Construction and Weight Analysis of Teaching Work Evaluation Model of Applied University Teachers Based on Grounded Theory and Analytic Hierarchy Process

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Abstract
Scientific and reasonable to evaluate teacher's teaching work, helps to guide teachers establish quality consciousness, and has yet to have a more mature applied based the reality of college teachers teaching evaluation model, through the interview of eight application-oriented university teachers, the grounded theory method is used to construct the teaching evaluation model of applied university teachers with professional factors, practice factors and development factors, the weight of each index was calculated through analytic hierarchy process. In this model, the weight of a professional element is 0.267, the weight of the practice element is 0.414, and the weight of the development element is 0.319. Among the nine secondary indicators, the top three are teacher literacy (0.159), teaching design (0.128), and teacher development (0.125). These indicators undoubtedly point out the direction for guiding teachers to carry out teaching work.

Keywords: *Teaching work evaluation, Evaluation Model, Grounded theory, Analytic hierarchy Process*

1.INTRODUCTION

In today's international trend of higher education reform and development, there is a general focus on improving teaching quality, which is largely related to teachers' teaching work. A scientific and reasonable evaluation of teachers' teaching work can help bring into play the macro-control function of the school, guide teachers to pay attention to teaching, establish quality consciousness. Application-oriented colleges and universities, as a type of colleges and universities, have the same requirements and standards for teachers' teaching work as other types of colleges and universities, but there are also differences [3][4]. At present, there is an absence of a more mature model for evaluating the teaching work of teachers in application-oriented colleges and universities. Therefore, it is proposed to use the method of grounded theory to summarize and refine the structural elements of the evaluation of teachers' teaching work in application-oriented colleges and universities, so as to build an evaluation model, in the hope of providing guidance for the evaluation of teachers' teaching work in application-orientation colleges and universities.

2.OVERVIEW OF THE EVALUATION OF TEACHING WORK AT HOME AND ABROAD

The current domestic teacher evaluation system has gone through different development courses and stages. Tian et al. (2006) [10] argued that the system can be divided into three main stages, with the evaluation content of each stage ranging from simply counting workload to attaching importance to teaching and research achievements. In terms of the selection of evaluation indicators, the indicators of the evaluation system formulated by Jiang and Zhang (2004) [6] in their university were classified and screened on the basis of extensive opinions. Xi (2008) [11] pointed out that the establishment of teaching evaluation indicators should consider the following factors: educational policies and regulations, syllabus and textbooks, teaching laws and principles, the laws of students' physical and mental development, new ideas, and so on. Liu and He (2006) [9] developed evaluation indicators according to the principles of national laws and policies, following three principles of teaching theory, conforming to system

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theory, and the composition model diagram of the teaching evaluation index system. In general, the evaluation indicators are mainly centered on the aspects of morality, ability, diligence, and achievement.

According to the research of Li (2007) [8]; Xia (2011) [12], there are three types of teacher teaching evaluation in American colleges and universities: annual evaluation, promotion evaluation, and tenure evaluation. The content of the evaluation mainly covers three aspects: teaching, scientific research, and social service. Xia (2011) pointed out that the British teacher evaluation system has experienced repeated stages of "emphasis on rewards and punishments—emphasis on development—emphasis on rewards and punishments", but in general, most colleges and universities in the U K currently use developmental evaluations, with a focus on teachers' development and eliminating rewards and punishments, and the evaluation methods are mainly face-to-face. According to the research of Chen and Chen (2007) [1], the evaluation of teachers' teaching work adopted by most colleges and universities in Japan is linked to salary, position, and professional title, mainly evaluating teachers' research performance, didactic performance, and teaching performance. Dai and Shi (2007) [5] pointed out that Canada adopts a combination of quantitative and qualitative methods to carry out the evaluation, which consists of consulting teachers' teaching files and students' feedback.

3.GROUNDED THEORY AND MODEL CONSTRUCTION

3.1. Grounded theory and research objects

Grounded theory is a qualitative research method with the main purpose of building a theory based on empirical information. Researchers generally have no theoretical basis before the start of the research, and directly summarize concepts and propositions from the original data, which are then elevated to theories [2].

Since the evaluation of teachers' teaching work is directly related to teachers, teachers are more aware of what teaching work they are doing and what teaching work they want to evaluate. Therefore, when constructing models, it is imperative to understand the real thoughts of front-line teachers and reflect on the perspectives of practice. At the same time, since the evaluation system of teachers' work in application-oriented colleges and universities is still new, there is no mature evaluation scheme for teachers' teaching work in application-oriented colleges and universities. While the grounded theory is formed on the basis of empirical data, it is more suitable for constructing the evaluation system of teachers' teaching work, so the grounded theory method is used to carry out the evaluation.

The research objects of this research are 8 teachers from a demonstrated application-oriented university in a certain province, covering full-time teachers and administrators, among whom the administrators are also engaged in teaching tasks all the year-round, with teaching experience ranging from 4 to 13 years, including teachers of specialized courses and teachers of basic courses. Some full-time teachers are also the deputy dean of teaching or the director of the teaching and research section or the professional person in charge and are relatively familiar with teaching work. Some full-time teachers have experience in conducting teaching work assessments for many years.

3.2. Study design and implementation

This research is mainly carried out in the form of semi-structured in-depth interviews. The interviews revolve around the following outlines:

(1) Do you think it is necessary to evaluate teachers' teaching work and why? (2) What aspects do you think can be used to evaluate a teacher's teaching work? (3) Which of these aspects do you think is the most important? (4) When evaluating a teacher's teaching work, what are you most concerned about? (5) Have you seen or personally experienced the evaluation of teaching work since teaching? (6) What do you think is fair and appropriate for the evaluation of teachers' teaching work? Can you give some examples? (7) Do you think the evaluation of teachers' teaching work has any influence (positive/negative) on teachers? Can you give me some examples? (8) Do you think the evaluation of teachers' teaching work is helpful to the improvement of teachers' teaching? Can you give me some examples?

3.3. Data coding and model constructing

After the interview, the iFLYTEK Hearing website was used to transcribe the interview recording into a Word transcript. The interviewer checked and revised the interview transcript according to the notes and audio files to form the interview text data, which was manually coded using Excel software.

3.3.1. Primary coding (open coding)

Primary coding is also called open coding, during which, researchers should keep an open mind, put aside their existing concepts and ideas, break up all the data, and compare them according to the existing data. After extracting concepts from data, similar concepts were grouped into the same category, and then they are regrouped in new ways. The purpose of coding is to categorize, that is, to reorganize existing data into different categories [2]. In the process of the primary coding, it is attempted to use the verb or gerund code features to ensure the freshness of the empirical materials; original codes, i.e., key expressions or vocabulary used

by the research subjects in the interviews, are used as much as possible, which can make the coded conceptual categories closely related to the intrinsic experiences that the research subjects are trying to express and present [7]. In this regard, an explanatory bridge between experience and theory can be built, and the risk of interpretive bridge breaking can be evaded, so as to facilitate the exploration of explanatory paths in local research [14]. In order to ensure the rationality and accuracy of the primary coding, the method of multiple verifications is adopted [14], that is, the primary coding is carried out by two team members. After the team members clarify the principles, requirements, and operations of the coding, all the interview contents were independently coded, and then the consistency of the two coding results was checked. The consistency of the two coding results was 89.3%, which was high. For inconsistencies, the two team members discussed and finally reached an agreement, resulting in 180 primary codes.

3.3.2. Secondary coding (spindle coding)

Secondary coding is also called spindle coding, the main task of which is to discover and establish the relationship between concepts and categories, i.e., based on the primary coding, this organic connection between the parts of the information, such as causal, temporal, and functional relationships, is expressed by further comparing, differentiating, focusing, and condensing the categories between concepts and concepts in the primary coding [2]. In the primary coding, the data is broken up for categorization, while in the secondary coding, these categories are restored into a coherent whole according to the internal organic connection, as if strung together on a spindle. In the process of spindle coding, openness should also be maintained. Analysis dimensions can be revised and adjusted, and concepts and categories can also be added, that is, they are not completely subject to the concepts formed in the previous open coding [14]. According to this method, we formed 9 secondary codes from 180 primary codes.

3.3.3. Tertiary coding (theoretical coding) and model constructing

The tertiary coding, also known as theoretical coding, is based on the previous two-level coding. For the purpose of theoretical construction, by systematically analyzing all discovered concepts, categories, and their relationships, and selecting a “core category” to integrate it, the selected core categories should be highly generalized and integrated, which can incorporate the previously discovered concepts, categories, and their relationships, and play an analytical and explanatory role. This is the process of rising from empirical data to theoretical structure [2][14], so it is also called “theoretical coding”. Through the analysis and integration of secondary codes, three core categories (i.e., element sets) are extracted, which are professional elements, practical elements, and development elements. The core categories and associated categories are shown in Table 1.

Table 1 Theoretical coding

Core categories	Secondary Code	Concept category	Freq-uency
Professional elements	Teacher literacy	Teaching style and attitude, teacher morality, teaching by words and deeds, and respect for students	4
	Knowledge composition	Industry cognition, cutting-edge knowledge, and subject expertise	6
Practical elements	Teaching design	Lesson plans, textbooks, syllabus, assessment, teaching objectives, teaching preparation, curriculum design, lesson plan design, courseware, lecture content design, familiarity with training objectives, and teaching schedule	24
	Teaching implementation	Test paper proposition, teaching innovation, teaching methods, teaching methods, teaching workload, blackboard writing, information-based teaching methods, teaching art, teaching organization, course ideology and politics, value guidance, thought guidance, important and difficult points, and teaching characteristics	24
	Teaching effect	Communication and feedback, course assessment, homework, student experience, student work, student gain, and students’ homework	48
	Guidance	Guiding students’ competitions, association instructors, after-school tutoring and answering questions, life planning	10

		guidance, and guiding innovation and entrepreneurship	
Development elements	Teaching, research and social services	Teaching reform, applying for projects, publishing papers, scientific research, academic activities, compiling applied teaching materials, reforming assessment methods, and developing social service projects	21
	Teacher development	Teaching competitions, personal development, learning seminars, teaching teams, lesson observation, peer exchanges, lecture listening, and practical exercises in enterprises	10
	Teaching reflection	Teaching reflection, self-reflection, self-evaluation	5

4.CALCULATING THE WEIGHTS OF INDICATORS USING THE AHP

In order to better analyze the weight of the secondary indicators in the evaluation model, the analytic hierarchy process (AHP) was used for weight analysis. This study sought 13 experts from application-oriented colleges and universities who participated in quality assessment and teacher teaching work evaluation to score the importance of secondary indicators in the teacher's teaching work evaluation model in application-oriented colleges and universities.

4.1. Constructing the pairwise judgment matrix

AHP requires a pairwise comparison of secondary indicators, so first, a pairwise judgment matrix is constructed. According to the above teaching work evaluation model, there are a total of 9 secondary indicators, and a 9×9 pairwise judgment matrix is constructed. Experts are independently invited to give scores to these secondary indicators for pairwise comparison. By means of the 1-5 scale method, when comparing the element A with the element B, if the element A is very important, then the scale is 5; if the element A is relatively important, then the scale is 3; if the elements A and B are equally important, then the scale is 1; on the contrary, if the element A is very unimportant, then the scale is 1/5, and if the element A is relatively unimportant, then the scale is 1/3.

4.2. Eigenvector (weight value) calculation and consistency check

The pairwise judgment matrices filled in by each of the above experts are normalized to calculate the eigenvector ω of each element (that is, the weight value of each secondary indicator). Then the maximum eigenvalue λ_{max} is calculated, and the calculation formula is as follows:

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

Then, use the consistency test to check whether there are logical errors. The consistency test uses the CR value for analysis. Before calculating the CR value, the CI value needs to be calculated first. The calculation formula is as follows:

$$CI=\frac{\lambda_{max}-n}{n-1} \quad (2)$$

$$CR=CI/RI \quad (3)$$

According to the consistency test RI value in the table, when n=9, RI is 1.46. After calculation, if CR<0.1, the matrix has consistent satisfaction; otherwise, if CR≥0.1, the matrix does not have consistent satisfaction, indicating that the matrix has logical errors.

Table 2 Feature vectors and consistency test table of second-level indicators of teachers' teaching work evaluation model in applied colleges and universities

NO.	ω_1	ω_2	ω_3	ω_4	ω_5	ω_6	ω_7	ω_8	ω_9	λ_{max}	CR
1	0.117	0.145	0.192	0.056	0.111	0.076	0.109	0.124	0.070	9.627	0.054
2	0.162	0.122	0.135	0.075	0.103	0.069	0.145	0.133	0.056	10.034	0.089
3	0.197	0.180	0.200	0.062	0.107	0.053	0.087	0.073	0.040	10.022	0.087
4	0.152	0.128	0.132	0.051	0.105	0.093	0.125	0.144	0.070	10.037	0.089
5	0.172	0.114	0.042	0.090	0.137	0.082	0.051	0.156	0.154	9.371	0.032
6	0.128	0.078	0.076	0.042	0.204	0.040	0.109	0.219	0.105	9.701	0.060
7	0.199	0.105	0.135	0.079	0.095	0.094	0.133	0.096	0.064	9.492	0.042
8	0.169	0.173	0.062	0.048	0.104	0.103	0.153	0.125	0.062	10.012	0.087
9	0.071	0.097	0.173	0.186	0.098	0.116	0.086	0.101	0.073	9.840	0.072
10	0.193	0.103	0.167	0.039	0.182	0.089	0.089	0.080	0.059	10.307	0.112

11	0.036	0.037	0.172	0.257	0.092	0.096	0.107	0.092	0.109	9.316	0.027
12	0.343	0.074	0.086	0.069	0.085	0.047	0.108	0.126	0.062	10.070	0.092
13	0.163	0.042	0.128	0.144	0.119	0.043	0.041	0.107	0.214	9.349	0.030

In accordance with the above method, the questionnaire was statistically analyzed using Excel form. For the sake of listing, the feature vectors (weight coefficients) of the nine secondary indicators are named ω_1, ω_2, ω_3, ω_4, ω_5, ω_6, ω_7, ω_8, and ω_9. At the same time, the corresponding maximum eigenvalue λ_{max} and the consistency coefficient are calculated (see Table 2).

It can be seen from Table 2 that the CR value in the AHP matrix of the expert with a serial number of 10 is greater than 0.1, which fails the consistency test, so the expert's scoring data needs to be eliminated. Eventually, a total of 12 AHP matrices passed the consistency check, and the next step was to calculate the element weights.

4.3. Weight calculation of secondary indicators in the evaluation model

The analytic hierarchy process matrices of the 12 experts who passed the consistency test were summarized and counted, and the average calculation results of the eigenvectors (weights) of the final 9 secondary indicators are shown in Table 3:

Table 3 List of weight coefficients of secondary indicators of the model

weight coefficient No.	weight coefficients	weight coefficient No.	weight coefficients
ω_1	0.159	ω_6	0.076
ω_2	0.108	ω_7	0.104
ω_3	0.128	ω_8	0.125
ω_4	0.097	ω_9	0.090
ω_5	0.113		

According to the evaluation model of teachers' teaching work in application-oriented colleges and universities, the weights of professional elements, practical elements, and development elements are calculated respectively.

Table 4 Summary of matrix weight coefficients for each indicator of the model

primary indicators	weight coefficients	secondary indicator	weight coefficients
Professional elements	0.267	Teacher literacy	0.159
		Knowledge composition	0.108
Practical elements	0.414	Teaching design	0.128
		Teaching implementation	0.097
		Teaching effect	0.113
		Guidance	0.076
Development elements	0.319	Teaching, research and social services	0.104
		Teacher development	0.125
		Teaching reflection	0.090

5.DISCUSSION AND CONCLUSION

Through grounded theory and analytic hierarchy process, this paper constructs a teaching evaluation model for teachers in application-oriented colleges and universities that includes three major indicators: professional elements, practical elements, and development elements. Among them, professional elements include two secondary indicators of teacher literacy and knowledge composition; practical elements include four secondary indicators of teaching design, teaching implementation, teaching effect, and guidance; development elements include three secondary indicators, namely, teaching, research and social services, teacher development, teaching reflection.

The weight of each index is calculated by using AHP. In this model, the weight of a professional element is 0.267, the weight of the practice element is 0.414, and the weight of the development element is 0.319. Among the nine secondary indicators, the top three are teacher literacy (0.159), teaching design (0.128), and teacher development (0.125). These indicators undoubtedly point out the direction for guiding teachers to carry out teaching work.

First, teacher quality is the top priority. Teacher literacy refers to the teacher's morality, teaching style and attitude, teaching by words and deeds, respect for students, and so on. State leaders have mentioned that teachers' morality is the first criterion for teacher evaluation. As a teacher, you should first learn to be an instructor, be a good example, implement the Party and national education policies, perform your duties as a teacher according to the law, have the appropriate moral quality, and reflect good teacher morality and style in your words and deeds; you should care for students, respect them, treat them fairly, be a good teacher and

friend to them, and cultivate them as builders and successors of socialism for the country. Therefore, teachers are guided to cultivate and develop good teacher qualities through evaluation.

Second, teaching design is the key link in teaching. Teaching design means that before teachers carry out teaching tasks, they should design the content of a course or a certain chapter, write relevant teaching materials, and make preparations for lessons. Although the curriculum design mentioned here is a general job requirement for university teachers from an inductive point of view, in the interview process, many teachers mentioned that the curriculum design of teachers in application-oriented colleges and universities needs to be based on the cultivation of application-oriented talents. From the perspective of teaching, it is not possible to teach according to the original subject teaching system. It is necessary to deconstruct and then reconstruct the course content. Literally, it is curriculum design, but the connotation of evaluation is focused on how to reconstruct and deconstruct the course based on the action logic of applied courses, which is one of the elements that make the evaluation of teachers in application-oriented colleges and universities differ from other types of colleges and universities, and is also an important basic skill that application-oriented colleges and universities should help teachers to develop.

Third, teacher development is an important means of teacher growth and progress. Teacher development means that teachers develop their educational and teaching ability to a higher level through continuous learning, practice, reflection, and research [13]. teachers can learn and develop by participating in various teaching competitions at all levels, attending training activities, communicating and discussing with their peers, and observing their peers' teaching. In the interviews, many interviewees also mentioned that teachers should participate in social practice exercises, and they believed that teachers in application-oriented universities should have strong professional practice skills, which are not only accumulated and cultivated during work and study. In particular, it is necessary to go to relevant enterprises for a certain period of practical exercise to promote the development of professional practical ability. This is also one of the different elements in application-oriented colleges and universities from other types of college teacher evaluations.

By and large, the evaluation system not only includes some job requirements that a qualified university teacher should have, such as teacher literacy, but also reflects some teaching work evaluation requirements unique to application-oriented university teachers. According to the training requirements of talents, the curriculum design is carried out by deconstructing and reconstructing the course based on the logic of action; a certain period of the practice exercise in enterprises can promote the development of professional ability. The model provides a reference for the evaluation of teachers' teaching work in similar institutions.

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