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# TEACHING QUALITY EVALUATION AND IMPROVEMENT BASED ON BIG DATA ANALYSIS

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**Abstract.** To address the limitations of Problem-Based Learning (PBL) and to foster student initiative while enhancing teaching quality, the author suggests a novel approach: leveraging big data analysis for teaching quality evaluation and improvement. This method involves conducting diverse and dynamic evaluations, randomly and repeatedly, involving students, teachers, and supervisors. By applying an enhanced Dempster evidence synthesis formula and weights derived from the Analytic Hierarchy Process, the system dynamically calculates each teacher's rating in their respective courses, allowing for continuous improvement. Additionally, personalized feature indicators and teaching quality evaluation metrics are developed to provide a comprehensive assessment. The results indicate that in the coarse evidence set algorithm, is obtained through experience. If is used as the weight alone, the subjectivity is too heavy, and is added for fusion operation, as well as the intervention of experience factor, a balance point between subjectivity and objectivity is found. The final score of 4.2878 was obtained by combining the weights between subjects obtained through Analytic Hierarchy Process, which is consistent with the survey and the public's opinion. This method avoids the deficiency of traditional evidence theory that treats all evidence equally, enhances the ability of information fusion, and obtains more realistic conclusions. Further validated the feasibility and usability of the personalized teaching quality evaluation and improvement model for software engineering.

**Key words:** Teaching quality, Personalized feature indicators, Apriori, Dempster evidence synthesis, Analytic Hierarchy Process

**1. Introduction.** Nowadays, the educational concept of "student-centered" has permeated various fields of educational activities, and improving student learning effectiveness has become a value demand for the development of higher education [1]. The quality of higher education teaching plays a pivotal role in nurturing talented individuals, directly influencing the caliber of graduates produced. Student learning outcomes serve as a tangible indicator of this quality [2,3]. Thus, enhancing teaching quality serves as a crucial avenue for improving talent cultivation in higher education institutions. It aligns with broader educational policies, bolsters the capacity of higher education to contribute to societal progress, drives teaching reforms, facilitates strategic positioning and distinctive operations for universities, elevates the standard of talent cultivation, and ultimately enhances student learning achievements.

As higher education continues to grow and evolve, the demand for effective teaching quality assurance systems that cater to students' expectations and aspirations becomes increasingly imperative. With rising enrollment rates and ever-changing dynamics within the educational landscape, there's a constant influx of new trends and student preferences. This necessitates a responsive approach to meet the evolving needs of students and ensure that their learning outcomes are consistently met. Students have diverse and diverse choices of courses, school curriculum is diverse, teaching equipment is constantly upgraded and updated, and learning resources are abundant. However, no one can accurately know whether students have achieved substantial improvement in their learning effectiveness. Merely evaluating the teaching quality of teachers cannot provide evidence for improving teaching quality. The ultimate measure of teaching quality lies in its impact on student learning outcomes. No matter how comprehensive the teaching content or high the teaching quality, if it fails to address the actual needs of students, it cannot effectively improve their learning effectiveness. Therefore, universities must prioritize student learning outcomes and establish robust teaching quality assurance systems focused on students' growth and development. By ensuring that students truly learn and benefit from their

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higher education experience, universities can uphold the quality of talent cultivation and pave the way for meaningful teaching reforms [4,5].

**2. Literature Review.** Data mining can mine or extract valuable patterns or patterns hidden within a large amount of incomplete, noisy, fuzzy, and random data [6,7]. It includes many specific methods, including neural networks, classification, decision trees, regression analysis, clustering, and association rules.

In recent years, more and more scholars have begun to study the application of data mining technology in teaching quality evaluation. Among many methods, clustering, association rules and other algorithms are the most commonly used. Yang, Y. H. et al. conducted a study on the correlation between XAPP (eXtreme Apprenticeship Pedagogical Pattern) and the management of teaching quality, employing the Plan-Do-Check-Act (PDCA) cycle as a framework. Their objective was to enhance teaching methods and quality to achieve superior teaching outcomes. To examine the teaching process of XAPP comprehensively, they established a closed-loop management system focusing on various modules: building the teaching team, designing courses, implementing courses, selecting textbooks, evaluating and adjusting teachers, conducting customer satisfaction surveys, and providing teaching evaluation and feedback. Through an analysis of the PDCA cycle's application in XAPP teaching quality management, they aimed to optimize piano teaching management practices, enhance the XAPP teaching system, refine curriculum design, improve textbook selection, and enhance the theoretical framework [8]. Pertuz, S. et al. proposed a quality evaluation method for use in blended learning and described an application case study of quality evaluation methods for three undergraduate courses in electronic engineering projects [9]. Che, Y. and others investigated the integration of decision trees in physical education teaching within the realm of big data, leading to the development of a comprehensive physical education teaching management system. Recognizing that the quality of physical education teaching significantly influences the advancement of school physical education, they emphasized the critical role of curriculum selection and enrichment in this process. By collecting and refining textbooks, they aimed to enhance teaching resources, stimulate personal growth and reflection, and elevate the artistic and creative aspects of teaching [10]. Zhao, L. and others employed quantitative and data analysis techniques to thoroughly explore the effectiveness and acceptance of the interactive teaching mode in blended English education. Their research aimed to provide a comprehensive understanding of how students perceive and engage with this teaching approach. The quantitative analysis revealed that a significant portion of respondents expressed favorable attitudes towards the interactive teaching mode, indicating a high level of acceptance among students. Only a minority of participants reported dissatisfaction with this teaching model [11].

With the continuous development of network technology, the teaching staff of the Software College is constantly strengthening. Teaching for software engineering must now rely on computer tools. Every PBL mode teaching in the Software College is fully capable of allowing students and teachers to evaluate and monitor the teaching process through computer networks. Based on the network and relying on information technology, we have transformed from questionnaire surveys to online evaluations, utilizing the storage functions of the network and data to achieve dynamic evaluation and timely feedback capabilities in learning. The author constructs a personalized teaching quality evaluation and improvement model for software engineering, which can not only continuously adjust existing evaluation models through data sampling and analysis, but also establish a complete set of personalized learning kits for students, improve the shortcomings of PBL mode, enhance students' initiative, and improve the teaching quality of teachers, enabling them to adapt to students' learning methods.

**3. Research Methods.**

**3.1. Teaching quality indicators.**

**3.1.1. Theoretical Principles of Teaching Quality Indicators.** The author prioritizes addressing the challenge of tailored education by developing personalized teaching quality evaluation criteria, essential for enhancing teaching quality and customizing courses to meet individual student needs. Focused on software engineering, the author aims to establish a comprehensive model for evaluating and improving teaching quality, specifically tailored to this field [12]. The objective of this personalized evaluation approach is to provide guidance for achieving teaching quality objectives in software engineering education. By delineating clear teaching

Table 3.1: Student Evaluation Index System

| Top level indicators | Second level indicators |
|---|---|
| Training Methods | Is there a unique teaching style Is the course case appropriate Is the language clear and the writing neat Whether multimedia devices such as PPTs are effectively used Can theory be combined with practice Is the teaching simple and easy to understand Homework assignment and feedback are reasonable |
| Teaching content | The teacher's expertise in the field of the course Is lesson preparation sufficient Is the amount of teaching information appropriate Strong logical content, prominent concepts, key and difficult points |
| Teaching attitude | Attend classes on time without unauthorized rescheduling Passionate and serious teaching Is it better to organize classroom teaching Answering student questions with a serious attitude Harmonious teacher-student relationship and sufficient communication Fair and strict treatment of students |
| Teaching effectiveness | Gained from this course Attractive teaching by teachers Are you willing to choose other courses from this teacher Teaching while emphasizing the cultivation of student abilities |

philosophies and evaluation standards, universities can ensure relevance and practicality in assessing personalized teaching. Ultimately, this approach empowers teachers to concentrate on enhancing teaching quality and fostering students' enthusiasm for learning. Although this is a personalized teaching quality assessment for software engineering, we also hope to adapt to various course types, teaching fields, and teaching methods of various majors in a comprehensive university. So it is required that the personalized teaching quality evaluation system should have both commonality and purposefulness, in order to meet more teaching modes and personalized needs. The evaluation indicators not only need to reflect the qualified standards of teaching quality, but also need to have the ability to improve. The previous teaching evaluation was only based on a simple weight distribution, which could not well meet and reflect the teaching situation of teachers. Not only would it lose the targeted improvement of teaching work, but the classification would also be too detailed, making the evaluation meaningless.

In summary, in order to establish a teaching quality indicator system, it is necessary to combine student evaluation, peer evaluation, and supervision evaluation as the basis. In the teaching process, teachers play a leading role, while students are the main body. The teaching methods, methods, and content are highly integrated in classroom teaching. In the previous text, we have addressed the different factors of cultural background, knowledge level, values, etc. in student evaluation [13-14]. So, by considering the differences in the areas of focus among peers and supervisors, and combining the differences of the above three subjects, we can objectively and fairly reflect the content of teaching quality evaluation and the direction of improvement. There are only three aspects of evaluation with different weights. The evaluation of the process is led by the teacher, but if the evaluation is conducted once every semester or half a semester, it is not significant enough, because the quality of teaching is closely related to the teacher's moral character, cultural level, teaching level, and preparation status, as well as their understanding of the teaching content, teachers can fully prepare before evaluation to cope with it. Therefore, evaluation must have continuity and randomness. At least, student evaluations should be maintained at least 4 times a semester, and peer and supervisory evaluations should be conducted at least 2 times, and conducted randomly.

**3.1.2. Establishment of Teaching Quality Index System.**

*1) The establishment of a student evaluation index system.* The establishment of a teaching quality indicator system should widely draw on the evaluation standards of domestic and foreign universities, combine with the actual work of the School of Software at Nanchang University, and use a hierarchical thinking and top-down approach to determine. Based on the previous evaluation standards for teaching quality at Nanchang University, the top-level evaluation indicators should include four aspects: teaching methods, teaching content, teaching attitude, and teaching effectiveness. The second level evaluation indicators are further classified, and the rating content of each indicator is divided into five levels: 5, 4, 3, 2, 1. The specific content of the table is shown in Table 3.1.

Table 3.2: Peer Teacher Indicator System

| Peer teacher evaluation indicators |
|---|
| Adequate lesson preparation and complete lesson plans |
| Suitable material selection and accurate concept |
| The content is novel and practical |
| Highlighting key points and clear regulations |
| Clear language and neat writing |
| Thinking driven, ability cultivation |
| Patience in tutoring and timely feedback on homework |
| Teaching according to individual needs and strong extracurricular interaction |
| Fair assessment and appropriate rating |

Table 3.3: Indicator System for Supervisors

| Supervisor evaluation indicators |
|---|
| Basic concepts correct |
| The basic theory is correct |
| Highlights of this lesson |
| Thorough analysis of difficulties |
| Explaining is inspiring |
| Clear regulations with strong logical coherence |
| Clear language and neat writing |
| Integrating theory with practice and emphasizing the cultivation of abilities |
| Pay attention to student emotions |

The basis for setting the content involved is:

(1) Teaching method: The correct method is of great significance in improving the quality of teaching. So improving teaching methods places the most emphasis on seven second level indicators.

(2) Teaching content: It is the core of classroom teaching, directly related to what students can learn, which has a significant impact on the quality of teaching.

(3) Teaching attitude: Teaching attitude is also an important factor affecting the quality of teaching, and whether a teacher is serious and responsible is related to whether students can effectively absorb and acquire knowledge.

(4) Teaching effectiveness: The effectiveness is the standard for testing whether students have learned knowledge, and the quality of teaching ultimately depends on the feedback of the teaching effectiveness.

*2) Establishment of peer teacher evaluation indicators.* Because peer teachers are very familiar with classroom teaching content and have the same teaching experience, they have a considerable say in whether the teaching content in the classroom is correct, innovative, and handled properly [15]. However, due to the relatively small number of peer teachers compared to students, the evaluation indicators of peer teachers are shown in Table 3.2, and the evaluation criteria are still 5 levels.

*3) Establishment of evaluation indicators for supervisors.* Supervisors are the main responsible persons representing the school's supervision of the teaching quality of teachers. They play the role of monitors in the teaching quality system, and their evaluation index system is shown in Table 3.3, which also has 5 different levels of indicators.

All data can be obtained through two aspects:

1. Collect data one by one through a questionnaire survey and enter it into the database.
2. In the computer operation course, you can directly operate on the computer and transfer it to the database through the network.

### 3.2. Algorithm for evaluating teaching quality.

**3.2.1. Improved Dempster evidence synthesis formula.** In the evaluation indicators of teaching quality, the indicators involved have non-linear relationships. If we rely solely on experience or treat all indicators equally. The Dempster synthesis rule provides a synthesis formula for these indicators, but in the evaluation of teaching quality, each indicator has different degrees of influence on the final value.

Rough set is an effective tool for handling various incomplete information such as imprecision, inconsistency, and incompleteness.

The specific steps for applying the comprehensive teaching quality evaluation algorithm are as follows:

*1.* Obtain data on teaching quality evaluation indicators (such as student evaluation indicator system) and form an information system S=(U,A,V,f); Among them, U represents the set of non empty valid objects, which we call the domain; A is the set of all indicators; V is the value range of indicator a, which is V=(5,4,3,2,1) in the teaching quality evaluation system; F is an information function that specifies the attribute values of each object in U.

*2.* Attribute importance, set $X \subseteq A$ as a subset of attributes and $a \subseteq A$ as an attribute. The importance of a to X is denoted as Sig X(a), and its calculation formula is Equation 3.1:

$$Sigx(a) = 1 - |X \cup \{a\}|/|X| \tag{3.1}$$

The meaning of this definition is to randomly select two objects in U, with a total of 2U selection methods, among them, there are |X| that are indistinguishable under the attribute subset X, and there are $|x| \cup \{a\}|$ cases that are indistinguishable after adding attribute a in X, which are obviously less than or equal to |X|. Therefore, $|X| - |X \cup \{a\}|$ represents the indistinguishable reduction in X due to the addition of attribute a, of course, it is the distinguishable increase, which refers to the number of selection methods that were previously indistinguishable under X but are now distinguishable under $|X \cup \{a\}|$.

Calculate the value of evaluation indicator $C = \{a_1, a_2, \cdots, a_n\}$ using Sig X(a), and each $SigX(a_i)$ is the corresponding attribute importance.

*3.* Normalize the importance $SigX(a_i)$ of each obtained attribute according to $\lambda_i = SigX(a_i)/\sum_{i=1}^{n} sigx(a_i)$, and this $\lambda_i$ is the weight value of each second level teaching quality evaluation indicator [16].

*4.* Determine the confidence level $M_i(A_i), i = 1, 2, \cdots, n$ for each attribute $a_i$ in student, peer teacher, and supervisor $C = \{a_1, a_2, \cdots, a_n\}$ based on college experience. Among them, $\sum_{A \subseteq \theta} m(A) = 1$.

*5.* Based on the experience of the college, select the appropriate experience factor and calculate the comprehensive reliability $M_i'(A_i)$ of $a_i$, as shown in equation 3.2

$$M_i'(A_i) = M_i(A_i) \times \theta + \lambda_i \times \sum_{A \subseteq \theta} m(A) \times (1 - \theta) \tag{3.2}$$

where $\theta$=[0,1], a smaller value indicates a greater emphasis on objective weight, and a larger value indicates a greater emphasis on experience.

*6.* By combining the evidence theory formula, equations 3.3 and 3.4 are obtained

$$m(A) = K^{-1} \times \sum_{\cap A_i \leqslant A} \prod_{1 \leqslant i \leqslant n} M_i'(A_i) \tag{3.3}$$

$$K = 1 - \sum_{nA_i \leqslant A} \prod_{1 \leqslant i \leqslant n} M_i'(A_i) \tag{3.4}$$

Obtain the final score for the evaluation of teaching quality.

**3.2.2. Application of Analytic Hierarchy Process in Teaching Quality Evaluation System .** After obtaining comprehensive evaluation values from three aspects, we still cannot determine the specific score of the teaching quality level of the course teacher, because the evaluation scores of the three main subjects: Students, peer teachers, and supervisors are not comparable to each other. Therefore, determining the weight

Table 3.4: Comparison of the Importance of Three Main Evaluation Indicators

| i / j | Student subject | Teacher peer subject | Supervisor subject |
|---|---|---|---|
| Student subject | 1 | | |
| Teacher peer subject | count backwards | 1 | |
| Supervisor subject | count backwards | count backwards | 1 |

Table 3.5: Comparison of the Importance of Three Main Evaluation Indicators

| Scale | Definition (comparing subjects i and j) |
|---|---|
| 1 | Subject i is equally important as j |
| 3 | Subject i is slightly more important than j |
| 5 | Subject i is clearly more important than j |
| 7 | Subject i is more important than j |
| 9 | Subject i is extremely important than j |
| 2,4,6,8 | Middle value between two adjacent values |
| count backwards | The inverse comparison between subject i and j $b_{\overline{j}} = 1/b_{ij}, b_{ii} = 1$ |

of each subject in the overall evaluation value is a very important issue that must be solved. In actual teaching evaluation, the weight is generally determined based on experience or leadership decisions, but the problem is that the actual weight difference is too large. The final result is inaccurate evaluation. So the objectivity and scientificity of weights directly affect the teaching quality evaluation of the course teachers. Analytic Hierarchy Process (AHP) is an analytical method for multi-objective decision-making, which combines qualitative and quantitative analysis, decomposes elements related to decision-making problems into levels such as objectives, criteria, and plans, and digitizes decision-making thinking. Analytic Hierarchy Process (AHP) constructs a judgment matrix B by comparing the relative importance of factors pairwise, and calculates the weights of the importance orders that are related to each other. This is called hierarchical single ranking. Determine the consistency of the matrix by calculating the eigenvalues and eigenvectors of B. The specific steps are as follows

*1.* In the teaching quality evaluation system, the three subjects need to obtain their weights. We adopt two methods: Hysical questionnaire survey and online survey, and distribute them together with the teaching quality evaluation indicators to all respondents, including students, teachers, and supervisors. Not only does it cover various populations, but it also ensures the objectivity of the survey. The survey table is shown in Table 3.4.

For the comparison of levels, the standard scaling method is used for quantification, and the specific scales are shown in Table 3.5.

*2.* Using the sum product method, normalize the factors in each column of the obtained judgment matrix, and the general term of the factors is Equation 3.5:

$$b_{ij} = b_{ij} / \sum b_{ij} (i, j = 1, 2, 3) \tag{3.5}$$

*3.* Add each normalized judgment matrix by row, and the general terms of the factors are shown in equation 3.6:

$$w_i = \sum_{j=1}^{3} b_{ij} (i = 1, 2, 3) \tag{3.6}$$

*4.* Normalize W again, as shown in equation 3.7:

$$w_j = w_i / \sum_{i=1}^{3} w_i (i = 1, 2, 3) \tag{3.7}$$

The obtained $W = (w_1, w_2, w_3)$ is the weight occupied by each subject.

However, the obtained weights need to be tested for reasonableness, which is called consistency testing. The calculation of consistency ratio is called C.R (Consistency Ratio), where CR=CI/RI. Among them, CI is called Consistency Index, which is used to determine consistency indicators, while RI is called Random Index, which is the average random consistency indicator. From $CI = (\lambda_{max} - n)/(n - 1)$, CR can be obtained. If CR is less than 0.10, we determine that the result of the matrix is consistent with the actual situation. Finally, the M (A) obtained earlier is multiplied by W and summed to obtain the teaching quality value of our course teacher, which determines whether the course meets our desired results.

### 3.3. System Analysis.

**3.3.1. System design objectives.** This system aims to combine software engineering personalized teaching design with software engineering personalized teaching quality evaluation and improvement. By leveraging personalized indicators tailored to software engineering, a suite of personalized software tools is developed to cater to individual student preferences and learning styles. These tools are utilized to evaluate the teaching quality of course instructors in software engineering, particularly in personalized teaching contexts. This initiative is instrumental in assessing and enhancing the teaching quality within Problem-Based Learning (PBL) modes, thereby driving advancements in teaching methodologies within the School of Software at Nanchang University [17]. In summary, the design objectives of the system are as follows:

1. The design of the system has practicality, applicability, and reliability.
2. The design of the database is logical and scalable.
3. The extraction and read in operations between data have a certain degree of flexibility and will not cause confusion.
4. Convenient for users to operate, reducing learning costs, and providing a simple and intuitive output interface.

**3.3.2. System Feasibility Analysis.** Nowadays, computers have become an essential part of people's lives, and network-based teaching quality evaluation is no longer limited to the collection of information through questionnaires in the classroom. Instead, students, teachers, and supervisors can conduct teaching quality evaluation anytime and anywhere, greatly improving efficiency. Questionnaire surveys have also become a supplementary way of data acquisition. In addition, the software engineering personalized teaching kit also meets the needs of student personality development. Students are also responsible for their knowledge when evaluating, and the school also improves the quality of their teaching, which is a win-win result. Economically speaking, it is feasible. In addition, by adopting the B/S structure mode and SQL Server 2005 database, the Software College can fully achieve self-sufficiency in terms of usability and operability, meeting the feasibility of operation and technical feasibility.

**3.3.3. System database design.** The system database uses SQL Server 2005 database management system. Below is a detailed explanation of the creation and logical structure of each data table in the database.

*1.* Overall design of E-R diagram

The overall logic design of E-R is shown in Figure 3.1.

*2.* Design of overall Table

Student Table: Including student name, student ID, gender, password, personalized indicators, and other data items, with the primary key being the student ID;

Teacher Table: Including teacher name, teacher ID, professional title, password, etc., with the primary key being the teacher ID;

Student transcript: Including student ID, course ID, grades, etc;

Supervisor Table: Including supervisor name, job number, password, etc., with the primary key being the supervisor employee number;

Administrator Table: Including administrator ID and password, with the primary key being administrator ID;

Curriculum schedule: Including course ID, teacher ID, course name, course credits, etc., with the primary key being course ID;

Teaching quality evaluation form: Including teaching ID, start time, teacher ID, course ID, evaluation score, etc. The primary key is the teaching ID (the same teacher, same course, courses opened at different

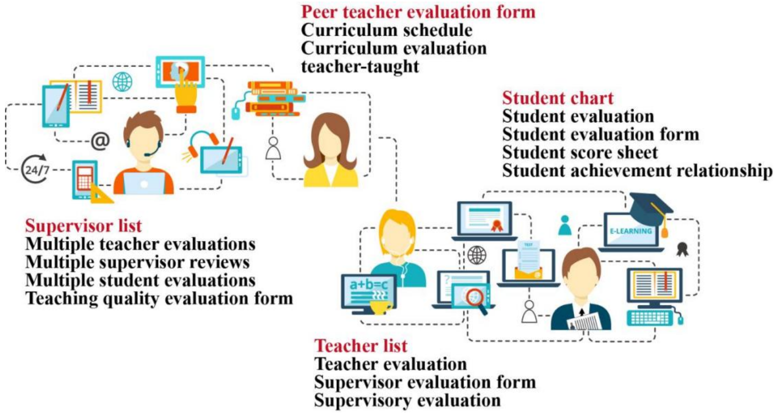


Fig. 3.1: E-R Logic Structure Diagram

times have a unique teaching ID representation, because the same teacher can take the same course in different years, it must be distinguished);

Student evaluation form: Including student ID, student evaluation indicators, and teaching number, with the primary key set to auto increment;

Peer teacher evaluation form: Including teacher ID, peer teacher evaluation indicators, and teaching number, with the primary key set to auto increment;

Supervisor evaluation form: Including supervisor ID, supervisor evaluation indicators, and teaching number, etc., with the main key set to auto increment.

**4. Result analysis.** After solving how to determine personalized courses for students, it is necessary for this group of students to conduct quality evaluation of software engineering personalized teaching. Because the students who participated in the evaluation were identified, the author will select evaluation information from students who are suitable for teaching quality evaluation. The data will be collected through a questionnaire on student teaching quality evaluation indicators, as well as 10 evaluations from peer teachers and 1 evaluation from supervisors.

**4.1. Simulation method for teaching quality evaluation data.** Prior to delving into the analysis of teaching quality evaluation, as previously discussed, it is crucial to assess the three primary stakeholders involved and assign appropriate weights to their evaluations. This entails determining the significance of each subject's assessment. Subsequently, utilizing their respective evaluation criteria, we compute the score for each subject's evaluation. These scores are then multiplied by the weights derived from the Analytic Hierarchy Process (AHP). Ultimately, this process yields the course's teaching quality level score, providing a comprehensive measure of teaching effectiveness[18].

**4.2. Compilation of Teaching Quality Evaluation Data.**

*1) Calculation of weights for the three major entities.* There are three types of subjects for evaluating teaching quality. One type is supervision, which comprehensively evaluates the teaching quality of the course through listening to lectures, represented by T1; Another type is peer teachers who discover the comprehensive quality of teaching by observing courses, represented by T2; The last category is students, mainly evaluating their own satisfaction and interest in the course, represented by T3. Summarize the results of all survey questionnaires and calculate the average value. The average value that T3 is considered more important than T2 is 3.6431; The average number of people who believe that T3 is more important than T1 is 2.7794; The average number of people who believe that T2 is more important than T1 is 1.4006. Based on the above data, a judgment matrix can be established as shown in Table 4.1.

After normalization, the matrix in Table 4.2 is obtained. By obtaining the average values of each row from the matrix, it can be calculated that T3=0.609498, T2=0.208339, T1=0.182164. After calculating the results, it

Table 4.1: Judgment Matrix

| | T3 | T2 | T1 |
|---|---|---|---|
| T3 | 1 | 3.6320 | 2.7683 |
| T2 | 1/3.6320 | 1 | 1.4005 |
| T1 | 1/2.7683 | 1/1.4005 | 1 |

Table 4.2: Normalized Matrix

| | T3 | T2 | T1 | Sum of rows | The average of the sum of rows |
|---|---|---|---|---|---|
| T3 | 0.611774 | 0.680042 | 0.536444 | 1.828382 | 0.609387 |
| T2 | 0.167846 | 0.186557 | 0.270281 | 0.625007 | 0.208228 |
| T1 | 0.220048 | 0.133167 | 0.193043 | 0.546380 | 0.182053 |

Table 4.3: Multiplied matrices

| | T3 | T2 | T1 | Sum of rows | weight | Sum of rows/weight |
|---|---|---|---|---|---|---|
| T3 | 0.611774 | 0.680042 | 0.536444 | 1.828382 | 0.609387 | 3.075808 |
| T2 | 0.167846 | 0.186557 | 0.270281 | 0.625007 | 0.208228 | 3.027541 |
| T1 | 0.220048 | 0.133168 | 0.193043 | 0.546380 | 0.182053 | 3.020327 |

is necessary to check the results: Multiply the values obtained from T3, T2, T1 by each column in the original matrix to obtain the matrix shown in Table 4.3. The obtained $\lambda_{max}$=(3.075919+3.027652+3.020438)/3=3.041336. Consistency indicator C.I=0.020668. When N=3, the average random consistency index R.L=0.58, and the proportion of consistency is C.R = 0.020668/0.58 = 0.035634. The results demonstrate good consistency. The final weight coefficients between the three main entities are:

$$T1 = 0.182163, \qquad T2 = 0.208339, \qquad T3 = 0.609498$$

*2) Calculation of teaching quality evaluation data.* As mentioned earlier, $S =< U, R, V, f >$ and U represent the collection of all research subjects, students, teachers, and supervisors; R is the set of attributes of the subject, please refer to the appendix for specific attributes; V is a set of attribute values; Vr is the value of the value attribute value (1-5); F is an allusion. Because U has three main subjects, and its peer teachers have fewer scores and lower attribute values, it is easy to display. Therefore, the calculation process here takes the teacher subject as an example. Calculate $SigX(a_i)$ based on the attribute importance formula, and calculate $\lambda_i = Sig(a_i)/\sum_{i=1}^{n} sigx(a_i)$: $\lambda_i = (0.12, 0.12, 0.12, 0.12, 0.12, 0.09, 0.1, 0.06, 0.15)$ Determine the reliability $M(A_i)$ of each attribute $a_i$ based on the information provided by the decision-maker, satisfying $M(A_i) = 1$.

$$M(A_i) = \{0.11, 0.20, 0.15, 0.17, 0.16, 0.11, 0.04, 0.03, 0.13\}$$

Then choose the appropriate empirical factor, as mentioned earlier, $\theta$=[0,1]. A smaller value indicates a greater emphasis on objective weight, while a larger value indicates a greater emphasis on experience. Therefore, we choose $\theta$=0.2 to place greater emphasis on objective weight. Calculate the comprehensive reliability $M_i'(A_i)$

$$M_i'(A_i) = \{0.118, 0.136, 0.126, 0.13, 0.128, 0.094, 0.088, 0.054, 0.146\}$$

Finally, based on the evidence theory synthesis formula, the score for each evaluation is obtained as shown in Figure 4.1.

Figure 4.1 shows the performance of file calculation processing.

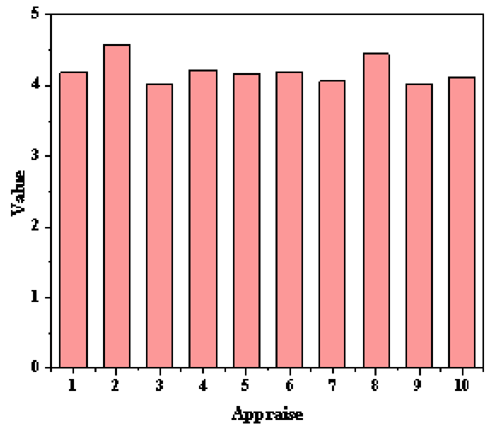


Fig. 4.1: Score for each evaluation

Finally, the evaluation of the webpage production engineering training course by peer teachers was 4.187 points. Using the same algorithm, the student evaluation score was 4.407 points, and the supervision score was 4.005 points.

Obtain a comprehensive score based on the weights of each entity obtained through the previous AHP Analytic Hierarchy Process

$$Q = 0.182183 * 4.016 + 0.208339 * 4.198 + 0.609498 * 4.418 = 4.2878$$

So the practical training score for webpage production engineering in this course is 4.2878 points.

**4.3. Analysis of Teaching Quality Evaluation Data.** The advantage of using the Analytic Hierarchy Process (AHP) lies in overcoming the influence of human bias and expectations on the allocation of weights between subjects. Through the method of group questionnaire surveys and an organic combination of experience and mathematical methods, it achieves objectivity, rationality, impartiality, scientificity, and persuasiveness. From the weight of the results, it can also be clearly reflected that personalized teaching in software engineering is a student-centered basic concept. In the rough evidence set algorithm, $M(A_i)$ is obtained through experience. If $M(A_i)$ is simply used as the weight, the subjectivity is too heavy [19]. For example, $a_2, a_3, a_4$ obtains higher weights on $M(A_i)$. However, with the fusion operation of $\lambda_i$ and the intervention of $\theta$ empirical factor, a balance point between subjectivity and objectivity is found. By combining the weights between subjects obtained through Analytic Hierarchy Process, the final score of 4.2989 is consistent with the survey and public opinion. This method avoids the deficiency of traditional evidence theory that treats all evidence equally, enhances the ability of information fusion, and obtains more realistic conclusions [20].

**5. Conclusion.** The author has established the weights of various evaluation indicators that affect teaching quality, calculated the evaluation weights among the three major subjects, established an initial data warehouse, and studied and established a personalized teaching quality evaluation model for software engineering, including design requirements, database documents, and ER diagram use cases. Enable the model to be quickly transformed into a system and put into use. In this data acquisition and operation, based on the establishment of personalized courses and students, suitable courses were found and students were involved in the evaluation. Students who were not suitable for the evaluation were eliminated, and an improved algorithm combining AHP Analytic Hierarchy Process and Rough Evidence Set Theory was used to successfully obtain the conclusions we need, further verifying the feasibility and usability of the software engineering personalized teaching quality evaluation and improvement model.

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