

# Optimization of Evaluation System of Teaching Supervision and Attendance Index in Colleges and Universities Based on Analytic Hierarchy Process

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**Abstract:** Teaching supervision is one of the important ways to improve teaching quality, especially for professional construction and engineering education. The main body of supervision is the evaluation of lectures. The establishment of a scientific and standard evaluation system is the premise of correct evaluation. In this paper, the existing evaluation standards are analyzed by using analytic hierarchy process to establish a hierarchical structure model to find out the shortcomings. Then, improve the deficiencies to form a scientific evaluation standard. In order to promote the continuous improvement of teachers' teaching level and the continuous development of teaching quality.

**Key words:** teaching supervision ; analytic hierarchy process ; construction evaluation ; index system

## 1 Introduction

Since the expansion of higher education, with the increase of enrollment scale in various universities, what measures can be taken to ensure that teaching continues to improve with the development of education, and to balance the relationship between the speed, efficiency, and quality of education development is one of the challenges that must be solved to achieve the long-term healthy development of higher education in China<sup>[1]</sup>. Especially for newly upgraded undergraduate universities in local areas, the increasing number of students has resulted in ineffective allocation of teacher resources. The majority of teachers in many universities are young and middle-aged. For these teachers with insufficient teaching experience, how to effectively improve their teaching ability is an urgent problem to be solved. Various universities have taken various measures at the school level, one of which is the teaching supervision system, which is an important component of teaching evaluation in universities<sup>[2]</sup>. Teaching supervision and evaluation can standardize the teaching order and improve the teaching quality level of teachers during teaching, therefore it is an important means to promote the growth of young teachers<sup>[3]</sup>. Currently, teaching supervision in universities mainly includes visit a class, various initial, mid-term, and final teaching inspections, etc. Its evaluation is mainly based on subjective judgment, which to some extent affects the standardization and effectiveness of supervision. This article attempts to start with the evaluation indicators of visit a class, explore the rationality of evaluation standards, and optimize them to serve the improvement of teachers' teaching quality and play the promoting role of teaching supervision in the teaching process.

## **2 Overview of Teaching Supervision**

### **2.1 The connotation of teaching supervision**

The term "teaching supervision" was first proposed in the 1920s, referring to teachers organizing teaching activities in a planned manner based on the existing teaching quality, implementing effective teaching reforms, and achieving the improvement of the overall teaching quality<sup>[4]</sup>. That is to say, by improving the teaching level and quality of teachers during the teaching process, the goal of improving teaching effectiveness is achieved. After several years of development, in 1938, a new concept was proposed in the article "Teaching Supervision: Principles and Practices for Improving Teaching". Teaching supervision became the exploration of various teaching methods in teaching activities, seeking the most suitable one and improving teaching efficiency<sup>[5]</sup>.

At present, teaching supervision is an important means of managing teaching work in various universities. Through practice, it has played a significant role in reforming teaching content and methods, improving the quality of the teaching staff, and promoting teaching management. In teaching supervision activities, professionals with years of experience in teaching frontline work usually supervise, inspect, guide, and evaluate, identify problems at various levels, and report them to relevant leaders, while providing opinions and suggestions.

### **2.2 Classroom teaching evaluation indicators**

Classroom teaching evaluation is a scientific and fair judgment based on the teacher's classroom teaching, behavior demonstrated in teaching activities, and teaching effectiveness. As young and middle-aged teachers who have been newly upgraded to undergraduate universities in local areas, their teaching experience is not sufficient, especially for new teachers, whose classroom teaching effectiveness is often not good enough. Therefore, the school's teaching supervision work mainly focuses on listening and guidance. Supervisors enter the classroom and listen to the teacher's lectures in real time. They can understand the teaching situation of a certain teacher and the students' learning status of the course. They can detect potential problems in the teaching process and promptly provide information feedback to the teaching teacher and teaching management unit.

Classroom teaching evaluation is not only highly timely for classroom teaching and can evaluate various unexpected teaching events, it is also a way to motivate teachers, promote teachers to recognize their own shortcomings, find ways to improve teaching effects, and enhance teaching abilities. important means that can promote the steady improvement of teaching<sup>[6]</sup>. Therefore, it is very necessary to formulate a reasonable classroom teaching evaluation index system.

Taking a second tier university in Hefei as an example. Teaching evaluation is mainly conducted from the aspects of teachers' teaching preparation, teaching attitude, teaching standards, teaching content, and teaching methods<sup>[7]</sup>. At the same time, the teaching effect of teaching is considered, and a comprehensive evaluation is conducted based on students' learning attitude and learning effectiveness. In the actual implementation process, evaluation methods such as combining individual and collective teaching supervision, and combining listening and inspection are adopted. Table 1 below shows the observation indicators for the evaluation of the school's supervision and attendance.

**Table 1** The observation index of teaching supervision attendance evaluation

ITEM	MAIN OBSERVATION POINTS
TEACHING PREPARATION (10 POINTS)	Come to the classroom 3-5 minutes in advance for pre class preparation. Class is over on schedule. Lesson plan/lecture notes(standardized and neat), teaching schedule, regular score book, the curriculum and other teaching documents are complete.
TEACHING ATTITUDE (15 POINTS)	Dignified appearance and strong sense of responsibility. Standard and clear language, with a loud voice. Full of energy and passion in class.
TEACHING NORMS (15 POINTS)	If multimedia courseware is used for teaching, the courseware production and use effect is good, and it is supplemented by blackboard writing. The writing on the blackboard should be standardized, neat, and clear in organization. Fully and effectively utilize classroom time.
TEACHING CONTENT (15 POINTS)	Thorough lesson preparation, complete manuscript preparation, and proficient teaching. Teaching is organized, highlighting key and difficult points, able to combine theory with practice, and providing targeted examples. Pay attention to teaching and educating people.
TEACHING METHOD (15 POINTS)	Emphasizing the Art of Teaching (“lecture” and “body language”). Not following the textbook and not covering all aspects can stimulate students' interest in learning, and pay attention to guiding students to think about the course content. Emphasize interactive teaching with good results and a good classroom atmosphere.
STUDENT LEARNING SITUATION (30 POINTS)	The teaching methods used by the teachers are appropriate, students are focused in class, and the classroom participation and cooperation are high. Teachers effectively manage classroom teaching order without sleeping, whispering, or playing with mobile phones. Students are able to understand and master the content taught.

From the above table, you can see the scores of various evaluation criteria. After the teaching supervisor scores, they can determine the level of teaching by the teacher who is attending this class. At the same time, targeted improvements can be made to the lower sub items. However, the score of this standard is mainly given based on subjective judgment, and whether its distribution is reasonable, scientific, reasonable, and targeted requires scientific methods to test.

### 3 Setting of Teaching Supervision Evaluation Indicators Based on Analytic Hierarchy Process

#### 3.1 Analytic Hierarchy Process(AHP)

Analytic Hierarchy Process (AHP) is a hierarchical analysis method proposed in the early 1970s, which combines qualitative and quantitative analysis to solve complex multi-objective problems. When using this method, the first step is to hierarchy the problem to be analyzed. Based on the nature and overall goal of the problem, the problem is decomposed into different constituent factors, and the factors are interrelated and subordinate to each other to form a multi-level

analytical structural model. Afterwards, the decision-maker judges the relative importance of each factor based on past experience, reasonably gives the weights of each standard for each decision plan, and then calculates the advantages and disadvantages of different plans based on the weights. Finally, the most suitable plan is selected. Therefore, the AHP is very suitable for determining the relative importance of various indicators in visit a class.

### 3.2 Hierarchy model for teacher classroom teaching evaluation

The steps of Analytic Hierarchy Process include: (1) Establish a hierarchical model; (2) Constructing a judgment matrix; (3) Hierarchical Single Sorting and Its Consistency Testing; (4) Hierarchical Total Sorting and Its Consistency Testing. Based on the Analytic Hierarchy Process and the evaluation indicators in Table 1, a hierarchical model for supervising teaching evaluation by teaching supervisors is constructed, as shown in Figure 1. The target layer is A, the indicator layer is B, and the teacher layer is C. For the sake of convenience, only the first level indicators were considered, and the teacher was represented by their professional title for analysis.

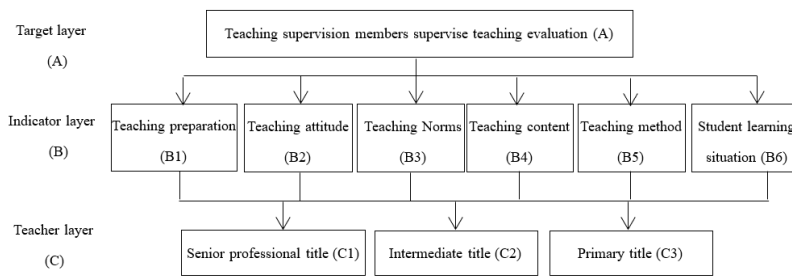


Figure 1 Hierarchy Model of Teacher's Classroom Teaching Evaluation

### 3.3 Construct a judgment matrix

#### (1) Consistency of the original indicator judgment matrix

Based on the established hierarchical structure model, construct a judgment matrix, and the relative importance of each evaluation indicator needs to be represented by numerical values. In this matrix, relative importance judgments are made based on the scores of each indicator and the proportion between the scores. The constructed A-B judgment matrix is shown in Table 2.

Table 2 Original A-B judgment matrix

A	Teaching preparation (B1)	Teaching attitude (B2)	Teaching Norms (B3)	Teaching content (B4)	Teaching method (B5)	Student learning situation (B6)
Teaching preparation (B1)	1	2/3	2/3	2/3	2/3	3
Teaching attitude (B2)	3/2	1	1	1	1	1/2
Teaching Norms (B3)	3/2	1	1	1	1	1/2
Teaching content (B4)	3/2	1	1	1	1	1/2
Teaching method (B5)	3/2	1	1	1	1	1/2
Student learning situation (B6)	1/3	2	2	2	2	1

Firstly, calculate the maximum feature root based on the above judgment matrix  $\lambda$ :

$$\lambda = \frac{1}{n} \sum_{i=1}^n \frac{(AW)_i}{w_i} = 6.6385 \quad (1)$$

Then calculate the consistency indicator CI:

$$CI = \frac{\lambda - n}{n - 1} = 0.1277 \quad (2)$$

Determine the size of the average random consistency indicator RI by looking up Table 3.

**Table 3** Average Random Consistency Indicators

n	1	2	3	4	5	6	7	8	9
RI	0	0	0.58	0.94	1.12	1.24	1.32	1.41	1.45

Finally, calculate the consistency CR of the matrix:

$$CR = \frac{CI}{RI} = 0.1029 \quad (3)$$

Due to  $CR > 0.1$ , according to the criteria of Analytic Hierarchy Process, the matrix is inconsistent. That is, the original standard score setting is not reasonable enough and needs to be modified.

(2) Consistency of the modified judgment matrix

In order to scientifically adjust the importance of indicators, expert survey method is used to score each indicator. The experts invited in this article mainly include two groups of people: firstly, frontline teachers with professional titles above associate professor in universities; the second is the teaching supervision experts in universities, with a total of 36 people, all of whom have years of work experience<sup>[8]</sup>. The basic information is shown in Table 4. The adjusted scores of various indicators based on expert opinions are shown in Table 5.

**Table 4** Basic Information on the Composition of Consulting Experts

Gender		Length of teaching(year)				Title	
male	female	<10	10-15	16-20	>20	professor	associate professor
28	8	6	10	13	7	21	15

**Table 5** Scores of Each Indicator

Item	Teaching preparation	Teaching attitude	Teaching Norms	Teaching content	Teaching method	Student learning situation
Score	10 points	15 points	15 points	20 points	20 points	20 points

The judgment matrix constructed based on the adjusted proportion of indicators is shown in Table 6.

**Table 6** Revised A-B judgment matrix

A	Teaching preparation (B1)	Teaching attitude (B2)	Teaching Norms (B3)	Teaching content (B4)	Teaching method (B5)	Student learning situation (B6)
Teaching preparation (B1)	1	2/3	2/3	2	2	2

Teaching attitude (B2)	3/2	1	1	3/4	3/4	3/4
Teaching Norms (B3)	3/2	1	1	3/4	3/4	3/4
Teaching content (B4)	1/2	4/3	4/3	1	1	1
Teaching method (B5)	1/2	4/3	4/3	1	1	1
Student learning situation (B6)	1/2	4/3	4/3	1	1	1

Calculated maximum characteristic root  $\lambda$ , the consistency index CI and consistency CR of the matrix are as follows :

$$\lambda = \frac{1}{n} \sum_{i=1}^n \frac{(AW)_i}{w_i} = 6.3363 \quad (4)$$

$$CI = \frac{\lambda - n}{n - 1} = 0.0673 \quad (5)$$

$$CR = \frac{CI}{RI} = 0.0542 \quad (6)$$

Due to  $CR < 0.1$ , this matrix is a consistency matrix.

Continue to construct the B-C matrix as shown in Tables 7-12.

**Table7** B1-C Matrix

B1	C1	C2	C3
C1	1	5	7
C2	1/5	1	3
C3	1/7	1/3	1

**Table8** B2-C Matrix

B2	C1	C2	C3
C1	1	3	5
C2	1/3	1	3
C3	1/5	1/3	1

**Table9** B3-C Matrix

B3	C1	C2	C3
C1	1	5	7
C2	1/5	1	3
C3	1/7	1/3	1

**Table10** B4-C Matrix

B4	C1	C2	C3
C1	1	5	7
C2	1/5	1	3
C3	1/7	1/3	1

**Table11** B5-C Matrix

B5	C1	C2	C3
C1	1	5	7
C2	1/5	1	3
C3	1/7	1/3	1

**Table12** B6-C Matrix

B6	C1	C2	C3
C1	1	3	5
C2	1/3	1	3
C3	1/5	1/3	1

#### 4 Empirical research

Taking a second tier university in a certain area as an example, based on the revised evaluation criteria model, invite professors and other experts with years of frontline teaching experience from the university to attend classes with three teachers with junior, intermediate, and senior professional titles, and provide evaluation scores.

Obtain the weight vectors of each primary indicator based on the matrix:

$$W^{A-B} = [0.2158, 0.1562, 0.1562, 0.1572, 0.1572, 0.1572]^T \quad (7)$$

The normalized weight phasor of the B-C judgment matrix is:

$$W^{B1-C} = [0.7306, 0.1884, 0.0810]^T \quad (8)$$

$$W^{B2-C} = [0.6370, 0.2583, 0.1047]^T \quad (9)$$

$$W^{B3-C} = [0.7306, 0.1884, 0.0810]^T \quad (10)$$

$$W^{B4-C} = [0.7306, 0.1884, 0.0810]^T \quad (11)$$

$$W^{B5-C} = [0.7306, 0.1884, 0.0810]^T \quad (12)$$

$$W^{B6-C} = [0.6370, 0.2583, 0.1047]^T \quad (13)$$

After calculation, CR=0.0624 for B1-C, B3-C, B4-C, and B5-C ;And CR=0.0370 for B2-C and B6-C . It can be seen that the CRs of the B-C matrix are all<0.1, indicating good consistency.

According to the results of hierarchical single ranking, calculate the weights of each teacher on the evaluation objectives, and obtain the total ranking results as shown in Table 11.

**Table 13** Hierarchy Total Sorting Result

	Total sorting weight	sort
Senior professional title (C1)	0.5145	1
Intermediate title (C2)	0.2781	2
Primary title (C3)	0.2073	3

The results show that the total ranking weights of C1, C2, and C3 decrease in order, indicating that teachers with senior professional titles have the best teaching effectiveness, while teachers

with junior professional titles from newly entered universities have the lowest teaching evaluation, which is consistent with the actual situation. Therefore, the hierarchical model provides results that are consistent with the actual evaluation situation. Therefore, the adjusted standard proportion is feasible.

Based on this, the school continued to invite the same group of supervision experts to evaluate the lectures of two teachers who were both lecturers, the average evaluation score for teacher A is 91 points, while teacher B is 83 points. After visiting students, the feedback received was that Teacher A's teaching effect was better than Teacher B's. This confirms that the adjusted indicator score distribution is scientific and reasonable, and the new indicator is feasible. The teaching supervisor made suggestions to Teacher B and conducted another lecture evaluation half a year later. It was found that the score had increased to 87, indicating a significant improvement in teaching level.

## 5 Conclusion

Teaching supervision work has been proven in years of practical work, which can strengthen teaching management, promote classroom teaching reform, and improve teaching quality. This article uses the Analytic Hierarchy Process to invite experts with rich teaching experience to improve the existing teaching supervision and evaluation standards. After practical testing, the improved standards are reasonable, which can promote the continuous improvement of teachers' teaching level and ensure the quality of talent cultivation.

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