i = 1, 2, \dots, n; j = 1, 2, \dots, m) \quad (3)$$

(3) Calculating the Information Entropy of Each Indicator

Based on the definition of information entropy in information theory, the information entropy of a set of data can be calculated using equation (4):

$$E_j = -\ln(n)^{-1} \sum_{i=1}^n P_{ij} \ln P_{ij} \quad (4)$$

Where $E_j \geq 0$, and if $P_{ij} = 0$, define $E_j = 0$.

(4) Determining the Weight of Each Indicator

Based on the information entropy calculation formula, the information entropy E_1, E_2, \dots, E_m of each indicator is calculated. There are two methods for this:

① Calculating the weight of each indicator based on the information entropy using equation (5):

$$w_j = \frac{1-E_j}{k-\sum E_j} \quad (j = 1, 2, \dots, m) \quad (5)$$

Where k refers to the number of indicators, i.e., $k = m$.

② Calculating the weight by computing the coefficient of variation using equation (6):

$$D_j = 1 - E_j \quad (6)$$

Then, the indicator weights are calculated using equation (7):

$$w_j = \frac{D_j}{\sum_{j=1}^m D_j} \quad (7)$$

(5) Finally, Calculating the Comprehensive Score for Each Scheme

The formula for calculating the comprehensive score of each scheme is as follows equation (8):

$$S_j = \sum_{j=1}^m w_j \cdot x_{ij} \quad (8)$$

The main flowchart of this method is shown in Figure 6.

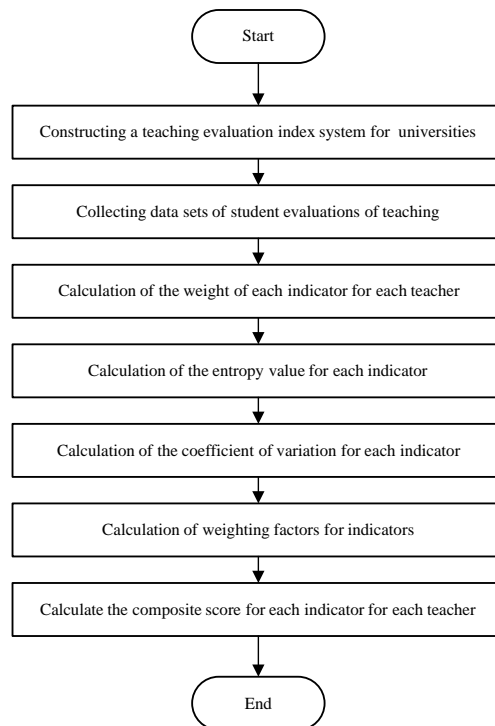


Figure 6: Flowchart of the Weighted Entropy CNN-Framework method.

4 EXPERIMENTAL RESULTS AND ANALYSIS

In this study, we obtained student evaluation data on ten courses taught by ten teachers in a university through a questionnaire survey, including the publicly released teaching performance rankings. We conducted an experimental analysis of the student evaluation data obtained, which consisted of 10 evaluation indicators, all of which were authentic student evaluation indicators from the university. These indicators are teaching objective, teaching content, teaching tool, teaching attitude, teaching method, teaching interaction, learning evaluation, ability cultivation, moral development, and satisfaction level. In this article, we aim to utilize the student evaluation data more objectively by assigning weights and correlating it with students' grades in the respective courses and teachers' rankings. Through the "evaluation-feedback-improvement" approach, we seek to achieve dual improvement for both teachers and students. Specifically, evaluating teachers' teaching quality based on student evaluation data and students' final grades can reflect teachers' shortcomings in their course teaching, providing timely feedback to teachers themselves and enabling them to make improvements in subsequent teaching processes. This will positively impact teachers' teaching quality and students' learning outcomes.

For the convenience of writing and easy understanding, this article designates the ten evaluation indicators as X1 to X10, as shown in Table 1.

<i>Variant</i>	<i>Evaluation Index</i>
X1	teaching objective
X2	teaching content
X3	teaching tool
X4	teaching attitude
X5	teaching approach
X6	teaching interaction
X7	learning evaluation
X8	ability cultivation
X9	moral development
X10	satisfaction level

Table 1: Correspondence of indicators.

4.1 Descriptive Analysis of Indicators

To gain insights into the statistical characteristics of the dataset and better understand it, this paper conducted a simple descriptive statistical analysis of the evaluation indicators obtained from the student evaluation data. To make the results more intuitive and visible, the results were plotted in a radar chart, as shown in Figure 7.

Figure 7 demonstrates the average ratings provided by 100 students on the various evaluation indicators for the ten teachers, labeled from A to J. The mean values of each of the ten indicators are displayed in the radar chart. Based on the similarity of the evaluation scores among the ten teachers, we categorize them into four groups. As evident from the figure, teachers A and B have closely similar ratings and are classified into one group. Similarly, teachers C, D, and E are grouped together, teachers F, G, and H form another group, and teachers I and J constitute the final group. To further illustrate these characteristics in a clearer and more intuitive manner, we have plotted the ten teachers in four separate sub-radar charts based on their respective groups, as shown in Figure 8.

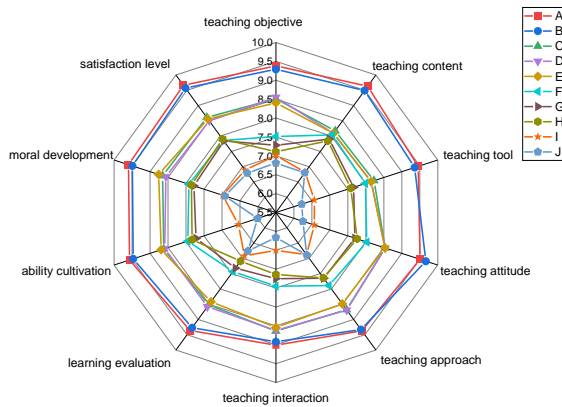


Figure 7: Radar chart of overall ratings of the ten teachers.

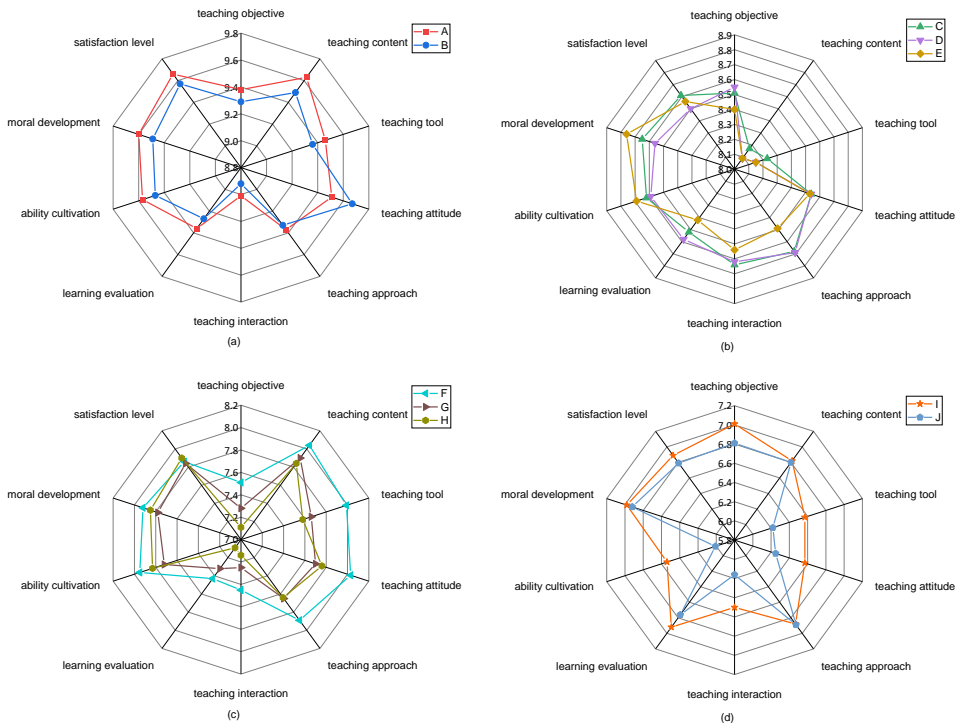


Figure 8: Basic situation of students' evaluation of teaching.

As can be seen from Figure 8, teachers of the same type tend to exhibit similar performance across different evaluation indicators. In Figure a, teachers' overall scores are relatively high, averaging around 9.4, but teachers A and B score lower in the "teaching interaction" indicator. In Figure b, the overall scores of teachers are slightly lower than in Figure a, but teachers C, D, and E have similar scores and score lower in the "teaching tool" and "teaching content" indicators, indicating that these teachers need further to improve their teaching tools and content in future teaching. In Figure c, the average scores of the three teachers on various indicators are slightly lower than in Figures a, and

b. Teacher F scores slightly higher than G and H, but they all have a commonality, scoring low in the "teaching objective," "teaching interaction," and "learning evaluation" indicators. This suggests that they have unclear teaching objectives, limited student interaction, and insufficient attention to students' learning processes. In Figure d, both teachers score low in all indicators, with the lowest score in the "ability cultivation" indicator. This indicates that teachers I and J may focus more on "giving a fish" rather than teaching students how to "fish" in the teaching process. Additionally, the scores for the "teaching tools," "teaching attitude," and "teaching interaction" indicators are also relatively low. Overall, the teaching quality of these two teachers is on the lower side, and they need to make improvements in multiple aspects of future teaching.

4.2 Weight Analysis Process

This study employed a combined qualitative and quantitative research approach to explore the information contained in student evaluations of teaching thoroughly. Firstly, we collected a significant amount of data through questionnaires and other methods, covering various indicators such as teaching objectives, teaching attitudes, and teaching tools. Subsequently, we utilized descriptive statistical analysis to organize and summarize the data, aiming to gain a comprehensive understanding of the overall teaching quality. Then, we employed methods such as the entropy weight method and regression analysis to explore the impact of each evaluation indicator on teachers' teaching quality, thus providing scientific evidence for teaching improvement. After analyzing the evaluations of 100 students, we ultimately obtained the average scores of 10 teachers across ten indicators, as exemplified in Table 2.

	<i>X1</i>	<i>X2</i>	<i>X3</i>	<i>X4</i>	<i>X5</i>	<i>X6</i>	<i>X7</i>	<i>X8</i>	<i>X9</i>	<i>X10</i>
Teacher A	9.38	9.63	9.46	9.51	9.37	9.01	9.36	9.57	9.60	9.66
Teacher B	9.29	9.49	9.36	9.67	9.33	8.92	9.27	9.47	9.49	9.57
Teacher C	8.51	8.17	8.23	8.54	8.68	8.64	8.52	8.62	8.65	8.61
...	...									

Table 2: Example of evaluation data.

The entropy weight method was used to calculate the weights of the evaluation indicators for this dataset, and the final results are presented in Table 3. (The following table shows three decimal places after the decimal point.)

<i>evaluation index</i>	<i>Entropy value</i>	<i>coefficient of variation</i>	<i>weight</i>
X1	0.973	0.027	0.084
X2	0.999	0.001	0.004
X3	0.981	0.019	0.060
X4	0.975	0.025	0.077
X5	0.957	0.043	0.133
X6	0.912	0.088	0.271
X7	0.969	0.031	0.096
X8	0.955	0.045	0.140

X9	0.977	0.023	0.073
X10	0.980	0.020	0.062

Table 3: Entropy value, coefficient of variation, and weight corresponding to each evaluation index

Based on the table above, it is clear that the weight of each indicator is like a weight on a scale, measuring the performance of every teacher in the teaching process. Notably, the significant weights of teaching methods, teaching interaction, and ability cultivation not only represent a simple numerical allocation but also profoundly reflect the modern concept of higher education.

The high weight of the teaching methods indicator reveals educators' pursuit of the art of teaching. It is not merely a means of delivering knowledge but a key to stimulating students' interest, guiding their thinking, and cultivating their innovative abilities. An excellent teaching method enables students to acquire knowledge in a relaxed and enjoyable atmosphere, fostering their ability to think independently, which will play a crucial role in their future careers.

Teaching interaction is another essential dimension. It requires teachers to be not just the sole disseminators of knowledge in the classroom but also the guides who engage in deep interactions and collaborative exploration with students. Through various forms, such as question-and-answer sessions, discussions, and practical activities, students are truly involved in the teaching process, igniting their enthusiasm for learning and enhancing their learning outcomes. This interactive teaching approach not only enhances students' learning experience but also promotes emotional exchanges between teachers and students, making education a warm and heartfelt transmission.

The rise of the ability cultivation indicator signifies a significant shift in higher education goals. Traditional education focuses on knowledge infusion, while modern education emphasizes the cultivation of students' abilities. These abilities include but are not limited to critical thinking, innovation, and team collaboration. They are the cornerstones for students to adapt to future society and achieve personal value. Therefore, higher education has also taken ability cultivation as an important consideration in evaluating teaching quality.

At the same time, we also notice that the weight of teaching content is relatively small among these 10 indicators. This does not mean that content is unimportant but reflects the shift in modern educational concepts. In the era of knowledge explosion, merely imparting knowledge is no longer sufficient to meet students' needs. More importantly, how to enable students to master learning methods, how to help them quickly filter out valuable content from vast amounts of information, and how to enable them to think independently and solve problems when faced with challenges. The cultivation of such abilities is far more crucial than mere knowledge transmission.

Therefore, teaching evaluation is not merely an assessment of teachers' teaching quality but also an interpretation of modern higher education concepts. It tells us that education is not just about knowledge transmission but also about ability cultivation, emotional exchanges, and the collision of ideas. Such education can truly cultivate talents who are adaptable to future society, innovative, and practical.

5 CONCLUSIONS

Through the analysis and research of big data on student teaching evaluations with the Weighted Entropy CNN-Framework method, this article draws the following conclusions: First, the flexibility of teaching methods, the frequency of teaching interaction, and the targeted cultivation of abilities are the factors that students attach great importance to teachers evaluating. This flexible and diverse teaching approach can significantly stimulate students' interest and internal motivation for learning. Secondly, the clear setting of teaching objectives and timely feedback on learning evaluations are crucial for improving teaching quality. Excellent teachers often ensure that students clearly understand the course objectives and can obtain immediate and effective feedback during the

learning process. This approach is more likely to win students' recognition and respect, thereby enhancing the teaching effect. In addition, teaching attitude, teaching tools, and moral cultivation also play indispensable supporting roles in improving teaching quality. Teachers' good teaching attitude and appropriate teaching tools provide solid guarantees for enhancing teaching quality.

Based on the above analysis, the following suggestions are proposed: Firstly, schools should increase the intensity of teacher training and evaluation to enhance teachers' teaching skills and abilities. Secondly, curriculum design should be more closely aligned with students' interests and actual needs, flexibly utilizing various teaching methods to optimize teaching effectiveness.

Overall, analyzing student evaluations of teaching reveals the current status and issues of teaching quality, providing valuable scientific evidence and guidance for teaching improvement. However, we should also recognize that student evaluations are only one aspect of teaching quality evaluation and need to be combined with other evaluation indicators and methods to evaluate teaching quality in a more comprehensive and objective manner. In the future, we will continue to delve into teaching evaluation methods and indicators, exploring more efficient evaluation models, in order to provide solid theoretical support and rich practical experience for improving the quality of higher education teaching and promoting educational reform.

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