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An Intelligent Model for Assessing Abilities of University Teachers Based on AHP and Delphi Method

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Abstract. *Employing academician with the basic teaching professions as well as values-guiding abilities is crucially important to colleges and universities and that is why they tries to develop talented teachers from the start to the end. How to find out the key abilities of an academician and how to cultivate their staffs' abilities is the top task and a hard problem of colleges and universities being faced with. This paper, by constructing reliable-valid assessment indicators, established an intelligent system to evaluate an academician's various abilities. For the proposed system, we use the statistical method to prove the indicators of the questionnaire exhibiting a high discriminative power. Then, the Delphi method coupled with the well-known analytic hierarchy process were employed to analyze the system's validity and reliability. It is shown that the proposed system has sound performance for identifying the key abilities of an academician. Finally, universities should encourage teachers to work in companies, engage in any united laboratory with an industrial circle, and participate in university-enterprise joint research projects so as to promote their staffs' qualities and thus improve the instruction quality by providing students with more talent cultivation as well.*
Keywords: Talented teachers of university; Intelligent evaluation system; AHP-Delphi method

1. **Introduction.** In today's world, to welcome a new era in higher education, the key point to colleges and universities focused on enhancing the teachers' various professional abilities, such as teaching skills, technical ability, practical ability, innovation and entrepreneurship ability and so on. Accordingly, some colleges and universities have changed their positioning and begun to promote innovative application development, giving rise to teachers with teaching and technical ability as well as career and values-guiding ability, hereinafter TACVA teachers in short. TACVA teachers are an extension of teachers with

teaching and technical ability who have been defined after teachers with two certificates, with two job titles, two qualities and two experiences [1,2].

Compared with teachers with teaching and technical ability, TACVA teachers place additional emphasis on practicality, innovation and compound abilities. These abilities can be used in multiple domains [3-5]. Additionally, TACVA teachers could not only highlight the basic teaching and professional technical ability over other staffs but also promote the whole career and values-guiding abilities [6]. Furthermore, TACVA teachers do not only possess the teaching and engineering qualifications as well as the technical ability [7,8]. Particularly, TACVA teachers also possess the academic and practical ability which exemplifies the combination of scientific spirit, craftsman spirit, theoretical knowledge & practical skills. all of which are necessary in the new education era [9,10].

Training students with practical ability in colleges and universities has revealed the key importance in cultivating students with innovation and entrepreneurship ability. This indicates that innovation and entrepreneurship education should not only focus on teaching basic qualities, which being common across all students, but also special qualities, which differing between students, such as innovative awareness, innovative spirit, innovative personality, entrepreneurship-related knowledge, and entrepreneurship ability [11,12]. Developing higher education quality and providing practical engineering education are the key ways to improve the higher education qualities.

Therefore, owning a team of TACVA teachers has become a core element for colleges and universities to introduce new subjects such as engineering, liberal arts, agriculture, and new medical development since much creations are made by the TACVA teachers [13]. Currently, identifying the required methods to develop TACVA teachers' qualities and abilities is a crucial part of college and university development. It is also the basis for innovating talent training systems.

Although numerous relevant studies have expanded the qualities of TACVA teachers, but those in an innovation-and-entrepreneurship ability-related careers and with the values-guiding abilities are still lack of ,which leads to these teachers can not equipped with the ability to develop students' values. Thus, TACVA teachers must possess the abilities of professional technical, innovation and entrepreneurship as well as the ability of superior teaching.

Motivated by evaluating the comprehensive abilities of university teachers scientifically and effectively, this study focuses on establishing a novel integrated model composed of a preliminary designed indicator lists and an intelligent assessing system for TACVA ability. To investigate the reliable-valid assessment of the indicators, the fundamental statistical method was employed and to confirme the whole system's validity and reliability the analytic hierarchy process employed respectively. Thus, quantitative data being generated thereafter, which provides the reference indices to college or university for developing TACVA teachers and for establishing related guidelines.

Contributions of this paper are reflected in the following three aspects: Firstly, through the form of questionnaire gives the evaluation system of teacher's ability while the validity and reliability being verified by the Cronbach's α value among the many impact factors. Moreover, significant influence analysis being carried out through calculating the Spearman's correlation coefficients so as to identify the key affecting factors. Secondly, it is used in combination of Delphi method with AHP method to solve the complex problem of teacher ability assessment, which is a new application of the two famous methods. Finally, research of this paper provides an effective method for universities to assess their teachers' abilities as well as an applicable way to cultivate their talented teachers. Remains of the paper are organized as follows: Section 2 concerns the framework of the proposed model and Section 3 deals with the reliability and significance of the indeces provided with in

the previous section by stardard statistics method. Section 4 refers to the well-known analytic hierarchy process of the model and the conclusion of the paper locates in Section 5.

2. **Framework of the Evaluate System.** First of all, we need to form a collection of indicators so as to assess the various abilities of university teachers. In the process, from literature analysis, professional teachers, managers and education experts were invited to take part in the discussion and a preliminary indicator set was established accordingly for evaluating teachers' ability. The design of the indece is included in the following subsection 2.1 and the detail illustration of the indece is the task of sub-section 2.2. Based on the two sections above, we will construct a teacher evaluation system in the third subsection and a detailed description of the system located therein, including the hierarchical structure analysis and more other contents.

2.1. **Design of the Evaluation Indeces.** To assess the abilities of college and university TACVA teachers, it should be determined according to the demands of their teachers, their job performances and organizational implementation evaluations. Therefore, based on teachers' abilities and values and on facilitating structural optimization, we here introduce a three-layer indicators system where the top Level to be basic teaching skill, professional ability, innovation and entrepreneurship ability. Obviously, these three indicators in Level 1 could logically demonstrate the major abilities for a TACVA teacher. Then, in compliance with indicator design principles, this study adopts the proof by exhaustion, literature data analysis optimization, and Delphi method to collect TACVA teachers' ability assessment indicators should be included in the top Level, here also regarding the national regulations on and requirements for talented individuals with practical ability. At the same time, professional teachers, managers and education experts were invited to participate in the discussion, and then-after, the following 15 preliminary indicators are suggested for evaluating college and university TACVA teachers' ability, shown as Level 2 in Table 1 below.

Table 1. Indicator system of assessing TACVA ability

Level 2-indicators	Level 1-indicators
• A1: Understand the teaching materials(UTM)	Basic teaching ability (BTA)
• A2: Design teaching materials(DTM)	
• A3: Teaching management-related ability(TMR)	
• A4: Teaching ability(TA)	
• A5: Teaching evaluation ability (TEA)	
• B1: Professional theoretical knowledge (PTK)	technical ability (PTA)
• B2: Professional level(PL)	
• B3: Practical industry-related experience(PIE)	
• B4: Patented inventions(PI)	
• B5: Skills certification issued by the industry(SCI)	
• C1: Innovative spirit(IS)	Innovation and entrepreneurship ability (IEA)
• C2: Innovative thinking(IT)	
• C3: Entrepreneurial spirit(EP)	
• C4: Entrepreneurial knowledge(EK)	
• C5: Entrepreneurial skills (ES)	

Furthermore, a detailed explanation of indicators is included in Level 2 , which are described in the following Table 2.

Table 2. The concepts of Level 2-indicators.

Concepts	Level 2 indicators	Level 1 indicators
• Analyze teaching materials	UTM-A1	BTA
• Organization high-quality teaching materials	DTM-A2	
• Organization or administration in teaching	TMR-A3	
• Implementation of teaching practice	TA-A4	
• Assess students' academic performance	TEA-A5	
• Systematic, generalized, deeper knowledge in a professional field	PTK-B1	PTA
• Level of competence of the subject	PL-B2	
• Engaged in related work for several years	PIE-B3	
• Create achievements in science and technology	PI-B4	
• Have a qualification to engage in a certain job	SCI-B5	
• Spirit of creating new things	IS-C1	IEA
• Thinking of creating new things	IT-C2	
• Groundbreaking ideas, concepts, and personal qualities in starting a new business	EP-C3	
• Acquiring comprehensive knowledge to start a new business	EK-C4	
• Ability to start a new business, and put into practice	ES-C5	

2.2. **Index Illustration.** Firstly, indicators in Level1 determines the teacher's sub-items and they are sorted according to the importance of their values, and their reliability and validity are tested. This study identifies 10 Level-2 indicators, based on which it develops a model to assess TACVA teachers' ability. In this study, basic teaching ability refers to teaching skills that teachers use to complete course teaching tasks, and the Level 2 indicators of basic teaching ability are the ability to design teaching materials, teaching ability, and teaching evaluation ability.

Secondly, professional technical ability refers to having proficient professional theoretical knowledge of the field in question, mastery of the research methods for the subject in question, a grasp of the academic trends and cutting-edge information concerning the subject in question, and accumulated first-line practical experience working in companies, as well as the ability to apply the latest patented invention results to the manufacturing and help companies obtain social production benefits. The Level 2 indicators of professional technical ability are professional theoretical knowledge, practical industry-related experience, patented inventions, and skills certifications issued by the industry.

Thirdly, innovation and entrepreneurship ability refers to teachers implementing innovative thinking-related training to students in an orderly and effective manner when developing their innovative ability and stimulating students' innovative and creative thinking. Also, it refers to teachers possessing practical company-related work experience, having a full grasp of the latest cutting-edge research results in the profession in question, designing curricula of the innovation-and-entrepreneurship education to enable the implementation of a reformed course model (combining professional and entrepreneurship education), and using practical entrepreneurial teaching bases to guide students how to apply professional theoretical and entrepreneurial management knowledge to design innovative inventions and enter career markets. The Level 2 indicators of innovation and entrepreneurship ability are entrepreneurial spirit, knowledge and skills.

According to this proposed indicators, we can build an evaluation system model for assessing TACVA abilities now that locates in the next subsection.

2.3. **Hierarchy Formulation.** It follows from the system theory coupled with scientific, comprehensive, adaptable, and feasible principles, as well as the criteria shown in Table 1 and Table 2 above, that a TACVA criteria system could then be formulated as follows, see Figure 1 below.

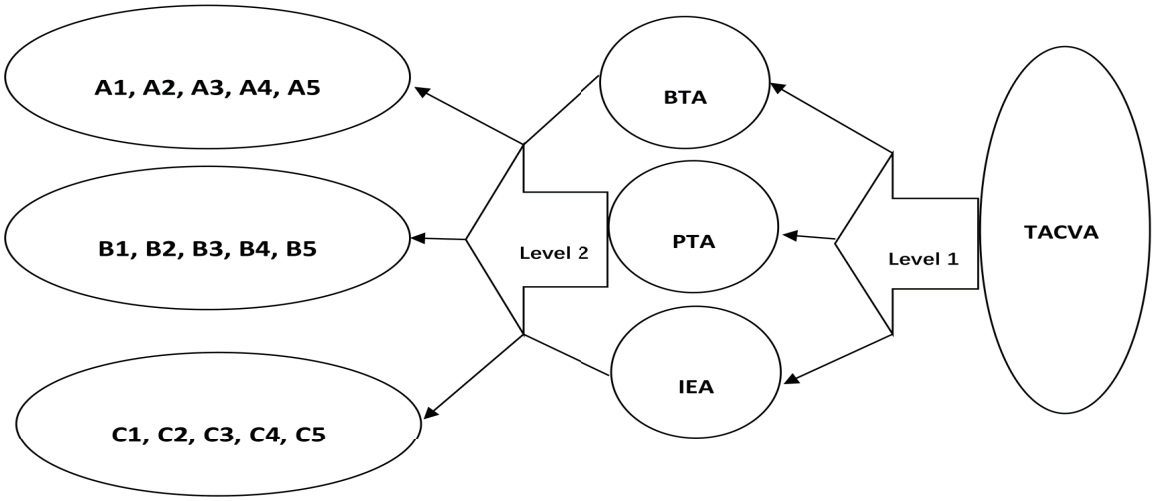

FIGURE 1. Frame Structure of the TACVA Criterion System.

As shown in Figure 1, the TACVA criterion system consists of four layers: the objective layer, the TACVA layer, the criterion layer, the target layer, details can be described as follows:

- The objective layer refers to achieve logical criteria for a teacher.
- The TACVA layer identifies the major abilities of a TACVA teacher should possess.
- The criterion layer includes criteria of a TACVA teacher based on the second layer.
- The target layer refers to the actions or projects of an university or college.

When the system hierarchy is clear, the main questions focus on the algorithms used in the system analysis. With the progress of intelligent computing technology, ontology alignment is one of the most competitive algorithms in recent years, refer to the literature [14, 15].

3. **Descriptive Statistics.** Here, we use a questionnaire to get the basic data and then check the applicability of these metrics by the famous Delphi method.

3.1. **Sample and Data Collection.** A total of 300 questionnaires have been sent to four different groups, namely students, professional teachers, managers and education experts, and 264 questionnaires recovered valid. As shown in Table 3, the numbers of valid questionnaires for the four groups are 24, 65, 16 and 159 and among them, there are 120, 88 and 56 with senior, intermediate, and other professional titles respectively.

TABLE 3. Profile of survey participants

		Number of participants	Percentage of sample
Job role	Students	24	9.10%
	Teachers	65	24.77%
	Managers	16	6.06%
	Educational experts	159	60.07%
Technical title	Professor/Associate professor	120	45.45%
	Lecturers	88	33.33%
	Others	56	21.22%

3.2. **Data Analysis.** Based on SPSS 17.0 and Excel 2013 to build the questionnaire database and analyze the reliability of the questionnaire. Here we use Cronbach's α coefficients as the index of items reliability, items with $\alpha > 0.7$ are accepted, the individual reliability was evaluated and shown in Table 4.

TABLE 4. The Cronbach's α value of all items.

Concepts	cronbach's α	Concepts	cronbach's α
A1	0.678	B4	0.876
A2	0.845	B5	0.855
A3	0.618	C1	0.630
A4	0.861	C2	0.683
A5	0.864	C3	0.835
B1	0.870	C4	0.874
B2	0.669	C5	0.681
B3	0.867		

From Table 4, because the Cronbach's α of A1, A3, B2, C1 and C2 are less than 0.7, they should be removed out from the the overall indeces. Then, accordingly, the results reveal a total Cronbach's α value of 0.899, i.e., $0.8 < Cronbach's\ \alpha = 0.899 < 0.9$, that is a valid case and signifys the questionnaire possesses a high reliability.

Subsequently, this study uses Spearman's rank correlation coefficient $rs = 1 - \dfrac{6\sum d^2}{n(n^2-1)}$ to explain the closeness and relevant directions between each item's score and the total score, where a score of $P < 0.05$ denotes a significant correlation at a significance level of 0.05, whereas a score of $P < 0.01$ denotes a significant correlation at a significance level of 0.01.

Similarly, SPSS 17.0 is employed to identify the Spearman's correlation coefficient between the score for each questionnaire item and the one for the total item. The results are shown in Table 5.

As can be seen from Table 5, the correlation coefficient between the score for each item and the one for the total item exhibits significant correlations at a significance level of 0.05 (two-tailed). This shows that the assessment indicators of the questionnaire exhibit a high discriminative power and content validity.

TABLE 5. Correlation coefficients of each questionnaire item and the total items.

Level 2 indicators	Correlation coefficient	Level 2 indicators	Correlation coefficient
A2	0.321**	B4	0.645**
A4	0.256**	B5	0.545**
A5	0.356**	C3	0.342**
B1	0.432**	C4	0.298**
B3	0.521**	C5	0.412**

It can be obtained from Table 1, Table 2 and Table 5 that there are significant influence relations among all the indicators of affecting TACVA teachers, and 15 indicators reduced to 10.

Further, the survey questionnaire has a Kaiser–Meyer–Olkin value of $0.821 > 0.5$, and Bartlett's test sig value of $0.000 < 0.01$, which verify that the selected factors could be used for factor analysis. Conducted on SPSS 17.0, principal component analysis results are carried out in Table 6 which reveals that the three principal components have a characteristic $root > 1$ and total variance of 70.254%. The components are named by the ability which they belong to, including basic teaching ability (B1), professional technical ability (B2), and innovation and entrepreneurship ability (B3). The total variance of the three principal components is 49.452%, 12.023%, and 9.003%, respectively. Furthermore, a total of 10 elements are categorized under the three principal components.

TABLE 6. Principal component analysis results

		Common factors derived	from the rotated	factor matrix
Level 2 indicators		Factor 1	Factor 2	Factor 3
A2			0.910	
A4			0.823	
A5			0.712	
B1		0.822		
B3		0.856		
B4		0.942		
B5		0.757		
C3				0.854
C4				0.893
C5				0.878
Initial eigenvalue	Variance (%)	49.452	12.023	9.003
	Cumulative value (%)	49.452	61.475	70.478

4. **AHP Analysis of the System.** System theory is the study of system general pattern, structure and law of knowledge. Mastering the method of system thinking, it is certain that one could be able to think and analyze problems systematically on the whole. It is an emerging science with logical and mathematical properties. The most difficult part of the system research is the algorithm about its function and the algorithms developed in the last ten years including genetic algorithm, neural network algorithm and evolutionary algorithm have been widely used in system analysis. Among them, the latest progress of evolutionary algorithm can be referred to the literature [16] , while the deep learning technology in artificial intelligence here suggested to refer the paper [17].

Here, we focuse on the analytic hierarchy process , AHP in short, of the proposed system which is an inevitable choice for the system analysis and decision making. The AHP

is a well-known decision-making method pioneered by professor Thomas Saaty which based on simple theories and it is easy to operate and can account for most experts' opinions. Furthermore, it can solve complex decision-making problems, thereby enhancing the reliability and accuracy of assessment results. By now, the AHP have become a popular and classical method in system analysis with a wide range of applications [18,19].

4.1. **Constructing the Weight Set.** The information of the indeces is acquired from the extensive assessments of specialists through the Delphi strategy. The Delphic strategy is an organized correspondence innovation that was initially evolved as an intuitive anticipating technique that depended on a gathering of specialists. Specialists answer the survey at least two rounds. After each round, the host will secretly give a synopsis of the specialists' expectations of the last round and the purposes behind their decisions. In this manner, specialists are urged to alter their past answers dependent on the reactions of different individuals from the gathering.

We accept that the scope of answers will be decreased all the while and the gathering will combine towards the 'right' answer. At long last, the cycle is halted after a pre-characterized stop rule, e.g., number of rounds, the accomplishment of agreement, and strength of results, and the mean or middle scores of the last adjusts decide the outcomes. Subsequently, a questionnaire is developed and items of which are measured by using a 5-point Likert scale: 5, 4, 3, 2, and 1 corresponding very important, quite important, important, not very important and not important, respectively.

We invites three groups of experts, a total of 10 experts, who have participated in TACVA teacher accreditation review committees to perform a pairwise comparison of the TACVA teacher ability evaluation form. Scores are given according to the AHP assessment scales. The numbers used during the pairwise comparison are $1/9, 1/8, \ldots, 1/2, 1, 2, 3, \ldots, 8, 9$.

When the pairwise comparison matrix values are obtained from the three expert groups, the AHP classic weight model is employed to calculate the weights of the indicators for each level.

Equations for calculating the classic weights are as follows:

$$W_i = \frac{(\sum_{j=1}^{n} a_{ij})^{\frac{1}{n}}}{\sum_{i=1}^{n}(\sum_{j=1}^{n} a_{ij})^{\frac{1}{n}}},\ i, j = 1, 2, ..., n,$$

here $\lambda_{max} = AW$ means the maximum eigenvalue of vector A.

The comparison matrices are converted into judgment matrices, Tables7–10, and the consistency indices $CI = \dfrac{\lambda_{max} - n}{n-1}$ and consistency index values $CR = \frac{CI}{RI}$ are calculated.According to Saaty (1980), when decision-makers wish to evaluate their judgments or when the overall hierarchical structure is to be tested, a CR of approximately 0.1 is appropriate, in general, a $CR < 0.1$is used, because it ensures consistency.

Table 7. Judgment matrix of all the factors.

	B1	B2	B3	Weight	λ_{max}	CI	CR
B1	1.000	0.789	1.121	0.317			
B2	1.182	1.000	1.446	0.395	3.002	0.001	0.002
B3	0.956	0.692	1.000	0.288			

Note: Consistency test: $CR = 0.002 < 0.1$, denoting valid results.

Table 8. Judgment matrix of the variable level of basic teaching ability.

	C11	C12	C13	Weight	λ_{max}	CI	CR
C11	1.000	1.562	3.492	0.514			
C12	0.640	1.000	2.590	0.346	3.002	0.001	0.002
C13	0.286	0.386	1.000	0.140			

Note: Consistency test: $CR = 0.002 < 0.1$, that means all being valid results.

Table 9. Judgment matrix of the variable level of professional technical ability.

	C21	C22	C23	C24	Weight	λ_{max}	CI	CR
C21	1.000	0.345	0.151	1.847	0.100			
C22	2.896	1.000	0.369	3.594	0.251			
C23	6.608	2.713	1.000	5.964	0.577	4.059	0.020	0.022
C24	0.542	0.278	0.168	1.000	0.072			

Note: Consistency test: $CR = 0.022 < 0.1$, valid results.

Table 10. Judgment matrix of the variable level of innovation and entrepreneurship ability.

	C31	C32	C33	Weight	λ_{max}	CI	CR
C31	1.000	0.311	0.836	0.184			
C32	3.344	1.000	2.595	0.593	3.014	0.007	0.012
C33	1.196	0.385	1.000	0.223			

Note: Consistency test: $CR = 0.012 < 0.1$, valid results.

Then, it follows from Table 7-10 that all weights of the indicators of different levels, shown as following Table 11, can be used to assess TACVA teachers' ability. As shown in Table 11, the consistency of all different level indicators performs well.

Table 11. Overall weights of the indicators.

Level 1 indicators (criterion level)	Criterion level weight	Level 2 indicators (variable level)	Variable level weight	Overall weight	Weight ranking
BTA-B1	0.395	DTM-C11	0.514	0.163	2
		TA-C12	0.346	0.110	4
		TEA-C13	0.14	0.044	8
PTA-B2	0.395	PTK-C21	0.1	0.040	9
		SCI-C22	0.251	0.099	5
		PIE-C23	0.577	0.228	1
		PI-C24	0.072	0.028	10
IEA-B3	0.288	EP-C31	0.184	0.053	7
		EK-C32	0.593	0.171	3
		ES-C33	0.223	0.064	6

Thus, by using an overall weight analysis on the variable-level indicators, we carry out sound results which coincide with the hypothesized results suggested in the previous

research. The variable-level indicators have different degrees of effects on TACVA teachers' ability, where professional technical ability, basic teaching ability, and innovation and entrepreneurship ability account for 39.5%, 31.7%, and 28.8%, respectively. The results show that professional technical ability is superior to basic teaching ability, and innovation and entrepreneurship ability are the core ability that TACVA teachers must possess.
Next ,we need to calculate the weight constants of all factors. The weight set of the evaluation factors are defined as $W = (W_1, W_2, ..., W_n)$ with $0 < w_j < \sum W_j = 1$.

4.2. **Constructing the Pairwise Comparison Matrix.** Let a be an evaluation factor, a_i represents the relative importance value.A comparison of different factors in a pairwise manner gave the comparison matrix $A(a_{ij})$, satisfying $a_i > 0$, $a_i a_j = 1$, and $a_{ii} = 1$. The pairwise comparison matrix of the guide level is shown in Table11.

Table 12. Pairwise comparison matrix of the guide level.

A	Professional Techical Ability	Innovation and Entrepreneurship Ability	Basic Teaching Ability
Professional Techical Ability	1	3/7	1/2
Innovation and Entrepreneurship Ability	7/3	1	3/4
Basic Teaching Ability	2	4/3	1

4.3. **Calculating the Weight Vector.** First, elements in the comparison matrix A were normalised and the general term was defined as:

$$\bar{a} = \frac{a_i}{\sum_{k=1}^{n} a_{kj}} \ (i, j = 1, 2, ..., n)$$

Second, the normalised elements in each row were summed:

$$\bar{W}_i = \sum_{j=1}^{n} \bar{a}_i \ (i, j = 1, 2, ..., n)$$

Third, the row vector was normalised to obtain the weight vector W:

$$W_i = \frac{\bar{W}_i}{\sum_{j=1}^{n} \bar{W}_j} \ (i, j = 1, 2, ..., n)$$

Then, we obtain the eigenvector $W = (W_1, W_2, W_3, ..., W_n)^T$ like this

$$W_0 = (0.238, 0.354, 0.408)^T$$

4.4. **Calculating the Maximum Eigenvalue of Matrix A.** From

$$AW = \begin{bmatrix} 1 & 3/7 & 1/2 \\ 7/3 & 1 & 3/4 \\ 2 & 4/3 & 1 \end{bmatrix} \begin{bmatrix} 0.238 \\ 0.354 \\ 0.408 \end{bmatrix} = \begin{bmatrix} (AW)_1 \\ (AW)_2 \\ (AW)_3 \end{bmatrix}$$

we obtain

$$\lambda_{max} = \frac{1}{n} \sum_{i=1}^{n} \frac{(AW)_i}{W_i} = \frac{1}{3} \times (\frac{(AW)_1}{W_1} + \frac{(AW)_2}{W_2} + \frac{(AW)_3}{W_3}) = 3.052$$

4.5. **Consistency Test.** First, the consistency index is as follows:

$$CI = \frac{\lambda_{max} - n}{n-1} = \frac{3.052 - 3}{3-1} = 0.026$$

Second, from the consistency index table, the average random consistency index of the third-order matrix RI, $RI = 0.55$. Last, the consistency ratio is calculated: $CR = CI/RI = 0.026/0.55 = 0.047 < 0.14$. The results indicate the consistency of satisfaction. The weights of different factors corresponding to the eigenvector W are: 0.238, 0.354, 0.408.

Furthermore, in the weight of all the variable-level indicators, the three top indicators are practical industry-related experience, the ability to design teaching materials, and entrepreneurial knowledge. Practical industry-related experience ranks first, indicating that it is the key indicator to enhance teachers' professional ability, keeping their professional theoretical knowledge up to date, and elevating their teaching practice, thereby realizing the goal of developing talented students with practical ability. The ability to design teaching materials ranks first in weight for basic teaching ability, revealing that teachers' ability to design high-standard and high-quality teaching materials determines the overall teaching-implementation results.

Therefore, teachers should use teaching objectives as guides, adopt appropriate teaching methods, and integrate their teaching knowledge, professional theoretical knowledge and practical professional experience to create an optimal teaching model. Although innovation and entrepreneurship ability only accounts for 28.8%, it is key to developing students' innovative thinking, entrepreneurial awareness and entrepreneurial skills. Particularly, entrepreneurial knowledge ranks third and is a key ability for teachers to develop talented students with innovation and entrepreneurship ability.

5. **Conclusion.** Creating a team of TACVA teachers is the key factor and requirement for colleges and universities to develop talented students with practical and innovative ability. To create such a team, colleges and universities must have their teachers work in companies, engage in school-company collaboration, and perform in school-professional industry research to help them actively enhance their professional and practical ability.

We construct a valid and reliable indicator system for assessing TACVA teachers' ability. The indicator system consists of two levels. Level 1 indicators are basic teaching ability, professional technical ability, and innovation and entrepreneurship ability. Level 2 contains 10 indicators, including the ability to design teaching materials, teaching ability, teaching evaluation ability which is the basic teaching ability, professional theoretical knowledge, skills certifications issued by the industry, practical industry-related experience, patented inventions which belong to professional technical ability, innovation and entrepreneurship spirit, entrepreneurial knowledge, and entrepreneurial skills which fall under innovation and entrepreneurship ability. The results indicate that professional technical ability is the core ability for college and university TACVA teachers, and basic teaching ability and innovation-and- entrepreneurship ability are also critical ones. These abilities are crucial when developing a team of TACVA teachers.

The future study should expand the scope and number of samples in the questionnaire survey on a system-usable basis, to ensure the assessment model can be used by college and university TACVA teachers in other regions.

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