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Measuring what matters: Evaluating the validity and reliability of teachers' competency scales in China

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Abstract: This study aims to assess the validity and reliability of teacher competency scales in China, focusing on the Chongqing region. Adopting a cross-sectional survey design, the study utilizes Hay McBer's teacher-teaching competency model to evaluate three key domains: Value of Teacher Professionalism (VTP), Teaching and Learning Skills (TLS), and Classroom Climate (CC). A sample of 200 teachers was surveyed, and data were analyzed using Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) through IBM SPSS and SEM AMOS programs. The methodology involved developing and validating a questionnaire based on expert consultations regarding face validity and content reliability (Cronbach's alpha). The findings reveal high reliability and validity across all dimensions, supported by strong expert consensus. EFA indicated that the first three components explained 87.944% of the total variance, with the primary component accounting for 80.552%. CFA confirmed the constructs' validity and reliability, with high loading factors, AVE, and CR values. The model fit indices suggested an adequate fit, with RMSEA within the acceptable range and strong incremental fit indices. This study provides a reliable and valid framework for assessing teacher competency in China, with practical implications for educational policy and teacher training programs.
Keywords: *Professional development, Teachers' competency, Teaching skill.*

1. Introduction

Teachers play an important role in encouraging both academic success and character development in children, therefore their competency is critical for obtaining great educational results. Globally, education changes rely greatly on active teacher participation, as evidenced by several policies and programs aiming at increasing teaching quality, such as China's 14th Five-Year Plan and the 'Double Reduction' strategy [1-3]. Research regularly demonstrates a strong relationship between teaching competence and student performance, emphasizing the importance of ongoing professional development and successful teaching practices [4-6]. However, while attempts to improve teacher competency have progressed, issues such as increased workload and burnout remain major problems [1, 3].

Research on teaching competency has evolved through four stages, focusing initially on experience-based studies, then on psychological and empirical research, and later integrating legal and national theories [7]. In China, the focus has shifted from merely enhancing academic achievement to a more holistic approach that includes student well-being and teacher development [8, 9]. Teachers' competency encompasses several aspects: knowledge conveyance, lesson organization, classroom management, and interactions involving content knowledge, pedagogical principles, and self-management skills [10]. It also involves planning, teaching, assessment, professional knowledge, and interpersonal skills [11-13].

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Chinese scholars regard teaching competency as crucial for achieving educational goals, emphasizing the integration of information technology into teaching. International research highlights the importance of interpersonal relationships, formal training, stress reduction, and continuous professional development [14-17]. In China, there is a focus on government roles, supportive environments, and personal qualities in enhancing teaching competency [2, 18, 19]. Overall, teaching competency is influenced by reflective abilities, training, assessment orientation, and organizational culture [20-24]. The study aims to validate a method for assessing teaching competency, specifically in Chongqing, China.

2. Methodology

This quantitative study used a cross-sectional survey design with a questionnaire based on McBer [25] teacher-teaching competency model, distributed to 200 teachers in Chongqing. The questionnaire measured three dimensions: Value of Teacher Professionalism (VTP), Teaching and Learning Skills (TLS), and Classroom Climate (CC). Validation included face and content validity through consultations with experts, while reliability was assessed using Cronbach's alpha, targeting a minimum of 0.7. Exploratory Factor Analysis (EFA) was conducted to confirm validity, with criteria from Tabachnick and Fidell [26] including significant Bartlett's Test of Sphericity ($p < 0.05$), a KMO value > 0.5, factor loadings > 0.5, communalities ≥ 0.5, eigenvalues ≥ 1.0, and explained variance > 60%. Confirmatory Factor Analysis (CFA) further validated the model, with factor loadings ideally around 0.708, AVE > 0.5, and Composite Reliability (CR) > 0.708 [27]. Model fit was evaluated using Chi-Square (CMIN), Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), Parsimony Normed Fit Index (PNFI), and Parsimony Comparative Fit Index (PCFI) with criteria from Byrne [28] and Meyers, et al. [29]. All data analyses were performed using IBM SPSS and Structural Equation Modeling (SEM) AMOS.

3. Finding and Discussion

3.1. Face and Content Validity

The English questionnaire was translated into Chinese by a linguistics expert initially. Following the forward translation, two further experts who were blind to the original English version back-to-back translated it into English, and any disagreements or loss of meaning were investigated. This back-translated English was assessed for concordance with the original in terms of meaning, grammar, and language style. Three experts in translation were involved: Expert A, who has over 20 years of experience at Chongqing University with educational leadership, and Experts B & C from the Chongqing Institute of Educational Sciences. Expert A recommended that exam-related content, job titles, etc., should be removed and sentences be made in Active Voice for all readable formats. Expert B recommended reducing jargon and complex words; Expert C emphasized easier recognition from the workplace, clearer introduction of a dimension, and simpler sentences.

The questionnaire was subjected to face and content validity by three educational leadership experts as it relates to accuracy and relevance to the inquiry questions, respectively. We defined two to ten experts in our selection, as suggested by Davis and Lynn. There were three experts with more than ten years of service experience, including Expert A (Universiti Malaysia Terengganu – Educational Leadership Communication), Expert B (Institut Aminuddin Baki Sri Layang), and Expert C (Universiti Pendidikan Sultan Idris). Expert A also warned against double-barreled questions, while Expert B said to write clearly and avoid redundancy. Expert C agreed with semantic alterations for clarity, e.g., rewording "Garners community support" as "Community engagement."

3.2. Expert Consensus

Fuzzy Delphi Method (FDM) data needs to be based on the threshold value (d) and at the same time meet the agreed percentage. The threshold value (d) of each constructed tested should be less than or equal to 0.2 [30, 31]. On the other hand, the percentage value of expert agreement should be greater

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than or equal to 75 percent [32, 33]. Table 1 shows the values of Threshold (d), the percentage of expert consensus for the main dimension of teachers' competency.

Table 1.
The values of Threshold (d), percentage of expert consensus for each dimension of teachers' competency.

No.	Dimension	Threshold Value (d)	Percentage of Expert Consensus	Expert Consensus
1	Value Of Teacher Professionalism	0.076	100.0%	Accepted
2	Teaching And Learning Skills	0.122	83.3%	Accepted
3	Classroom Climate	0.082	100.0%	Accepted

Referring to Table 1, the analysis is based on two parameters: a threshold value ($d \leq 0.2$) and an expert agreement level. The dimension "Value of Teacher Professionalism" had a threshold (d) = 0.076 with an expert consensus of 100%, indicating very high agreement between experts regarding its relevance. The threshold (d) for the "Teaching and Learning Skills" dimension was 0.122 with an expert consensus of 83.3%, which satisfies both requisites, confirming its importance despite variability in expert opinions. The " Classroom Climate " dimension, with a threshold (d) = 0.082 and expert consensus of 100%, had a complete agreement in terms of its relevance. In conclusion, all three FDM dimensions were met, underpinning their importance in evaluating teacher competency. These findings provide further validation for including these dimensions in frameworks for assessing teachers, emphasizing their role in professional development and educational policy.

Next, table 2 shows the values of Threshold (d), the percentage of expert consensus for each item in constructs.

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Table 2.
The values of Threshold (d), percentage of expert consensus for each item.

Item	Item statement	Values of Threshold, d	Percentage of Expert Consensus	Expert Consensus
VTP1	I feel a strong sense of belonging to my school	0.076	100.0%	Accepted
VTP2	I will adopt appropriate teaching methods according to the students' academic level	0.042	100 %	Accepted
VTP3	I am confident in my ability to teach effectively	0.068	100.0%	Accepted
VTP4	I excel in teaching effectively	0.042	100.00%	Accepted
VTP5	I consistently provide accurate feedback based on teaching situations	0.068	100.00%	Accepted
VTP6	I frequently reflect on my teaching practices	0.026	100.00%	Accepted
VTP7	The internet assists me in developing lesson plans and instructional strategies	0.042	100.00%	Accepted
TLS1	I am knowledgeable about various learning theories	0.016	100.00%	Accepted
TLS2	I consistently select teaching techniques based on the syllabus	0.068	100.00%	Accepted
TLS3	I always listen to and respond to students' questions	0.122	83.33%	Accepted
TLS4	I consistently identify and correct students' misunderstandings of course content	0.042	100.00%	Accepted
CC1	I always assess students' understanding of the course through tests and quizzes	0.016	100.00%	Accepted
CC2	I always listen to students' questions, ideas, and suggestions	0.068	100.00%	Accepted
CC3	I always provide feedback on students' questions	0.122	83.33%	Accepted
CC4	After class, I always communicate with students through social media apps such as WeChat, QQ, DingTalk, etc.	0.042	100.00%	Accepted

Referring to Table 2, all the proposed indicator items reached a Threshold value (d) of less than 0.2 and exceeded 75% of the expert consensus. The analysis shows a high level of expert consensus across the VTP, TLS, and CC categories, with most items achieving 100% agreement and low threshold values (d) between 0.016 and 0.076, indicating strong acceptance and validity. For the VTP items, all seven achieved unanimous expert agreement (100%), confirming their relevance and robustness. In the TLS category, three out of four items reached 100% consensus, while TLS3 had a slightly lower agreement (83.33%) and a higher threshold value of 0.122, suggesting minor discrepancies requiring refinement. Similarly, in the CC items, three items reached 100% consensus, while CC3 also had 83.33% consensus and a threshold value of 0.122, indicating a need for clarification. Overall, the findings demonstrate strong content validity, with high levels of expert agreement and low threshold values. The lower consensus on TLS3 and CC3 suggests areas for improvement, such as refining wording or providing additional context to enhance clarity and alignment.

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3.3. Respondents Demographic

Initially, 200 data points were collected, but only 187 met the criteria for further analysis after normality tests. Most respondents are female (83.4%), with males making up 16.6%. Regarding experience, 32.65% have 1 to 5 years, and 29.4% have more than 20 years. Smaller groups include those with 6-10 years (20.9%), 11-15 years (11.2%), and 15-20 years (5.9%) of experience. Most respondents hold a bachelor's degree (88.8%), while a smaller percentage have a master's degree (9.1%) or an associate degree or below (2.1%).

3.4. Reliability Analysis

A reliability analysis using Cronbach's Alpha was conducted to evaluate the consistency of the instruments used in this study. All constructs demonstrated excellent internal consistency, with Cronbach's Alpha values well above the recommended threshold of 0.9. Specifically, Value of Teachers' Professionalism had a Cronbach's Alpha of 0.972, indicating very strong reliability across seven items. Teaching and Learning Skills had a Cronbach's Alpha of 0.950, and classroom climate had a Cronbach's Alpha of 0.922, both reflecting high reliability. These results confirm that the instruments used are reliable for measuring teacher effectiveness and professional development. Reliability statistics are summarized in Table 3.

Table 3.
Summaries of reliability statistic.

Dimension	Construct	Cronbach's Alpha	No. of Items
	Value of Teacher Professionalism	0.972	7
	Teaching and Learning Skills	0.950	4
	Classroom Climate	0.950	4
Teachers Competency		0.982	15

3.5. Exploratory Factor Analysis (EFA)

The KMO value of 0.946 indicates an excellent sample size and strong correlations among variables, making the dataset highly suitable for factor analysis. Bartlett's Test of Sphericity shows a chi-square of 5494.971 (df = 120, $p < 0.000$), confirming significant correlations among variables. These findings show that the data is ideal for discovering dominating patterns using factor analysis.

Table 4.
The KMO and Bartlett's Test of teacher's teaching competency.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.918
Bartlett's Test of Sphericity	Approx. Chi-Square	4827.939
	df	105
	Sig.	0.000

The suitability of the data for factor analysis can be ascertained based on results presented in Table 4 of the Kaiser-Meyer-Olkin (KMO) Measure and Bartlett's Test of Sphericity.The KMO value is well above the threshold of .918. We have a Kaiser–Meyer–Olkin measure of sample adequacy of .70, signifying that the number in our data set is large enough for factor analytic approaches. A KMO value above .90 is considered "wonderful," according to Holcomb [34] meaning that there is a substantial amount of variance shared between the variables, and it would be feasible for factoring. The value obtained from Bartlett's Test of Sphericity is Chi-Square = 4827.939 (df=105, $p < .000$). The significant result ($p < .05$) indicates that all entries in the correlation matrix are different from 1, confirming that there are indeed relationships among these variables and not an identity matrix. Finally, these results validate that the dataset is proper for factor analyses. In general, both the KMO measure and Bartlett test indicate that the data collected to assess teachers' teaching competency is acceptable for factor analysis. A good KMO value shows we have a large enough sample, and Bartlett's test is significant, suggesting that the structure of our data yields meaningful factors.

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3.6. Confirmatory Factor Analysis

The analysis reveals three main constructs from the data using Confirmatory Factor Analysis (CFA) which are values of teachers' professionalism (VTP), teaching and learning skills (TLS), and classroom climate (CC). Each construct has multiple items, and several statistics, including loading factors, Average Variance Extracted (AVE), Composite Reliability (CR), and Square Root of AVE (SQ*R* AVE), were provided to assess their measurement properties. These results are key to determining if the constructs are strong and can be taken forward for more analysis related to the construct demonstrated in Table 5. Generally, these statistics confirm that the VTP, TLS, and CC constructs are reliable and valid measures within the model, with strong evidence of item reliability, convergent validity, internal consistency, and discriminant validity.

Table 5.
The values of loading factor, AVE, CR, and square root AVE.

Items	Loading Factor	AVE	CR	SQ AVE
VTP1	0.857	0.839	0.973	0.915
VTP2	0.907			
VTP3	0.915			
VTP4	0.918			
VTP5	0.902			
VTP6	0.952			
VTP7	0.957			
TLS1	0.935	0.830	0.956	0.919
TLS2	0.928			
TLS3	0.975			
TLS4	0.830			
CC1	0.990	0.814	0.945	0.902
CC2	0.992			
CC3	0.777			
CC4	0.873			

3.7. Value of Teachers' Professionalism (VTP)

The VTP construct, which includes seven items (VTP1 to VTP7), has high loading factors (0.857 to 0.957), indicating a good fit for measuring the construct. With an AVE of 0.839, it meets the convergent validity threshold, indicating that the underlying characteristic accounts for the majority of the variance. The Composite Reliability (CR) of 0.973 indicates strong internal consistency. The Square Root of AVE (SQAVE) is 0.916, confirming discriminant validity and demonstrating that VTP is a separate construct with little overlap with other variables.

3.8. Teaching and Learning Skill (TLS)

The TLS construct consists of four components (TLS1–TLS4), with loading factors ranging from 0.830 to 0.975. These high values suggest substantial correlations between each item and the TLS construct, proving the item's reliability. The AVE of 0.830 is above the 0.5 threshold, indicating convergent validity. The Composite Reliability (CR) of 0.956 indicates strong internal consistency, while the Square Root of AVE (SQAVE) of 0.919 validates discriminant validity, suggesting that TLS differs from other constructs.

3.9. Classroom Climate (CC)

The CC construct, which consists of four items (CC1–CC4), exhibits significant measuring features. Loading factors range between 0.777 and 0.992, showing that all components provide a considerable contribution to the construct. The AVE of 0.814 validates convergent validity, and the Composite Reliability (CR) of 0.945 shows strong internal consistency. The Square Root of AVE (SQAVE) of 0.902 supports discriminant validity, suggesting that CC stands out from the other constructs in the model.

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3.10. Construct Validity

To assess construct validity, several model fit criteria are used: the Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), and Chi-square to degrees of freedom ratio (Chisq/df). As shown in Table 6, the RMSEA value is 0.093, slightly above the ideal threshold of 0.06 but within the acceptable range, suggesting a moderate fit. Values between 0.08 and 0.10 often indicate a model that is acceptable but may benefit from refinement. Incremental fit indices also showed favorable results. The CFI was 0.973, reflecting an excellent fit (values above 0.90 indicate a good fit). The Normed Fit Index (NFI) of 0.960 further supports this, indicating strong model performance compared to a baseline. Chisq/df ratio was 2.843, which is within the acceptable range, suggesting a reasonable balance between model complexity and fit (with values up to 3 considered acceptable). Overall, these indices suggest that the model has a reasonable fit, with strong incremental fit indices indicating good performance relative to alternative models. However, slight improvements may be considered based on the RMSEA value.

Table 6.
Teachers' Competency Model Fitness Index.

Category	Index	Index value	Result
Absolute fit	RMSEA	0.094	The required level is achieved
Incremental fit	CFI	0.973	The required level is achieved
	NFI	0.960	The required level is achieved
Parsimonious fit	Chisq/df	2.843	The required level is achieved

Finally, this study successfully developed the final measurement model of teachers' competency as illustrated in Figure 1. Table 7 summarises the accepted item indicators for the teachers' competency scale.

Table 7.
The summary of accepted item indicators.

Dimension	Construct	No. of items propose	Accepted Item
Teachers Competency	Value of Teacher Professionalism	7	7
	Teaching and Learning Skills	4	4
	Classroom Climate	4	4
	Total	15	15

Referring to Table 7, the approval of all 15 proposed items within the three fundamental constructs demonstrates the effectiveness of the evaluation framework. This demonstrates that the evaluation appropriately addresses critical aspects of teacher competency, providing a comprehensive perspective on teacher competency. By taking such a thorough approach, the framework guarantees that all areas of teaching are covered, from professionalism and instructional abilities to classroom management, supporting improved teaching practices and increasing student accomplishment.

In conclusion, our study successfully created a rigorous teacher competency evaluation method. The adoption of all proposed criteria demonstrates the evaluation's value in evaluating important aspects of teacher performance, thereby assisting educators in their professional development and adding to their overall classroom effectiveness.

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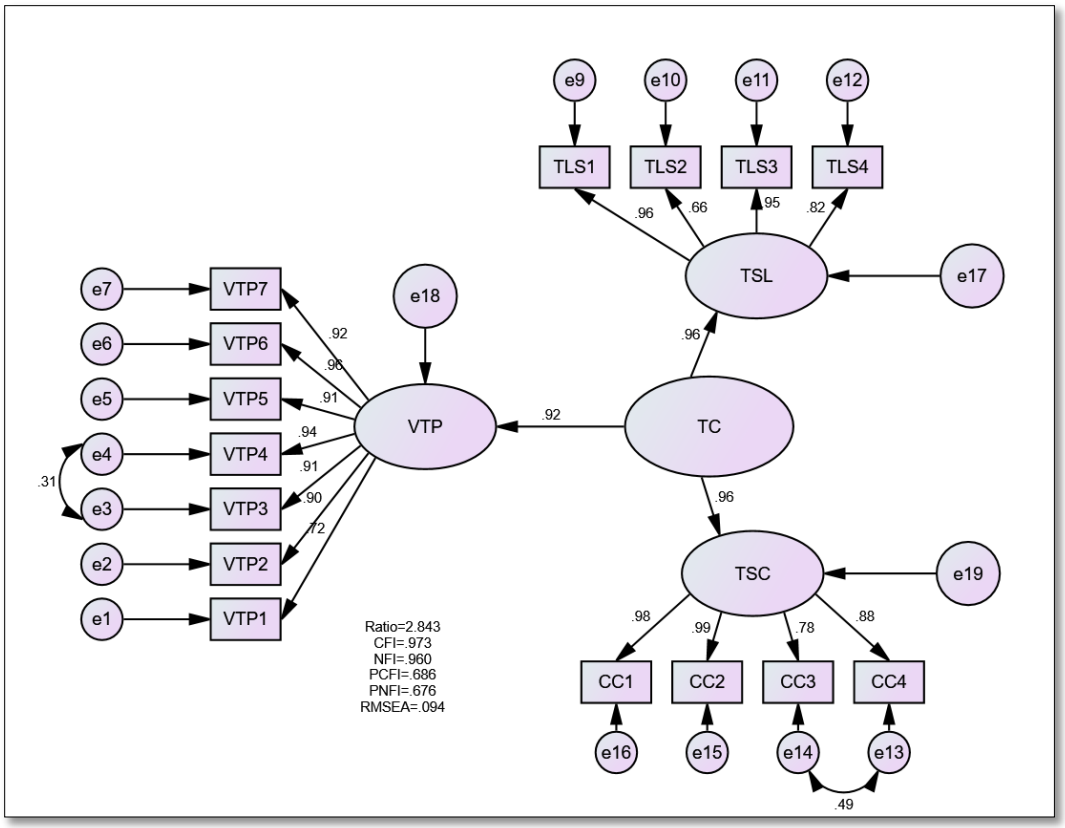

Figure 1.
The final measurement model of teachers' competency.

4. Conclusion

In conclusion, this study successfully validates the teacher competency scales in China, specifically in Chongqing, using Hay McBer's teacher-teaching competency model. The research highlights three key dimensions: Value of Teacher Professionalism (VTP), Teaching and Learning Skills (TLS), and classroom climate CC). The rigorous methodology, including face and content validity consultations with experts and reliability assessments using Cronbach's alpha, ensures the robustness of the findings. Both Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) confirm the high reliability and validity of the constructs, with strong expert consensus supporting the relevance of the competency indicators.

The study's findings underscore the critical role of continuous professional development and effective teaching strategies in enhancing educational outcomes. The validated model provides a reliable framework for assessing teacher competency, which can inform educational policy and teacher training programs. The high levels of internal consistency and strong model fit indices further reinforce the applicability of the competency scales in diverse educational settings. Overall, this research contributes significantly to the understanding and improvement of teacher competency assessment, promoting better educational practices and outcomes.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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Author Contributions:

Author 1 developed instruments and collected data. She also analyze the research data that has been collected assits by author 2. Authors 1 and 2 write the article together.

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