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RESEARCH ARTICLE

Influence of International Management Strategy and Curriculum on Traditional Chinese Medicine Curriculum: Preliminary Findings from Public Vocational Colleges in Shandong Province, China

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ABSTRACT

This study evaluated the effectiveness of pilot studies and data analysis methods in Traditional Chinese Medicine (TCM) curriculum systems at vocational colleges in Shandong, China. A pilot study involving 110 participants from two colleges was conducted to test the feasibility of larger trials and determine appropriate sample sizes, highlighting the importance of statistical foundations for successful studies. Data were collected using the Wen Juanxing platform and analyzed with SPSS and Smart PLS to evaluate the impact of international management strategies on TCM education. The dataset was cleaned for Exploratory Factor Analysis (EFA), which identified seven principal components related to the TCM curriculum system and educator capabilities. Reliability analysis showed high internal consistency for the instruments used. Discriminant validity was confirmed using the Fornell-Larcker criterion and the HTMT ratio, verifying the constructs' independence and relevance. This study emphasizes the essential role of pilot studies in educational research and demonstrates the need for a comprehensive analytical framework to effectively evaluate and refine TCM curriculum systems, utilizing SPSS and Smart PLS as crucial tools in the analysis process.

INTRODUCTION

According to de Moura et al. (2024), a pilot study is a small-scale preliminary inquiry designed to inform the structure of a larger final trial. Instead of evaluating treatment efficacy, it focuses on feasibility, such as determining the viability and methodology of a larger trial. Pilot studies are essential for increasing the likelihood of success for the main study by testing research instruments, providing valuable insights, and refining study methods. Additionally, the sample sizes of pilot studies significantly impact the determination of sample sizes for subsequent trials, ensuring that the study has sufficient statistical power and is conducted ethically (Wang et al., 2023).

For this study, the pilot sample was selected from Shandong College of Traditional Chinese Medicine and Qufu School of Traditional Chinese Medicine, consisting of 110 participants. Choosing an appropriate sample size for a pilot study is crucial for ensuring its effectiveness and the success of later primary studies. An external pilot study should ideally include at least 70 participants (35 per group) to accurately estimate the standard deviation in continuous outcomes (Sorzano et al., 2017). Obtaining a sufficient sample size in a pilot study is vital to acquire accurate measurements of unknown factors, guiding the development and organization of definitive trials. However, a pilot study with a sample size of 110 may be considered excessive, potentially leading to unnecessarily large definitive trials and inefficient allocation of resources.

2.0 LITERATURE REVIEW

Traditional Chinese Medicine (TCM) is integral to Chinese culture and healthcare and is gaining global attention. The education system for TCM, especially in vocational colleges, faces the challenge of incorporating international management strategies to achieve global standards and enhance cross-cultural competence. Ma (2021) emphasizes the need for a robust curriculum that deepens students' understanding of TCM culture, which enhances their humanistic literacy and core competencies. Similarly, Zhao and Guo (2021) suggest adapting the TCM curriculum to meet the needs of ethnic minorities by integrating essential medical curriculum components and optimizing teaching content to develop a practical and targeted training system for TCM professionals.

Zhao and Guo (2021) also highlight the importance of strong foreign language skills for TCM experts to promote TCM globally. They advocate for a curriculum system that boosts students' English skills related to TCM culture, thereby increasing their confidence and global communication abilities. Lei (2013) supports this view, emphasizing the need to reform the English for Specific Purposes (ESP) curriculum in postgraduate TCM education from an exam-oriented to an application-oriented approach, aimed at cultivating interdisciplinary talents with solid medical English skills. Chan et al. (2016) analyze factors that influence the curriculum structure for higher adult education in TCM, identifying key elements that impact curriculum quality and offering insights into structuring effective training programs. They argue that integrating international management strategies in the TCM curriculum at vocational colleges in Shandong, China, requires a comprehensive approach to curriculum development.

Further discussions by Xiaoxuan et al. (2023) focus on cultural and social adaptations in TCM education, underlining the significance of cultural competency. Zhao and Guo (2021) and Chen et al. (2016) discuss the linguistic and global communication dimensions, advocating for enhanced English proficiency to boost global engagement. Xue et al. (2015) propose a methodological approach to curriculum development, emphasizing data-driven decisions in higher adult education. Integrating international management strategies into the TCM curriculum in Shandong is pivotal for producing globally competent professionals. The reviewed studies offer valuable insights into various aspects of curriculum development, improving the educational experience, and preparing students to meet international standards. These strategies collectively enhance the global dissemination and practice of TCM, ensuring students are equipped to navigate the complexities of the global healthcare environment.

These preliminary findings suggest that the strategic inclusion of international management principles and curriculum development tailored to global standards significantly contributes to the evolution of TCM education in Shandong Province. This approach not only broadens the scope of TCM but also ensures that it remains a dynamic and globally relevant field.

3.0 DATA ANALYSIS

This study aimed to extract actionable insights from collected data to evaluate the effectiveness of international management strategies on the TCM curriculum system at vocational colleges in Shandong. Data were systematically gathered using the Wen Juanxing online platform and formatted for compatibility with SPSS for in-depth analysis. Utilizing both SPSS and Smart PLS tools, the analysis employed statistical and inferential methods to scrutinize the data. This comprehensive examination revealed how these management strategies impact educator capabilities and curriculum outcomes. The findings from this analytical phase were pivotal in assessing whether the study's objectives—understanding the influence of international management on the curriculum—were effectively met. This methodological approach progressed from data acquisition to nuanced analysis, ensuring the research aligns with established academic frameworks. The research process adhered to recognized academic standards by employing various qualitative traditions and analytical methodologies, from data collection to detailed analysis (Nassauer & Legewie, 2021).

3.1 Data Cleaning

Data cleansing is the process of identifying, correcting, or eliminating incorrect, erroneous, or outdated data from a dataset (Guo et al., 2023). In this study, the initial data cleansing involved examining for missing values, detecting outliers, and conducting normality tests. Missing data refers to instances where the value of a variable of interest has not been measured or documented in the dataset (Johnson et al., 2021). A total of 320 questionnaires were used in this study, and the data were inputted into SPSS 26.0. Among the respondents, 12 did not provide information about their international academic visits or intellectual exchanges within the previous three years. This absence could be due to the educators' lack of international travel experience or their unwillingness to respond to the question. As a result, these 12 cases were removed from the dataset, leaving 298 cases for analysis.

Data cleaning in SPSS involves addressing outliers and missing data, which is crucial for enhancing data quality and analysis accuracy (Guo et al., 2023). Various methodologies have been proposed to tackle these issues effectively (Guo et al., 2023). Initially, all the data were imported into SPSS, and the 'selecting case' function was used to identify all outliers and missing values. Subsequently, the 'replacing missing values' function was employed to substitute the outliers and missing values with the median or maximum value.

3.2 Demographic Information Analysis

Demographic information analysis is crucial for regional development planning, public policy formulation, and socio-economic decision-making. By leveraging demographic databases integrated with spatial information systems, as demonstrated in Indonesia (Chandrashekar et al., 2022), challenges such as data synchronization between central and local governments and improving the precision of population statistics can be addressed. Demographic analysis involves both the statistical investigation of population data and understanding the causes and consequences of population changes within a broader sociocultural context (Chandrashekar et al., 2022). Table 3.1 provides a detailed analysis of demographic information based on the questionnaire responses.

Table 3.1: Demographic Information of the Participant in the Pilot Study (N=110)

Variables		**Frequency**	**Percent**	**Cumulative Percent**
Gender	Male	58	52.7	52.7
	Female	52	47.3	100.0
Age	20-30	27	24.5	24.5
	31-40	54	49.1	49.1
	41-50	20	18.2	18.2
	51-60	6	5.5	5.5
	Over 60	3	2.7	2.7
Department	International Management Department	11	10.0	10.0
	Secondary Department	71	64.5	64.5
	Other Department	28	25.5	25.5
Primary Teaching Responsibilities	TCM-related courses	37	33.6	33.6
	Pharmacology-related courses	20	18.2	18.2
	Acupuncture and massage-related courses	19	17.3	17.3
	International courses	2	1.8	1.8
	Language courses	7	6.4	6.4

	Other courses	25	22.7	22.7
Academic Title	Teaching Assistant	34	30.9	30.9
	Lecturer	53	48.2	48.2
	Associate Professor	16	14.5	14.5
	Professor	7	6.4	6.4
Workplace	Shandong College of Traditional Chinese Medicine	101	91.8	91.8
	Qufu School of Traditional Chinese Medicine	9	8.2	8.2
Time Spent Abroad for Study Visits or Academic Exchanges in the Last Three Years	None	59	53.6	53.6
	1-6 months	35	31.8	31.8
	More than 6 months	16	14.5	14.5
	Total	110	100.0	100.0

From Table 3.1, the demographic information of the participants can be summarized as follows. The demographics indicated a higher proportion of female participants (52.7%) compared to male participants (47.3%). The demographic data included seven questions: gender, age, department, primary teaching responsibilities, academic title, workplace, and time spent abroad for study visits or academic exchanges. Among the participants, 49.1% were within the 31-40 age range, indicating that the majority were young to middle-aged individuals. Most teachers were from the Secondary Department, with 37 participants responsible for TCM-related courses. Additionally, 48.2% of the teachers held an intermediate professional title. The majority of participants were from Shandong College of TCM (101 participants), while only nine teachers were from Qufu School of TCM. Furthermore, most participants did not have experience abroad for study visits or academic exchanges in the past three years.

3.3 Exploratory Factor Analysis

Before conducting Exploratory Factor Analysis (EFA), it is essential to evaluate the Kaiser-Meyer-Olkin (KMO) value and perform Bartlett's Test of Sphericity. According to Kaiser and Rice (1974) (Williams et al., 2023), a KMO value above 0.90 is classified as excellent, values in the 0.80s are commendable, values in the 0.70s are average, values in the 0.60s are mediocre, and values in the 0.50s are poor. Values below 0.50 are considered inadequate for factor analysis due to an insufficient sample size. Bartlett's Test of Sphericity, as emphasized by Pallant (2020) (Hao et al., 2023), assesses the discrepancy between the correlation matrix and an identity matrix. A statistically significant result ($p<.05$) suggests strong correlations between variables, indicating that the dataset is suitable for factor analysis. These initial evaluations are crucial for ensuring the strength and accuracy of the subsequent factor analysis procedure.

Table 3.3: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**0.835**
Bartlett's Test of Sphericity	Approx. Chi-Square	3034.085
	df	861
	Sig.	0.000

Table 3.3 shows that the KMO value was 0.835, which is considered excellent according to Kaiser and Rice (1974). Bartlett's Test of Sphericity was also statistically significant with $p = 0.000$ ($p < 0.05$), indicating that the sample size was adequate and suitable for factor analysis. In this study, factor extraction in SPSS 26 was performed using the principal component method, which aligns with standard data reduction techniques (Arije et al., 2023). To enhance the interpretability of the results, a direct oblimin rotation method was applied after extraction to interpret the components, due to their predicted strong association (George et al., 2021).

Exploratory Factor Analysis (EFA) is frequently utilized in various studies to uncover latent dimensions within different contexts. Data cleansing is a crucial step in EFA to ensure the precision and reliability of the outcomes. Researchers can enhance the quality of large datasets, such as the U.S. Food and Drug Administration adverse event reporting system (FAERS) database, by employing data cleaning tools, human correction approaches, and programming scripts (Fusaroli et al., 2023). Best practices in data cleaning emphasize early error prevention, diligent identification of errors throughout data collection and analysis, and comprehensive documentation of all cleaning procedures (Liotta et al., 2023).

Following the analysis of EFA results, we obtained the factor loadings for all variables. The loadings of these variables on principal components reflect their contribution to the total variance in the dataset, with values above 0.4 indicating a significant association (Kim, 2021). According to the EFA results, most of the questionnaire items demonstrated good validity and reliably assessed the various hypothesized variables affecting the internationalization of the curriculum system. During the assessment, three items were eliminated, retaining 42 items for subsequent reliability analysis. To assess the internal consistency of the questionnaire, the Cronbach's alpha coefficient was calculated. Following Williams et al. (2023), the Cronbach's alpha values and reliability levels were obtained, as shown in Table 3.11. These steps ensured the scientific rigor and accuracy of our research tools.

From Table 3.12, it can be concluded that IP3 was extracted as a single principal component, and CM2 was also extracted as a single principal component. The loading of IIP4 on all principal components was less than 0.4, while the loading of CI3 on both principal components was greater than 0.4. After removing IP3, CM2, and IIP4, EFA was performed again. Removing these items before EFA allowed for a more precise analysis of the remaining variables, potentially revealing additional aspects of the data structure. Table 3.2 demonstrates the results after the deletion of IP3, CM2, and IIP4.

Table 3.2: EFA Analysis of Internationalization Strategy Scale for TCM Curriculum

Rotated Component Matrixa							
	Component						
Variables	1	2	3	4	5	6	7

IS1			0.848				
IS2			0.750				
IS3			0.799				
IS4			0.697				
IS5			0.653				
IS6			0.782				
IP1				0.815			
IP2				0.692			
IP5				0.769			
IP6				0.848			
IP7				0.712			
IIP1				0.698			
IIP2							0.741
IIP3							0.808
IIP4							0.650
IIP5							0.648
IIP6							0.771
EC1	0.826						
EC2	0.783						
EC3	0.766						
EC4	0.719						
EC5	0.788						
EC6	0.783						
EC7	0.774						
CI1					0.743		
CI2					0.803		
CI3					0.713		
CI4					0.804		
CI5					0.666		
CI6					0.757		
CC1		0.747					
CC2		0.761					
CC3		0.789					

CC4		0.744					
CC5		0.768					
CC6		0.746					
CM1						0.758	
CM3						0.791	
CM4						0.803	
CM5						0.563	
CM6						0.703	
CM7						0.808	
Total	4.800	4.360	4.307	4.013	3.992	3.727	3.169
% of Variance	11.429	10.380	10.255	9.555	9.506	8.874	7.545
Cumulative %	11.429	21.809	32.064	41.619	51.125	59.999	67.544
Extraction Method: Principal Component Analysis. **Rotation Method: Varimax with Kaiser Normalization.a** **a. Rotation converged in 7 iterations.**							
Note: IS: International System, IP: International Planning, IIP: International Inspiration Policy, EC: Educators' Capability, CI : Curriculum Implementation, CC: Curriculum Content, CM: Curriculum Management							

The process of repeated component extraction and removal reveals underlying patterns and correlations within the dataset, enhancing our understanding of its complexity and structure (Zou et al., 2021). Wang et al. propose a compositional data feature extraction method that maintains constraints while decorrelating components, effectively reducing dimensionality. This method has been validated using both synthetic and real-world datasets (Ilin et al., 2006). Table 3.3 presents the results following the removal of three items. The analysis identified seven principal components, aligning with our theoretical expectations. Notably, the cumulative variance explained by these components reached 67.544%. In exploratory factor analysis (EFA), this cumulative percentage represents the proportion of variance in the observed variables accounted for by the identified latent components (Omura et al., 2022).

3.5 Reliability of Research Instrument

Assessing the internal consistency reliability of research instruments is crucial for ensuring accurate and consistent measurements. Recent studies have utilized various techniques to evaluate reliability, including Cronbach's alpha, rho_C, and composite reliability, with a common threshold of 0.7 for acceptable reliability (Zhao et al., 2024). For instance, a study on college student athletes found that questionnaires assessing mental health aspects such as strain, anxiety, and depression demonstrated reliable internal consistency, with acceptable to superior reliability levels (Kullan et al., 2022). Similarly, research on learning

organization instruments in primary schools revealed excellent reliability as indicated by Cronbach's alpha values, suggesting consistent measurement of learning organization practices (Azizam et al., 2022). These findings underscore the importance of using dependable tools to ensure accurate and uniform study results. Table 3.11 below presents the reliability measures for the three research instruments used in this study.

Table 3.11: The Reliability of Scales

Construct reliability and validity			
	Cronbach's alpha	Composite reliability (rho_c)	Average variance extracted (AVE)
Content	0.902	0.924	0.670
Educators' Capabilities	0.916	0.933	0.665
Implementation	0.881	0.910	0.628
Incentive Policy	0.841	0.887	0.611
International Management Strategies	0.910	0.923	0.631
Management	0.879	0.908	0.623
Planning	0.888	0.914	0.641
System	0.912	0.932	0.694
TCM Curriculum System	0.904	0.917	0.599

The results in Table 3.11 demonstrate strong internal consistency for the latent variables in this study. Cronbach's alpha values ranged from 0.841 to 0.916, while Composite reliability values ranged from 0.887 to 0.933. Both measures exceed the common threshold of 0.7, indicating high reliability of the research instruments.

These findings align with reliability evaluations in various research contexts. However, recent studies emphasize the importance of considering multiple criteria beyond the single 0.7 threshold for Cronbach's alpha (Karakaya & Alparslan, 2022). To ensure robust reliability assessment, it is crucial to analyze inter-item correlation matrices, means, standard deviations, item count, and findings from prior research.

Table 3.12 presents the values of outer loadings, which likely refers to the factor loadings or indicator loadings in the context of structural equation modeling or factor analysis. These loadings provide additional insight into the relationship between individual items and their respective latent constructs, further supporting the reliability and validity of the research instruments used in this study.

Table 3.14 : Outer Loadings

Variables	**Content**	**Educators' Capabilities**	**Implementation**	**Incentive Policy**	**Management**	**Planning**	**System**
CC1	0.828						
CC2	0.800						
CC3	0.851						
CC4	0.779						
CC5	0.830						

CC6	0.823						
CI1			0.806				
CI2			0.810				
CI3			0.746				
CI4			0.834				
CI5			0.764				
CI6			0.794				
CM1					0.763		
CM3					0.806		
CM4					0.789		
CM5					0.743		
CM6					0.835		
CM7					0.798		
EC1		0.841					
EC2		0.801					
EC3		0.781					
EC4		0.806					
EC5		0.790					
EC6		0.805					
EC7		0.881					
IIP1				0.779			
IIP2				0.813			
IIP3				0.816			
IIP5				0.741			

IIP6				0.757			
IP1						0.834	
IP2						0.797	
IP4						0.740	
IP5						0.865	
IP6						0.811	
IP7						0.751	
IS1							0.859
IS2							0.805
IS3							0.875
IS4							0.808
IS5							0.811
IS6							0.839
Note: IS: International System, IP: International Planning, IIP: International Inspiration Policy, EC: Educators' Capability, CI ： Curriculum Implementation, CC: Curriculum Content, CM: Curriculum Management							

Table 3.12, which displays the outer loadings, provides valuable insights into the measurement model's quality. The factor loadings for each item range from 0.740 to 0.881, all exceeding the recommended threshold of 0.7 (Tao et al., 2019). These strong loadings suggest that the latent variables have a robust ability to explain their corresponding observed items. This finding aligns with the concept of latent component models, where hidden factors play a crucial role in explaining observed variables (Tao et al., 2019). The consistency of these high factor loadings across all items indicates a well-constructed measurement model, demonstrating that each observed variable effectively represents its intended latent construct. This result strengthens the overall validity and reliability of the research instrument, providing a solid foundation for further analysis and interpretation of the study's findings.

3.6 Validity of the Research Instruments

Ensuring discriminant validity is crucial in research involving latent variables to avoid issues with multicollinearity. The Fornell and Larcker criterion is a widely used method for assessing discriminant validity (Karakaya & Alparslan, 2022). Table 3.12 below presents the values of the Fornell-Larcker criterion for this study.

Table 3.12: Fornell-Larcker criterion

Variables	Content	Educators' Capabilities	Implementation	Incentive Policy	Management	Planning	System
Content	0.819						
Educators' Capabilities	0.426	0.816					
Implementation	0.385	0.332	0.793				
Incentive Policy	0.262	0.337	0.328	0.782			
Management	0.461	0.309	0.345	0.307	0.789		
Planning	0.321	0.256	0.229	0.354	0.214	0.801	
System	0.364	0.311	0.401	0.488	0.309	0.500	0.833
Note: The diagonal boldface represents the square root of the average value of each dimension.							

Assessing discriminant validity is crucial in structural equation modeling to ensure that constructs are distinctly separate. The principle states that the square root of the Average Variance Extracted (AVE) for each latent variable should exceed its correlation coefficient with other latent variables (Matthes & Dwayne, 2019). Table 3.13 confirms this criterion for our data, demonstrating discriminative validity. However, recent studies suggest that traditional methods like the Fornell-Larcker criterion and cross-loadings evaluation may not always detect discriminant validity issues (Henseler et al., 2015). In response, researchers have proposed the heterotrait-monotrait (HTMT) ratio of correlations as a more reliable alternative (Rönkkö & Cho, 2022; Henseler et al., 2015). This method addresses potential shortcomings of traditional approaches. Table 3.14 below presents the HTMT values for our study, offering an additional perspective on the discriminant validity of our constructs.

Table 3.16 : Discriminant Validity -- HTMT

	Content	Educators' Capabilities	Implementation	Incentive Policy	Management	Planning	System
Content							
Educators' Capabilities	0.458						
Implementation	0.426	0.360					
Incentive Policy	0.295	0.368	0.378				
Management	0.505	0.336	0.379	0.341			
Planning	0.356	0.279	0.259	0.402	0.230		
System	0.400	0.337	0.447	0.546	0.338	0.544	

Table 3.14 concludes that the HTMT (Heterotrait-Monotrait) values for each latent variable, in comparison to other latent variables, are below the threshold of 0.85. This indicates that the data demonstrate discriminant validity. To verify that the HTMT values are indeed less than 0.85, one can use structural equation modeling approaches like the Loglinear Model, Latent Class Model, and Latent Variable Models for Longitudinal Data, as suggested by Torres-Narváez et al. (2018). Accurately assessing the HTMT values involves a thorough review of the statistical methods and approaches detailed in the referenced research articles (Cao, 2023).

In SmartPLS, the R Square value measures the proportion of variance in the dependent variable explained by the independent variables within a structural equation model. This metric indicates how well the model predicts the variability in the dependent variable, with higher values suggesting greater predictive

effectiveness (Anwar & Siswanto, 2020). Table 3.15 illustrates that the R Square values accounted for 13.3% and 32.6% of the variance in the respective variables.

Table 3.17 : R-square

	R-square	R-square adjusted
Educators' Capabilities	0.141	0.133
TCM Curriculum System	0.339	0.326

3.7 CONCLUSION

This study successfully evaluated the effectiveness of pilot studies and data analysis methods within Traditional Chinese Medicine (TCM) curriculum systems at vocational colleges in Shandong, China. By conducting a pilot study with 110 participants from two colleges, the feasibility of larger trials and the determination of appropriate sample sizes were tested, underscoring the significance of a strong statistical foundation for successful studies. Data collection through the Wen Juanxing platform, followed by analysis using SPSS and Smart PLS, provided valuable insights into the impact of international management strategies on TCM education.

The Exploratory Factor Analysis (EFA) identified seven principal components related to the TCM curriculum system and educator capabilities, ensuring a comprehensive understanding of the system's dynamics. Reliability analysis confirmed the high internal consistency of the instruments used, while discriminant validity, established through the Fornell-Larcker criterion and the HTMT ratio, verified the constructs' independence and relevance.

This study contributes significantly to stakeholders, including educational administrators, curriculum developers, and policymakers, by providing a validated framework for assessing and refining TCM curriculum systems. The insights gained from the analysis help in understanding the impact of international management strategies, thereby guiding strategic decisions to enhance educational outcomes. Additionally, the study's methodology offers a replicable model for similar educational research, promoting data-driven improvements in vocational education. The use of SPSS and Smart PLS as analytical tools underscores their value in educational research, facilitating robust and reliable data analysis that stakeholders can trust for informed decision-making.

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