

The Reliability and Validity Analysis of Questionnaire

The research questionnaire design process is divided into three stages: theoretical framework construction, pre-investigation and formal investigation. In the stage of theoretical framework construction, based on literature analysis and traditional Chinese medicine (TCM) training program, high-impact educational practices (HIPs) are preliminarily divided into 15 activities in three categories: practical (5 items), research (4 items) and expansion (6 items). Educational achievements are divided into 22 indicators in three dimensions: knowledge, ability and emotional values. By interviewing 28 students in school to supplement the special activities of TCM, an analytical framework consisting of 15 educational practices and 22 educational achievements was finally formed.

In the pre-investigation stage, a questionnaire was compiled, including demographic information, 15 educational practices participation (5-level Likert scale) and 22 self-assessment of educational achievements (5-level scale). 124 questionnaires were distributed in advance and 94 valid questionnaires were collected. The validity test showed that KMO=0.928, and three common factors were extracted (cumulative variance 68.37%); The educational achievements scale KMO=0.946, and three factors (cumulative variance of 80.61%) are extracted, which is consistent with the theoretical framework. In the reliability test, Cronbach's α of the two scales is 0.953 and 0.978 respectively, and the α coefficients of all dimensions are higher than 0.6/0.8, and the items are reserved.

The formal investigation followed the pre-survey questionnaire, and 210 valid data were recovered after distribution. The re-examination of reliability and validity shows that the overall educational activity scale α =0.934, the educational gain α =0.972, and all dimensions α are over 0.6, which confirms that the tool is reliable. Through literature review, interview revision, pre-survey and formal verification, the whole process ensures that the questionnaire can effectively measure the relationship between HIPs of Chinese medicine undergraduates and their educational achievements.

1. Reliability test of questionnaire

In this study, SPSS20.0 was used to test the reliability of the scale of HIPs for undergraduates majoring in TCM. The specific results are shown in Table 1. Usually, when the α coefficient is greater than 0.7, the representative scale has good reliability. The test results show that the Cronbach' α coefficient of both scales of the questionnaire is greater than 0.8, and the reliability of the questionnaire is good.

Table 1 Reliability test results of HIPs scale for undergraduates majoring in TCM

Inventory	Measurement Dimension	Number of	Cronbach' α coefficient
		items	Total table
High-Impact Educational Practices	Practical activities	5	0.854
	Research activities	4	
	Expanding activities	6	
Educational Achievements	Professional Abilities	8	0.955
	General Competencies	7	
	Emotional Value	7	

2. Questionnaire validity test

Questionnaire validity usually includes content validity and structural validity, in which content validity measures the consistency between the content of the questionnaire and the measured topic, and structural validity tests the consistency between the actual structure of the questionnaire and the theoretical expectation.

In terms of content validity, the questionnaire designed in this study has gone through the steps of existing literature research, text analysis of training programs, supplementary interviews with students, comprehensive comparison and summary, etc. The research process is scientific and reasonable, and the design of questionnaire items corresponds to the content and expression of measurement topics, so it can be considered that the questionnaire in this study has certain content validity.

The structural validity of the questionnaire was tested, and KMO value and Bartlett spherical test were calculated. When the calculated KMO value was greater than 0.6 and the result of Bartlett spherical test was $P < 0.05$, the data was suitable for factor analysis. From Table 2, it can be seen that KMO values of the scale of HIPs for undergraduates majoring in TCM are all greater than 0.80, and Bartlett test is significant ($P < 0.001$), so factor analysis can be carried out on the scale.

Table 2 KMO value and Bartlett test results of HIPs scale for undergraduates majoring in

TCM		
Verification project	Verification index	statistical values
KMO Test	KMO value	0.839
	Approximate	1206.843
Bartlett spherical test	chi-square	
	Degree of freedom (df)	105
	Significance	0.000

Table 3 Factor analysis results of HIPs scale for undergraduates majoring in TCM (Factor Load)

Item Variables and Item	Factor 1	Factor 2	Factor 3	Factor 4
Eigenvalue	2.973	2.96	1.826	1.587
Explanatory variance%	19.819	19.731	12.175	10.578
Cumulative explanatory variance%	19.819	39.55	51.725	62.303
P1 Social practice or investigation	0.772			
P2 Volunteer service - skills of TCM	0.740			
P3 Volunteer service - TCM cultural communication	0.793			
P4 Participate in community activities	0.731			
P5 Clinical apprenticeship		0.598		
R1 Participate in various academic, professional, entrepreneurial or design competitions			0.438	
R2 Contribute to professional academic journals/conferences, etc.			0.749	
R3 Preside over or participate in scientific research projects and patent applications			0.738	
R4 Participate in academic lectures and conferences		0.721		
E1 Language learning beyond the curriculum requirements (second foreign language)				0.646
E2 Overseas exchange visiting school				0.613
E3 Minor second degree (double degree)				0.763
E4 Study of classic works of TCM		0.830		
E5 Discussion on famous medical records		0.842		
E6 Obtain a professional qualification certificate/skill level certificate		0.592		

Note: Extraction method: principal component analysis. Rotation method: Kaiser normalization maximum variance method. A. the rotation has converged after 5 iterations.

In this study, exploratory factor analysis (principal axis factor method, Promax oblique rotation) was used to test the structural validity of the questionnaire. The results show that four common factors with characteristic values > 1 are extracted, and the cumulative explanatory variance is 62.30% (meeting the standard of $> 60\%$). The factor load of each item is greater than 0.40, and the specific distribution is as follows:

Factor 1 (practical activities): the explanatory variance is 19.819%, "social practice or investigation" ($P1=0.772$), "volunteer service - skills of TCM" ($P2=0.740$), "volunteer service - TCM cultural communication" ($P3=0.793$), "participate in

community activities" (P4=0.731) and "clinical apprenticeship" (P5=0.598). Although the load of P5 is slightly lower, as the core practice requirement of clinical teaching for undergraduates of TCM, its attribution strengthens the standardized practice attribute of P5.

Factor 2 (expanding activities-classic study): the explanatory variance is 19.731%, "study of classic works of TCM" (E4=0.83) and "discussion on famous medical records" (E5=0.84) highlight the in-depth expansion of the specialty.

Factor 3 (research activity): the explanatory variance is 12.175%, focusing on "participate in various academic, professional, entrepreneurial or design competitions" (R1=0.75) and "preside over or participate in scientific research projects and patent applications" (R3=0.74). R4 Participate in academic lectures and conferences: Although it does not directly produce research results, it belongs to regular participation in academic research activities (such as acquiring cutting-edge knowledge and supplementing academic horizons) and can be interpreted as "academic supporting research activities".

Factor 4 (expanding activities-cross-disciplinary development): the explanatory variance is 10.578%, and "Language learning beyond the curriculum requirements (second foreign language)" (E1=0.65) and "Minor second degree (double degree)" (E3=0.76) reflect cross-border ability training.

Table 4 KMO value and Bartlett test results of education achievements scale for undergraduates majoring in TCM

Project	Index	Statistical Values
Kaiser Meyer Olkin	KMO value	0.946
	Approximate chi-square	3455.386
Bartlett Spherical Test	Degree of freedom (df)	231
	Significance	0.000

The results showed that KMO value was $0.946 > 0.9$, Bartlett spherical test was $P < 0.001$, and the items in the educational achievements scale for undergraduates majoring in TCM were suitable for factor analysis. Therefore, the principal component analysis method is used to extract common factors, and the characteristic value > 1 is used as the factor selection standard, and a total of three common factors

are extracted, which is consistent with the expected division of the scale. According to the theory of factor analysis, the model can be accepted if the common factor can reflect more than 60% of the variance variation of the model. The contribution rate of cumulative variance is 80.61% > 60% after the common factors are extracted from the educational achievements scale for undergraduates majoring in TCM. Three common factors can provide enough information for the original data. On this basis, the maximum variance method (Varimax) is used for orthogonal rotation to calculate the load of each item corresponding to the common factor, and the item with the factor load less than 0.4 is deleted to verify the corresponding relationship between the item and the dimension. The results are shown in Table 5.

Table 5 Factor Analysis Results of Education achievements Scale for Undergraduates Majoring in TCM (Factor Load)

Item Variables and Item	Factor 1	Factor 2	Factor 3
Eigenvalue	6.494	5.765	5.475
Explanatory variance%	29.52	26.205	24.888
Cumulative explanatory variance%	29.52	55.726	80.613
Recognize the culture of TCM and have full confidence that TCM can solve clinical problems.	0.887		
Clear the future commitment to engage in the cause of Chinese medicine and contribute to the development of Chinese medicine.	0.86		
Caring for and respecting patients and serving them wholeheartedly.	0.834		
Willing to explain and guide Chinese medicine related knowledge and technology to others.	0.833		
Keep learning actively and think that learning is endless.	0.718		
In the face of adversity such as failure, difficulties, setbacks, etc., bravely move forward.	0.692		
Plan and implement your own schedule.	0.654		
Guided by Chinese medicine thinking, solve scientific research and clinical problems		0.793	
Master common scientific research ideas and methods.		0.766	
Be familiar with the operation of data analysis software, process raw data and make relevant statistical analysis.		0.765	
Proceed from practical problems, search for relevant materials, design research plans and carry out scientific research.		0.747	
Handle common clinical diseases, frequently-occurring diseases or some critical diseases under the guidance of superior doctors.		0.699	
Master the professional knowledge of TCM at present.		0.655	
Constantly study and understand the traditional theory of TCM		0.651	

Item Variables and Item	Factor 1	Factor 2	Factor 3
Master the knowledge of humanities and social sciences and traditional culture.		0.618	
Find like-minded partners and solve some problems through teamwork.			0.771
Unite team members, make a reasonable overall plan and lead the team to achieve the goal.			0.769
Flexible handling of emergencies			0.752
Good written expression skills.			0.742
Good oral skills.			0.71
In-depth analysis and evaluation of the logic of knowledge/viewpoint, and reasonable questioning of theoretical knowledge and clinical problems.			0.641
Communicate effectively with classmates, teachers, patients and their families.			0.621

Note: extraction method: principal component analysis; Rotation method: orthogonal rotation method with Kaiser standardization; A. the rotation converges after 7 iterations.

From the results of factor load, it can be seen that the corresponding relationship between each item and the common factor is clear and definite, and the educational achievements scale for undergraduates majoring in TCM has good structural validity. At the same time, according to the results of factor analysis, referring to the classification and naming methods of students' various achievements, we adjust the naming of factors and name factors 1-3 as Emotional Values, Professional Abilities and General Competencies respectively.