Fuzzy Evaluation of Teaching Quality in "Smart Classroom" with Application of Entropy Weight Coupled TOPSIS

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***Abstract*—This research aims to investigate the scientific assessment methodology for the teaching quality of smart classrooms and to develop a multi-dimensional evaluation system utilizing a combination of the entropy weight technique and the TOPSIS approach. To comprehensively assess the pedagogical proficiency of educators, this paper selects the dimensions of teaching preparation, the process, teaching effect and teaching reflection, and combines the questionnaire survey and statistical data to collect and analyze the data. The research methodology initially standardized the raw data to mitigate discrepancies among various scales; subsequently, the weight method was employed to ascertain the weight of each evaluation index, thereby indicating the significance of the indices through information entropy; ultimately, the TOPSIS method was utilized to evaluate teachers' performance across each dimension and rank them based on their proximity to the optimal and negative ideal solutions, culminating in a comprehensive assessment of teaching quality. The results of the study show that the entropy weight method can effectively determine the weight of each index, and the TOPSIS method provides teachers with a clear ranking of teaching quality by calculating the distance from the ideal solution, helping to identify strengths and weaknesses in teaching. This paper concludes that the evaluation method combining the entropy weight method and TOPSIS method can provide an objective and comprehensive teaching quality assessment for the smart classroom, but there are limitations such as the small sample data size and some teaching dimensions are not adequately covered, etc. Future research can further improve the evaluation system by expanding the sample size and increasing the evaluation dimensions to enhance its applicability and accuracy, so as to provide stronger support for the continuous optimization of the smart classroom.**

Keywords—Smart classroom; entropy weight method; TOPSIS method; teaching quality; optimization and improvement

I. Introduction

The evolution of information technology has rendered traditional teaching models insufficient for modern educational needs, thereby catalyzing the development of innovative educational frameworks and philosophies [1]. The smart classroom, which integrates advanced information technology with instructional practices, has emerged as a crucial element in contemporary educational reform [2]. Utilizing the Internet, big data, cloud computing, and other advanced technologies, the intelligent classroom offers educators and learners an abundance of resources and tools, thus substantially broadening the reach and capabilities of educational practices [3]. This innovative teaching model not only enhances classroom instruction but also transforms the educational process into one that is more personalized, interactive, and intelligent. Unlike traditional classrooms, smart classrooms can facilitate personalized teaching, independent learning, cooperative learning, and other diverse teaching methods, thereby better accommodating the varied learning needs and interests of students [4]. As smart classrooms become increasingly widespread in schools, research has begun to focus on optimizing their teaching design and strategies to enhance educational effectiveness [5].

As smart classrooms gain popularity, researchers have increasingly focused on assessing their instructional effectiveness [6]. Accurately evaluating the teaching quality of the smart classroom has emerged as a critical problem in contemporary educational research. Unlike the conventional teaching evaluation system, the assessment in a smart classroom considers not only students' academic performance but also their engagement, interest in learning, collaboration, and the feedback provided by teachers [7]. Therefore, how to scientifically formulate the evaluation standards and methods of teaching quality in smart classroom has become a key direction of research [8]. Many scholars have proposed different evaluation models and methods, such as learning outcome evaluation model, teaching quality evaluation model and so on [9] [10]. Through these evaluation models, the teaching effect of smart classroom can be assessed more comprehensively, providing theoretical support and practical guidance for future educational reform.

Evaluating and enhancing the pedagogical standards in "intelligent learning environments" has emerged as a pivotal concern. This investigation employs the entropy weight approach and the TOPSIS methodology as standard evaluation instruments to gauge the educational quality in "intelligent learning environments." The entropy weight approach assigns weights by computing the information entropy of each metric. Information entropy indicates the extent of variability in a metric; a higher entropy value implies greater information richness and thus a higher weight. The entropy weight approach's advantage lies in its ability to automatically distribute weights based on the data's distribution, reducing subjectivity, minimizing human intervention, and making it appropriate for complex and dynamic decision-making contexts [11]. The TOPSIS approach, which stands for Technique for Order Preference by Similarity to Ideal Solution, serves as a ranking mechanism that assesses the advantages and

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disadvantages of different options by measuring the distance of each option from both the optimal and the least favorable solutions [12]. This method pinpoints the choice that is closest to the ideal and farthest from the negative ideal by evaluating the proximity of each alternative to the ideal solution [13]. Recognized for its intuitive comprehension and straightforward computation, it is particularly suitable for decision-making scenarios involving multiple evaluation criteria.

The entropy weight approach can objectively ascertain the weight of each evaluation index in assessing the teaching quality of intelligent learning environments, while the TOPSIS methodology can identify the strengths and weaknesses of different implementation plans for intelligent learning environments [14]. By integrating these two methodologies, it is anticipated that the teaching effectiveness will be evaluated in a more comprehensive and scientific manner, ensuring an objective and thorough assessment process [15].

This study aims to investigate the scientific assessment methodology for the teaching quality of smart classrooms and to develop a multi-dimensional evaluation system utilizing a combination of the entropy weight technique and the TOPSIS approach. To comprehensively assess the teaching quality of teachers, this paper selects the dimensions of teaching preparation, teaching process, teaching effect and teaching reflection, and combines the questionnaire survey and statistical data to collect and analyze the data.

This paper is organized as follows: It begins with an introduction to the study's background and objectives, elucidating the research's significance and innovative aspects in Section I. Section II offers a review of the relevant literature and theoretical framework, laying the groundwork for the subsequent analysis. The third section details the research methodology, including data collection and analysis procedures. Section III presents the study's main findings, illustrated through graphical representations and data analysis. Following this, the paper discusses the results, corroborating and expanding upon existing theories while also highlighting the study's limitations and areas for improvement. Lastly, the paper summarizes the key conclusions and offers recommendations for future research directions.

II. Teaching Quality Evaluation Modeling for the "Smart Classroom"

A. Establishment of an Evaluation Indicator System

This paper outlines the selection of indicators for assessing teaching quality in the "smart classroom," focusing on two primary considerations: the significance and feasibility of crucial aspects, leading to the choice of the most representative and quantitative indicators. These indicators can precisely represent the attainment of the objectives and can be optimized to a certain degree. Secondly, the chosen indicators are assessed to ascertain the actual attainment of the objectives and modified as necessary [16]. These metrics can be achieved by implementing an effective data collection and reporting system to deliver prompt feedback during the teaching and learning process. The ongoing assessment and modification guarantee the efficacy of the teaching quality evaluation system. Future enhancements will encompass many elements: refining indicator settings to align with actual requirements, enhancing data collection methods to augment accuracy, and streamlining processes to boost evaluation speed. The evaluation system can adapt more readily to alterations in the educational landscape and technological advancements.

This paper develops a "smart classroom" teaching quality evaluation index system by integrating the aforementioned concepts and pertinent research, with the objective of establishing a scientific foundation for assessing teaching efficacy and facilitating educational change. The data mostly originate from a questionnaire survey conducted across many classes at a school, hence ensuring the representativeness and practicality of the findings.

B. Entropy Weighted TOPSIS Modeling

1) Entropy weight method: The entropy weighting approach can ascertain the weights of indicators for evaluating teaching quality in a smart classroom, facilitating the assessment of the relative significance of various elements in teaching quality [17]. From Fig. 1, in the intelligent classroom, elements such as educators' proficiency, students' achievement, and the impact of the instructional process are critical assessment metrics. The entropy weighting approach ascertains the weight of each indicator by aggregating data and computing the information entropy associated with each indicator. A higher entropy number indicates a greater disparity among the indicators, necessitating a reduced weight; conversely, a lower entropy value signifies a lesser disparity, warranting a proportionally increased weight. The Entropy Weight Method (EWM) functions as a multi-attribute decision-making tool, designed to determine the weights of different indicators. First introduced by American academic Jay Forrester in 1960, the method has since been advanced and perfected by later scholars. It is grounded in the concept of information entropy, which quantifies the degree of variation among indicators [18]. A higher entropy suggests greater heterogeneity among the indicators, thus warranting a lower weight assignment. In contrast, a lower entropy value implies less variation and a correspondingly higher importance of the indicator. Therefore, by calculating the entropy for each indicator, the EWM can methodically assign appropriate weights to them.

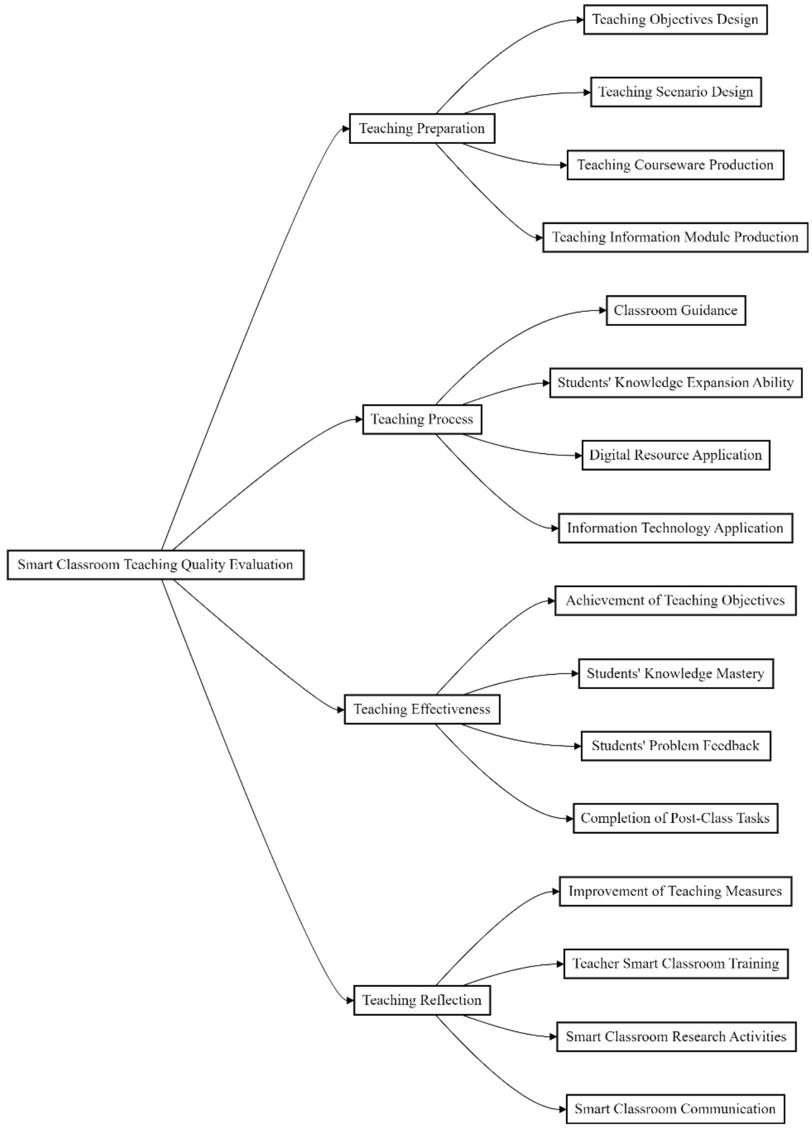

Fig. 1. Teaching quality evaluation index system.

The entropy weight technique offers the benefits of objectively representing the significance of each indication while being straightforward and quick to implement. Nonetheless, the entropy weight technique possesses many disadvantages, including sensitivity to variations in data and stringent standardization prerequisites for the decision matrix. Consequently, this work modifies the standardization approach of the entropy weight method to enhance its applicability and precision [19].

Specifically, the steps of the entropy power method are as follows:

a) Normalization of assessment data: Normalization of sample data involves transforming the original data into a standardized normal distribution characterized by a mean of zero and a standard deviation of one. This process allows for the harmonization of variables that possess disparate scales, units, and ranges into a uniform metric, thereby enhancing the precision of data analysis and the robustness of model development.

In order to maintain the distributional characteristics of the data, reduce the interference of outliers on the results, and facilitate the subsequent application of the model, this paper adopts the following formula for data normalization: normalized over r_{ij}.

Standardized as follows Eq. (1):

$$r_{ij} = \frac{x_{ij} - min(x_j)}{max(x_j) - min(x_j)} \tag{1}$$

Where $max(x_j)$ - Maximum value of sample single indicator data;

$min(x_j)$-Sample single-indicator data minimum.

b) Calculating information entropy E_j

$$E_j = -\frac{1}{lnm}\sum_{i=1}^{m} p_{ij} lnp_{ij} \tag{2}$$

In Eq. (2) and Eq. (3), m represents the number of calculation samples, in this paper the calculation sample is 5; p_{ij} computing the median information entropy.

$$p_{ij} = \frac{r_{ij}}{\sum_{j=1}^{n} r_{ij}} \tag{3}$$

c) Calculation of weights β_i (ω), Eq. (4):

$$\beta_i = \frac{1-E_j}{\sum_{j=1}^{n}\left(1-E_j\right)} \tag{4}$$

2) TOPSIS model: The TOPSIS technique, a prevalent multi-attribute decision-making approach, evaluates and ranks alternatives by measuring the distance of each criterion from both the ideal and the nadir solutions, thereby gauging their merits and demerits. When applied to the assessment of teaching quality in smart classrooms, each criterion's value is juxtaposed against the best and worst possible outcomes. Scores are computed based on the proximity of each alternative to the ideal and the remoteness from the nadir solution, with rankings established accordingly. The ideal solution embodies the optimal values across all criteria, whereas the nadir solution reflects the least favorable outcomes. Consequently, TOPSIS efficiently discerns the superior teaching quality strategy, namely, the one that most closely approximates the ideal and is maximally distant from the nadir solution.

Since its introduction by Hwang and Yoon in 1981, the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) has gained extensive application across diverse domains, including decision-making, supply chain management, and investment evaluation [20], [21]. The method's fundamental concept involves assessing the strengths and weaknesses of various scenarios by comparing them to two benchmarks: the ideal solution and the negative ideal solution. The ideal solution signifies the optimal outcome that maximizes benefit-oriented metrics or minimizes cost-related ones, whereas the negative ideal solution denotes the least favorable outcome across all metrics. TOPSIS provides an intuitive ranking by quantifying the distance of each alternative from these two reference points.

While TOPSIS excels in comprehensive assessments, it faces a limitation in weight determination, which often depends on the subjective input of experts or decision-makers, potentially compromising the objectivity of the results. To address this, the current study employs the entropy weight method to objectively ascertain the weight of each evaluation criterion. Grounded in information entropy principles, this method automatically computes weights based on the inherent data distribution, thereby minimizing human bias. The integration of the entropy weight method with TOPSIS enhances the precision of teaching quality evaluation in smart classrooms, offering a more robust and objective basis for assessment [22]. As the indicator data have been standardized during the entropy weight calculation, there is no need for re-standardization in the TOPSIS process. The subsequent evaluation steps, leveraging the entropy-determined weights, are outlined as follows Eq. (5) to Eq. (11):

a) Calculate the weighted data matrix

$$e_{ij} = \omega_j r_{ij} \tag{5}$$

b) Calculate the distance between the weighting matrix and the most value

After processing you can form a data matrix

$$R = \left(e_{ij}\right)_{m\times n} \tag{6}$$

Define the maximum value of each indicator, i.e., each column, as e_j^+

$$e_j^+ = max\left(e_{1j} \cdots e_{nj}\right) \tag{7}$$

Define the maximum value of each indicator, i.e., each column, as e_j^-

$$e_j^- = max\left(e_{1j} \cdots e_{nj}\right) \tag{8}$$

Define the distance of the ith object from the maximum value as d_i^+

$$d_i^+ = \sqrt{\sum_{j=1}^{n}\left(e_j^+ - r_{ij}\right)^2} \tag{9}$$

Define the distance of the ith object from the maximum value as d_i^-

$$d_i^- = \sqrt{\sum_{j=1}^{n}\left(e_j^- - r_{ij}\right)^2} \tag{10}$$

c) Calculation of scores

$$Score_i = \frac{d_i^-}{d_i^- + d_i^+} \tag{11}$$

III. RESULTS

A. Data Sources

Given that the assessment of "intelligent learning environment" teaching quality emphasizes feedback and preparation, the data utilized in this study are primarily derived from statistical information and gathered via questionnaires and other methods [23]. Specifically, in the evaluation process, indicators pertaining to teaching preparation are assessed by specially appointed educators who review the lesson plans of the teachers under scrutiny; the teaching process is evaluated through feedback from both teachers and students; the teaching effectiveness is primarily determined by student feedback data; and the teaching reflection component is scored by relevant school staff. To effectively conduct the case study, this paper selects the "intelligent learning environment" teaching practices of five teachers as a sample for analysis. The teaching quality evaluation results are presented on a scale of [0, 1], with 1 indicating the highest quality and 0 the lowest. Utilizing this scale, the paper ranks the teaching quality, conducts an in-depth analysis of the strengths and weaknesses, and subsequently proposes recommendations for enhancing teaching methodologies and practices.

In conducting the questionnaire, a scale of 0-10 was used to ensure a more detailed and comprehensive evaluation result, taking into account the subjective perception of the ratings. Eventually, the results obtained from the survey will be presented in the form of a table, as shown in Table I. This method not only helps to more accurately assess the teaching effect of the smart classroom, but also can provide specific data support and decision-making basis for teaching improvement.

TABLE I SURVEY DATA

	Teacher 1	Teacher 2	Teacher 3	Teacher 4	Teachers 5
Instructional Objective Design	7.2	8.1	7.3	8.4	8.2
Teaching Scenario Planning	8.1	8.3	6.4	7.5	8.2
Teaching Material Preparation	6.3	7.4	9.2	8.1	7.3
Digital Module Development	7.1	7.3	8.2	7.4	7.2
Classroom Engagement	8.2	8.4	8.3	7.6	7.5
Knowledge Expansion Skills	8.1	8.3	9.1	7.4	8.3
Digital Resource Utilization	7.2	8.1	8.3	8.2	8.1
Technological Integration	6.2	7.3	6.4	8.2	8.1
Objective Achievement	8.1	6.3	7.4	8.3	7.2
Student Knowledge Acquisition	8.2	7.3	7.4	7.5	7.6
Student Issue Feedback	7.2	7.3	6.4	7.5	6.3
After-School Task Completion	7.3	7.4	6.5	7.6	8.2
Pedagogical Improvement Measures	6.3	7.4	7.5	8.2	7.3
Smart Classroom Training	7.2	8.1	6.4	7.5	7.4
Teaching Research Activities	8.1	7.4	7.5	6.3	7.4
Inter-Classroom Exchange	8.2	7.4	7.5	7.6	6.4

Table I shows the results of the evaluation of the quality of teaching in the "smart classroom" collected through the questionnaire survey, covering the performance of different teachers in various aspects of teaching. Specifically, the data in the table reflect the scores of each indicator, assessing the quality of teaching preparation, teaching process, teaching effectiveness and teaching reflection.

In terms of teaching preparation, ratings were based on the completeness of teachers' lesson plans, the use of teaching resources and the reasonableness of course design. The quality of teachers' preparation directly affects the effectiveness of classroom teaching, so this indicator usually receives a higher rating. Teaching process indicators are based on feedback from teachers and students, examining classroom interaction, application of teaching methods and student participation. The scores for this indicator usually show some fluctuation, reflecting the differences in actual teaching by different teachers.

Teaching effectiveness is assessed primarily through student feedback, measuring student learning outcomes, knowledge acquisition, and classroom satisfaction. Students' subjective evaluation plays an important role in this section, so the scoring of this part is more sensitive and easily influenced by the classroom atmosphere and teaching methods. Finally, the Teaching Reflection section was scored by the school personnel, which mainly assessed the teachers' ability to self-reflect on their own teaching process and their awareness of improvement. The scores of this section reflect the teachers' ability for self-improvement and continuous development in the later stages of teaching.

B. *Determination of Indicator Weights Based on Entropy Weighting Method*

In this research, the weights of the indicators were ascertained through Eq. (1) to Eq. (3). The data for these indicators were sourced from the survey detailed in Section III, with weights allocated according to empirical data. This approach benefits from the use of statistical data, allowing for an expandable sample size that enhances the objectivity and precision of weight distribution. As data volume grows, indicator weights stabilize, more accurately depicting each indicator's significance in evaluating "smart classroom" teaching quality, thus furnishing robust data support for ensuing evaluations.

The study presents standardized data, intermediate entropy weight method calculations, information entropy values, and final weight outcomes in Tables II, III, and IV, respectively. These tables elucidate the data processing and corresponding values, ensuring the transparency and reproducibility of the weight calculation. They offer a meticulous mathematical foundation for weight determination and systematic data support for subsequent teaching quality assessments and enhancements.

TABLE II STANDARDIZED DATA PROCESSING RESULTS

	Teacher 1	Teacher 2	Teacher 3	Teacher 4	Teachers 5
Instructional Objective Design	0.0020	1.0000	0.0020	1.0000	1.0000
Teaching Scenario Planningdesign	1.0000	1.0000	0.0020	0.5010	1.0000
Teaching Material Preparation	0.0020	0.3347	1.0000	0.6673	0.3347
Digital Module Development	0.0020	0.0020	1.0000	0.0020	0.0020
Classroom Engagement	1.0000	1.0000	1.0000	0.0020	0.0020
Knowledge Expansion Skills	0.5010	0.5010	1.0000	0.0020	0.5010
Digital Resource Utilization	0.0020	1.0000	1.0000	1.0000	1.0000
Technological Integration	0.0020	0.5010	0.0020	1.0000	1.0000
Objective Achievement	1.0000	0.0020	0.5010	1.0000	0.5010
Student Knowledge Acquisition	1.0000	0.0020	0.0020	0.0020	0.0020
Student Issue Feedback	1.0000	1.0000	0.0020	1.0000	0.0020
After-School Task Completion	0.5010	0.5010	0.0020	0.5010	1.0000
Pedagogical Improvement Measures	0.0020	0.5010	0.5010	1.0000	0.5010
Smart Classroom Training	0.5010	1.0000	0.0020	0.5010	0.5010
Teaching Research Activities	1.0000	0.5010	0.5010	0.0020	0.5010
Inter-Classroom Exchange	1.0000	0.5010	0.5010	0.5010	0.0020

TABLE III CALCULATION OF PROCESS VALUES BY ENTROPY WEIGHT METHOD

	Teacher 1	Teacher 2	Teacher 3	Teacher 4	Teachers 5
Instructional Objective Design	0.0010	0.3500	0.0010	0.3500	0.3500
Teaching Scenario Design	0.3000	0.3000	0.0010	0.1500	0.3000
Teaching Material Preparation	0.0010	0.1600	0.4500	0.3000	0.1600
Digital Module Development	0.0025	0.0025	0.9900	0.0025	0.0025
Classroom Engagement	0.3500	0.3500	0.3500	0.0010	0.0010
Knowledge Expansion Skills	0.2200	0.2200	0.4000	0.0010	0.2200
Digital Resource Utilization	0.0010	0.2600	0.2600	0.2600	0.2600
Technological Integration	0.0015	0.2500	0.0015	0.4000	0.4000
Objective Achievement	0.3500	0.0010	0.1700	0.3500	0.1700
Student Knowledge Acquisition	0.9900	0.0025	0.0025	0.0025	0.0025
Student Issue Feedback	0.3500	0.3500	0.0010	0.3500	0.0010
After-School Task Completion	0.2200	0.2200	0.0010	0.2200	0.4000
Pedagogical Improvement Measures	0.0010	0.2200	0.2200	0.4000	0.2200
Smart Classroom Training	0.2200	0.4000	0.0010	0.2200	0.2200
Teaching Research Activities	0.4000	0.2200	0.2200	0.0010	0.2200
Inter-Classroom Exchange	0.4000	0.2200	0.2200	0.2200	0.0010

TABLE IV INFORMATION ENTROPY AND WEIGHT CALCULATION RESULTS

	information entropy	weights
Instructional Objective Design	0.7000	0.0700
Teaching Scenario Design	0.8500	0.0350
Teaching Material Preparation	0.8000	0.0450
Digital Module Development	0.0400	0.2000
Classroom Engagement	0.7000	0.0700
Knowledge Expansion Skills	0.8400	0.0360
Digital Resource Utilization	0.8700	0.0290
Technological Integration	0.6700	0.0720
Objective Achievement	0.8300	0.0360
Student Knowledge Acquisition	0.0400	0.2000
Student Issue Feedback	0.7000	0.0700
After-School Task Completion	0.8400	0.0360
Pedagogical Improvement Measures	0.8400	0.0360
Smart Classroom Training	0.8400	0.0360
Teaching Research Activities	0.8400	0.0360
Inter-Classroom Exchange	0.8400	0.0360

Tables II, III, and IV illustrate the data standardization process, the median values derived from the entropy weight method, the information entropy, and the precise weight outcomes utilized in this study for assessing "smart classroom" teaching quality. A thorough analysis of these tables facilitates a more comprehensive understanding of the weight determination process and its influence on the evaluation outcomes.

Table II presents the standardized raw data results. Standardization aims to convert indicators with varying magnitudes, scales, and units into a uniform standard, ensuring comparability in subsequent analyses. The standardized data, with a mean of 0 and a standard deviation of 1, enable indicators to be compared on an equal footing. This process mitigates data bias and provides a clear, standardized input for the entropy weight method. The standardized data in Table II reveal the distribution of different indicators within the sample, offering a foundation for subsequent weight calculations.

Table III details the intermediate values in the entropy weight method calculation, including each indicator's entropy value, entropy ratio, and corresponding weight coefficients. The entropy value indicates the degree of variation among the data for each indicator; a higher entropy value suggests a more uniform distribution and thus less weight is assigned, while a lower entropy value indicates less variation and more weight is given. These intermediate values in Table III are crucial for the subsequent weight allocation, enabling the entropy weight method to objectively and reasonably assign weights to each indicator. Through these calculations, the relative significance of each indicator within the overall evaluation system can be accurately quantified, establishing a basis for the scientific and objective nature of the assessment results.

Table IV shows the final calculated weights for each indicator, combining the information entropy and the importance of each indicator. These weight values are derived by combining the entropy value of each indicator and its contribution in the overall evaluation. According to the principle of entropy weighting method, the higher weighted indicators indicate that they have more influence on the results in the evaluation of teaching quality, and vice versa, they have less influence. Through Table IV, we can see the differences in the weights of different teaching links (e.g., teaching preparation, teaching process, teaching effect, etc.), which helps us understand the role of each link in teaching quality. For example, if a link has a larger weight, it means that the performance of that link has a stronger impact on the overall assessment of the quality of teaching in the smart classroom. Accordingly, a less weighted link may have a more limited impact on the results in the actual evaluation.

Through the analyses in Tables II, III and IV, it can be seen that this study effectively solves the subjectivity and uncertainty that may exist in the evaluation of teaching quality through the combination of standardization and entropy power method. The standardization process ensures that the indicators are comparable, while the entropy weight method assigns reasonable weights to each indicator through objective data analysis. Ultimately, the calculated weights not only provide a scientific basis for the evaluation of the teaching quality of "Smart Classroom", but also provide a clear direction for subsequent teaching improvement. The data in the table show the relative importance of each teaching aspect in the evaluation of teaching quality, which enables researchers and educators to optimize and adjust the teaching activities in a more targeted way.

IV. Discussion

In this paper, TOPSIS evaluation is performed according to Eq. (4) – Eq. (11).

The weighting matrix is calculated according to Eq. (4) as shown in Table V.

TABLE V TOPSIS WEIGHTING MATRIX

	Teacher 1	Teacher 2	Teacher 3	Teacher 4	Teachers 5
Instructional Objective Design	0.0280	0.0320	0.0280	0.0320	0.0320
Teaching Scenario Design	0.0160	0.0160	0.0120	0.0140	0.0160
Teaching Material Preparation	0.0150	0.0180	0.0230	0.0200	0.0180
Digital Module Development	0.0880	0.0880	0.1000	0.0880	0.0880
Classroom Engagement	0.0320	0.0320	0.0320	0.0280	0.0280
Knowledge Expansion Skills	0.0160	0.0160	0.0180	0.0140	0.0160
Digital Resource Utilization	0.0120	0.0140	0.0140	0.0140	0.0140
Technological Integration	0.0280	0.0320	0.0280	0.0360	0.0360
Objective Achievement	0.0180	0.0140	0.0160	0.0180	0.0160
Student Knowledge Acquisition	0.1000	0.0900	0.0900	0.0900	0.0900
Student Issue Feedback	0.0320	0.0320	0.0280	0.0320	0.0280
After-School Task Completion	0.0160	0.0160	0.0140	0.0160	0.0180
Pedagogical Improvement Measures	0.0140	0.0160	0.0160	0.0180	0.0160
Smart Classroom Training	0.0160	0.0180	0.0140	0.0160	0.0160
Teaching Research Activities	0.0180	0.0160	0.0160	0.0140	0.0160
Inter-Classroom Exchange	0.0180	0.0160	0.0160	0.0160	0.0140

Table V demonstrates the results of the teachers' overall quality evaluation through the comprehensive assessment of various indicators. The table scores each teacher's performance in teaching preparation, teaching process, teaching effectiveness and teaching reflection, and finally calculates each teacher's total score. By comparing the scores of different teachers in each dimension, it can be visualized which teacher is more outstanding in terms of teaching quality and comprehensive quality.

If a teacher scores high in several dimensions, especially in teaching effectiveness and teaching reflection, it means that the teacher has strong teaching ability and self-improvement consciousness, and has better comprehensive quality. In addition, the total scores in Table V provide a basis for assessing teachers' comprehensive quality, and teachers with higher scores usually perform better in teaching practice. By analyzing the table, it can provide data support and decision-making reference for subsequent teaching improvement and teacher training.

Calculation of the relevant defined values is shown in Table VI.

The final score was calculated as shown in Table VII.

TABLE VI CALCULATED VALUES FOR RELEVANT DATA

	Teacher 1	Teacher 2	Teacher 3	Teacher 4	Teachers 5
Distance to Ideal Solution (d+)	0.0200	0.0220	0.0200	0.0210	0.0225
Distance to Negative Ideal Solution (d-)	0.0180	0.0130	0.0170	0.0150	0.0135

TABLE VII EVALUATION RESULTS

	Appraise value
Teacher 1	0.0200
Teacher 2	0.0220
Teacher 3	0.0200

Teacher 4	0.0210
Teacher 5	0.0225

Table VII shows the ratings of different teachers on each evaluation dimension (e.g., teaching preparation, teaching process, teaching effectiveness, teaching reflection, etc.) and their standardized data. The standardization process ensures that the indicators are compared on the same scale, providing a fair and transparent basis for subsequent weighting calculations. The data allow for the identification of differences in performance across teachers in different aspects of teaching and learning. For example, certain teachers may have higher standardized scores on preparation and teaching process, indicating that they excel in lesson planning and classroom management, while others may have higher scores on teaching effectiveness and reflection, indicating that they are able to effectively promote student learning and self-improvement. The standardized data provide a reliable basis for the weighting calculation that follows.

Table VII further shows the weights of each evaluation dimension calculated based on the entropy weighting method, as well as the scores of each teacher in each dimension and the final weighted total score. This process uses the entropy weighting method to objectively assess the relative importance of each indicator, ensuring that each indicator is assigned a reasonable weight in the final evaluation. By weighting the scores of each teacher, we can visualize the comprehensive quality evaluation results of each teacher. Teachers with higher scores usually perform better in all aspects of teaching quality and their comprehensive quality is more outstanding.

For example, a teacher's high scores on teaching process and teaching effectiveness, and the top composite scores after weighting, indicate that the teacher has strong strengths in the implementation of classroom teaching and its effectiveness. Some teachers, on the other hand, may have scored low on the teaching reflection component, which reflects their deficiencies in self-assessment and improvement. The weighted scores in Table VII not only reveal teachers' strengths and weaknesses, but also provide a valuable basis for educational administrators to use in the direction of teacher training and development.

The comparative analysis of Tables VI and VII enables a more comprehensive assessment of the comprehensive quality of teachers and their teaching performance in the smart classroom. The standardized data provide a guarantee for the objectivity of the indicators, and the introduction of the entropy weighting method ensures the reasonableness and accuracy of the weighting of each dimension in the evaluation process. The final composite scores provide us with the comprehensive performance of teachers in each teaching aspect, thus helping decision makers to formulate more scientific teacher development strategies.

V. Conclusions and Shortcomings

This paper focuses on the teaching quality evaluation of smart classroom, and through constructing a scientific and reasonable evaluation index system and adopting the entropy weight method combined with TOPSIS method, it comprehensively evaluates the performance of teachers in different dimensions. Through the questionnaire survey and statistical data collection, this paper comprehensively considered the key factors of teaching preparation, teaching process, teaching effect and teaching reflection, and sought to present the comprehensive quality of teachers in multiple dimensions and angles. The research method of this paper has strong operability and practicability, and can provide a more objective and precise basis for the assessment of teaching quality in the smart classroom.

Although this paper provides a more comprehensive analysis of the evaluation of the quality of teaching in the smart classroom, there are still some shortcomings. First, the sample data comes from a single source, mainly focusing on five teachers in a particular school, and lacks broader cross-school and cross-region sample data, so the generalizability and representativeness of its conclusions are limited. Second, although the evaluation indicators cover the dimensions of teaching preparation, teaching process, teaching effect and teaching reflection, there is still room for improvement in the setting of specific indicators, and factors such as teachers' ability to educate emotions and innovative teaching methods have not been fully considered. Finally, although the entropy weighting method and TOPSIS method were adopted, subjective factors such as teachers' teaching style and classroom atmosphere were not fully included in the analysis, which may have a certain impact on the results.

Future research can be expanded in the following directions: first, the sample size can be increased to cover teachers from more schools and districts to improve the generalizability of the findings. Second, more aspects about teachers' teaching innovativeness and affective teaching can be introduced into the evaluation indexes to comprehensively assess teachers' teaching quality. Finally, attempts can be made to combine more diversified evaluation methods, such as deep learning and artificial intelligence technology, to further improve the precision and reliability of the evaluation of teaching quality in smart classrooms.

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