

# Study of the Relationship between Tutors and Master Graduates Based on Analytic Hierarchy Process

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## Abstract

In order to understand the changing relationship between tutors and master graduates, the changing relationship and the causes of conflict is studied through questionnaires and interviews and other analysis means. The feedback information of the questionnaire is analyzed by using the analytic hierarchy process. It is proposed to solve the current teacher-student relationship contradictory ways, and to build a new teacher-student relationship which is focused in graduate student.

**Keywords:** graduate education; teacher-student relationship; AHP; questionnaire

## 1. Introduction

The relationship between tutors and graduates directly affects the quality of graduate education[1]. With the growth of enrolled scale of graduate students, the particularity and complexity of the relationship between tutors and graduates has become more prominent[2]. The study of harmonious relationship between tutors and graduates will become an important subject. Some scholars analyzed the factors that affect the relationship in the form of questionnaire[3]. But the result often being comprehensively because of the different of factors of investigation. This article studies the influence factors of relationship between tutors and graduates through questionnaires combined with AHP.

## 2. Influence Factors and Questionnaire Design

Factors affecting the relationship between tutors and graduates are various. Questionnaire is one of the most effective methods in acquiring the influence factors[4]. We summarize 17 influence factors after consultation with a number of senior tutors, and the 17 factors are divided into three layers according to the principle of AHP. The three layers include target layer, criterion layer and scheme layer. The structure graph is shown in Fig. 1.

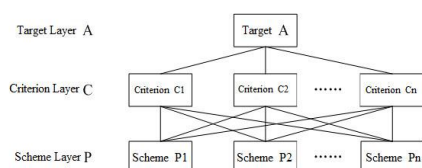


Fig. 1: The model structure graph of AHP

The research issue of to establish a new teacher-student relationship which is focused in graduate student is regarded as target layer A, there are 3 influence factors including graduate training system C1, tutor academic guidance C2, academic attitude of graduates C3, we regard the three influence factors C1-C3 as criterion layer C. 17 specific factors is scheme layer P, the 17 specific factors are respectively atmosphere of scientific research of college P1, the number of graduates of tutor P2, the way to determine the re-search direction P3, selection mode of tutor P4, change system of tutor P5, re-search conditions P6, mentoring attitude P7, mentoring frequency P8, mentoring effect P9, arrangements for research content P10, research reward P11, the main focus of tutor P12, attitude of the profession P13, motivation of graduate P14, purpose of graduate P15, attitude of communication with tutor P16, dilemma in learning P17.

We design the Questionnaire considering all factors we mentioned. The survey is anonymous by using random sampling. 360 questionnaires are distributed in the survey, and recovered 352 valid questionnaires, the result achieve the desired purpose and the effective rate of 97.8% ensure the accuracy of the overall situation of graduates.

## 3. Weight of Main Influence Factors

This article adopt AHP to determine the weight of main factors affecting the relationship between tutors and graduates. The complex objects are arranged in an ordered hierarchical structure, the various evaluation items are compared and we calculate the relative important coefficient, the coefficient is weight[5]. We establish judgment matrix  $A$  based on a new teacher-student relationship which is focused in graduate student. The initial judgment matrix is  $A = (a_{ij})_{n \times n}$ ,  $a_{ij}$  represent the scale coefficient after comparing  $a_i$  and  $a_j$ , we general regard 1-9 and its reciprocal as the scale. The meaning of 1-9 is shown in table 1.

The survey is conducted according to the questionnaire from 3 aspects including graduate training system, tutor academic guidance and academic attitude of graduates. The scale value is calculated and converted though the result of survey. The result is shown in table 2.

Table 1 The meaning of 1-9

$a_{ij}$	meaning
1	$i$ and $j$ are equally important
3	$i$ and $j$ are slightly important
5	$i$ and $j$ are obviously important
7	$i$ and $j$ are very important
9	$i$ and $j$ are extremely important
2, 4, 6, 8	Intermediate value between adjacent
reciprocal	If $i/j = a_{ij}$ , then $a_{ji} = j/i = 1/a_{ij}$

Table 2 Calculation of the scale value under the teacher-student relationship which is focused in graduate student

A	Headcount	Conversion value	Scale value
C1	130	14.44	9
C2	121	14.44	8
C3	95	14.44	7

Judgment matrix  $A$  of a new teacher-student relationship which is focused in graduate student is established based on the scale value in table 2. Judgment matrix  $A$  is shown in Eq. 1.

$$A = \begin{bmatrix} 1 & 9/8 & 9/7 \\ 8/9 & 1 & 8/7 \\ 7/9 & 7/8 & 1 \end{bmatrix} \quad (1)$$

The survey is conducted on the impact of graduate training system for the teacher-student relationship based on the questionnaire from 6 aspects. The statistical results are shown in table 3.

Table 3 Calculation of the scale value under the graduate training system

C1	Headcount	Total points	Average score	Unit value	Scale value
P1	346	2150	6.21	0.684	4
P2	345	2092.5	6.07	0.684	4
P3	330	2060	6.24	0.684	4
P4	350	3355	9.59	0.684	9
P5	348	1432.5	4.12	0.684	1
P6	348	2142.5	6.16	0.684	4

Judgment matrix  $C_1$  of graduate training system is established based on the statistical results in table 3. Judgment matrix  $C_1$  is shown in Eq. 2.

$$C_1 = \begin{bmatrix} 1 & 1 & 1 & 4/9 & 4 & 1 \\ 1 & 1 & 1 & 4/9 & 4 & 1 \\ 1 & 1 & 1 & 4/9 & 4 & 1 \\ 9/4 & 9/4 & 9/4 & 1 & 9 & 9/4 \\ 1/4 & 1/4 & 1/4 & 1/9 & 1 & 1/4 \\ 1 & 1 & 1 & 4/9 & 4 & 1 \end{bmatrix} \quad (2)$$

The survey is conducted on the impact of tutor academic guidance for the teacher-student relationship based on the questionnaire from 6 aspects. The statistical results are shown in table 4.

Table 4 Calculation of the scale value under the tutor academic guidance

C2	Headcount	Total points	Average score	Unit value	Scale value
P7	352	2557.5	7.27	0.451	8
P8	352	2695	7.66	0.451	9
P9	348	2215	6.36	0.451	6
P10	351	2040	5.81	0.451	3
P11	300	1215	4.05	0.451	1
P12	348	2472.5	7.10	0.451	8

Judgment matrix  $C_2$  of tutor academic guidance is established based on the statistical results in table 4. Judgment matrix  $C_2$  is shown in Eq. 3.

$$C_2 = \begin{bmatrix} 1 & 8/9 & 4/3 & 8/3 & 8 & 1 \\ 9/8 & 1 & 3/2 & 3 & 9 & 9/8 \\ 3/4 & 2/3 & 1 & 2 & 6 & 3/4 \\ 3/8 & 1/3 & 1/2 & 1 & 3 & 3/8 \\ 1/8 & 1/9 & 1/6 & 1/3 & 1 & 1/8 \\ 1 & 8/9 & 4/3 & 8/3 & 8 & 1 \end{bmatrix} \quad (3)$$

The survey is conducted on the impact of academic attitude of graduates for the teacher-student relationship based on the questionnaire from 5 aspects. The statistical results are shown in table 5.

Table 5 Calculation of the scale value under the academic attitude of graduates

C3	Headcount	Total points	Average score	Unit value	Scale value
P13	349	2105	6.03	0.284	3
P14	335	2427.5	7.25	0.284	7
P15	346	1942.5	5.61	0.284	1
P16	348	2382.5	6.85	0.284	5
P17	320	2517.5	7.88	0.284	9

Judgment matrix  $C_3$  of academic attitude of graduates is established based on the statistical results in table 5. Judgment matrix  $C_3$  is shown in Eq. 4.

$$C_3 = \begin{bmatrix} 1 & 3/7 & 3 & 3/5 & 1/3 \\ 7/3 & 1 & 7 & 7/5 & 7/9 \\ 1/3 & 1/7 & 1 & 1/5 & 1/9 \\ 5/3 & 5/7 & 5 & 1 & 5/9 \\ 3 & 9/7 & 9 & 9/5 & 1 \end{bmatrix} \quad (4)$$

The consistency of  $C_1$ ,  $C_2$ ,  $C_3$ ,  $A$  should be verified due to the AHP. MATLAB is applied to calculate all characteristic roots and eigenvectors of  $C_1$ ,  $C_2$ ,  $C_3$  and  $A$ .

The maximum characteristic root of  $C_1$  is  $\lambda_{\max} = 6$ , the equation of consistency index is shown in Eq. 5.

$$CI = \frac{\lambda_{\max} - n}{n - 1} \quad (5)$$

$n = 6$ ,  $CI = 0$ . The consistency ratio can be calculated according to the equation  $CR = \frac{CI}{RI}$ ,  $RI$  is random consistency index, the value is shown in table 6.

Table 6 The random consistency index

n	RI
1	0
2	0
3	0.58
4	0.90
5	1.12
6	1.24
7	1.32
8	1.41
9	1.45

The result is  $CR = 0 < 0.1$ ,  $C_1$  pass the consistency test. The eigenvector corresponding to the maximum Eigen value  $\lambda_{\max}$  is

$$\omega_1 = (0.154, 0.154, 0.154, 0.346, 0.039, 0.154)^T$$

The consistency of  $C_2$ ,  $C_3$ ,  $A$  is test in the same way, and the eigenvector corresponding to the maximum Eigen value  $\lambda_{\max}$  is calculated.

$$\omega_2 = (0.228, 0.257, 0.171, 0.086, 0.029, 0.228)^T$$

$$\omega_3 = (0.120, 0.280, 0.040, 0.200, 0.360)^T$$

$$\omega = (0.375, 0.333, 0.292)^T$$

The result is ranked based on above data, as shown in table 7.

Table 7 The rank of influence factors of teacher-student relationship

	C1	C2	C3	Hierarchy general ranking
P1	0.375	0.333	0.292	
P2	0.154	0	0	0.058
P3	0.154	0	0	0.058
P4	0.346	0	0	0.130
P5	0.039	0	0	0.015
P6	0.154	0	0	0.058
P7	0	0.228	0	0.076
P8	0	0.257	0	0.086
P9	0	0.171	0	0.057
P10	0	0.086	0	0.029
P11	0	0.029	0	0.010
P12	0	0.228	0	0.076
P13	0	0	0.120	0.035
P14	0	0	0.280	0.082
P15	0	0	0.040	0.012
P16	0	0	0.200	0.058
P17	0	0	0.360	0.105
$\Sigma$	1.000	1.000	1.000	1.000

#### 4. Analysis of Influence Factors and Building a New Teacher-Student Relationship which is Focused on Graduate Student

The influence factors of teacher-student relationship is analyzed based on the results of the questionnaire. In criterion layer, we can see the influence degree from table 7. Graduate training system is more important than tutor academic guidance, and tutor academic guidance is more important than academic attitude of graduates.

Graduate training system is the decisive factor affecting the relationship between teachers and students, selection mode of tutor is the primary factor affecting the harmonious relationship between teachers and students. The level of tutor academic guidance directly affect the harmonious relationship between teachers and students, which mentoring frequency is most important. Graduates with good academic attitude is an important factor in promoting the harmonious teacher-student relationship, which dilemma that graduates encounter is a very important influence factor.

A new teacher-student relationship which is focused in graduate student is built according to above analysis. Firstly, a two-way selection system in selection mode of tutor should be established. Secondly, the level of tutor

academic guidance should be improved. Finally, the scientific research ability of graduates should be improved, and the academic attitude of graduates should be corrected.

## 5. Conclusion

The evaluation index system of relationship between tutors and graduates is a complex system. Questionnaire is designed after listening to the views of a number of experts and teachers. Research of influence factors between tutors and graduates is conducted by using AHP, and judgment matrix is established based on the result of questionnaire. The main factors effecting the relationship between tutors and graduates are concluded after analysis, a new teacher-student relationship which is focused in graduate student is built based on the main factors, and it will help to improve the quality of post-graduate education.

## Acknowledgments

This work was financially supported by Postgraduate Education Innovation Program of Shandong Province (SDYY12094).

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