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RESEARCH ARTICLE

Catalysts of change: Modelling teacher leadership for educational reform in the model teacher leadership in Shandong nursing educators

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ABSTRACT

This study explores the multidimensional concept of teacher leadership among nursing college lecturersin Shandong Province, China. However, various barriers continue to impede the development of teacherleadership in China. These include inadequate policy support, limited professional training, and low levels ofteacher awareness regarding leadership roles. Therefore, this study aims to develop a measurement model fornursing teacher leadership. A quantitative cross-sectional survey design was employed, involving 266nursing college educators. Data were collected using a five-point Likert scale questionnaire comprising 42measurement items, which were validated through face and content validity assessments, and analyzed usingConfirmatory Factor Analysis (CFA) to ensure the reliability and validity of the constructs with the aid ofSEM Amos software.Through the reliability analysis, the findings indicated that all constructs achievedstrong reliability, with Cronbach's alpha values ranging from 0.837 to 0.963. In addition, this studysuccessfully developed a Nursing Teacher Leadership measurement model and validated 41 leadershipbehaviours encompassing dimensions such as self-awareness, change leadership, communication, diversity,instructional proficiency, and continuous improvement. These leadership behaviours among nursing lecturerswere confirmed. The findings suggest that educators are ready to take on greater roles in decision-making,yet there is a need for professional development programs to enhance their instructional competencies.Thisstudy is expected to contribute to the literature on teacher leadership by providing empirical evidence from,the Chinese context and emphasizing the importance of comprehensive support systems to developleadership skills among nursing educators. Future research is recommended to expand the study acrossnursing colleges throughout China to allow for broader generalization of the findings.

Keywords: Teacher leadership; leadership devolepment; nursing education; nursing college

1. Introduction

Teacher leadership has gained increasing prominence as a pivotal element in educational reform andschool improvement efforts over the past decade[1]. No longer confined to the classroom, teachers are nowexpected to engage in collaborative practices, lead pedagogical innovation, and disseminate expertise amongpeers[2-5]. Research has consistently shown that teacher leadership enhances instructional quality,

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promotesstudent achievement, and supports the holistic development of schools[6-7]. Moreover, teacher leaders areincreasingly recognized as influential actors in policy making and systemic reform[8]. The concept ofcollective efficacy, where teachers work together towards shared goals, has also been found to positivelyimpact student outcomes[2-4] . As such, teacher leadership has evolved from being an optional responsibilityto an essential component of effective school systems[7,9].

In addition, the formation of teacher leadership is closely linked to identity development. Transitioningfrom a classroom educator to a teacher leader requires a shift in self-perception and professional identity[10].This transformation is shaped by individual agency, institutional culture, and broader societal norms[11].

Supportive school principals and collaborative environments have been identified as key enablers innurturing leadership aspirations among teachers[12-13]. As teacher leadership becomes central to educationalinnovation and reform[7,14], understanding how teacher identity evolves across cultural contexts becomesincreasingly important. The reciprocal relationship between leadership and teacher self-efficacy, particularlywithin culturally grounded systems, underscores the need for leadership development programs that are bothinclusive and responsive[15,16].

The Chinese education context, however, presents unique structural and cultural complexities thatinfluence teacher leadership development. Although the concept was introduced later than in Westerncontexts, around 2005[17], it has gradually attracted scholarly and policy attention. Nevertheless, teachers inChina, especially at the secondary level, often face challenges such as excessive administrative workloadsand limited autonomy in decision making[11]. These structural constraints, together with institutional norms,continue to inhibit the full development of teacher leadership[18].

Recent research, however, challenges the assumption that Chinese schools lack innovation andcollaborative leadership. Distributed leadership, for instance, has been shown to positively affect teacherleadership dimensions in secondary schools[19], and no positional teacher leaders, those without formalauthority, can effectively drive instructional reform when supported by recognition systems and mentoringstructures[20]. Yet, hierarchical and top-down leadership models remain prevalent in many Chinese schools[21].Furthermore, multiple barriers continue to hinder the development of teacher leadership in China. Theseinclude inadequate policy support, limited professional training, and low levels of teacher awarenessregarding leadership roles[22]. Organizational and structural limitations further restrict opportunities forleadership development[23]. The centralized management system and limited channels for teacherparticipation reduce the potential for involvement in school decision making. There is also a lack ofleadership preparation programs at the school level, creating a disconnect between policy initiatives andimplementation[24]. Additional obstacles such as insufficient collaboration time, ineffective school leadership,rigid accountability measures, and limited in-school support further hinder the growth of professionallearning communities. Cultural expectations, principal roles, and formal selection mechanisms also influencehow teacher leadership identity is formed[25].

Despite these challenges, teacher leadership continues to be recognized as a critical factor in supportingcurriculum reform, enhancing student development, and improving school management. However, itsimplementation within the Chinese education system remains fragmented and underdeveloped. Research hasshown that while many teachers believe they are capable of leading change and are willing to engage indecision making, they often lack confidence in their instructional abilities[22]. In addition, the literature is stillheavily influenced by Western models, and there is limited empirical evidence that captures the contextualrealities of Chinese schools[22,26].

Given these gaps, there is an urgent need for rigorous and context-specific research that clarifies thedefinition and practices of teacher leadership in Chinese secondary schools. Such research must also aim toenhance instructional capacity alongside leadership development and identify professional developmentstrategies that are effective for both novice and experienced teacher leaders. Consequently, the purpose ofthis study is to determine the dimensions of teacher leadership that are valid and reliable within the contextof Shandong, China, through the application of confirmatory factor analysis (CFA).

2. Literature review

Teacher leadership has become a vital component of educational reform across the globe. The role ofteachers has evolved from being mere transmitters of knowledge to becoming active agents of change ininstructional and institutional development[27]. Contemporary literature defines teacher leadership as thecapacity of teachers to influence peers, school administrators, and the wider school community in efforts toenhance teaching and learning[22]. In Western educational systems, teacher leadership is commonlyconceptualized through distributed leadership frameworks, which decentralize authority and fostercollaborative practices among staff members[27]. Additionally, transformational leadership theory highlightsthe motivational and innovative influence of teacher leaders, particularly in leading pedagogical reforms[27].

A growing body of research has explored the reciprocal relationship between teacher leadership andself-efficacy. Teachers with a strong belief in their instructional abilities are more inclined to adoptinnovative strategies and overcome classroom challenges. In turn, involvement in leadership roles, such asmentoring colleagues or leading curriculum design, enhances their professional confidence and self-efficacy[27]. However, much of this research has been conducted within single educational systems, limiting theexploration of how cultural variables may influence this relationship.

Cross-cultural comparisons illustrate significant variation in the interpretation and enactment of teacherleadership. Western education systems tend to emphasize participatory governance and democraticengagement, encouraging teachers to lead professional development initiatives and participate in schooldecision-making processes[27]. In contrast, Eastern traditions particularly those influenced by Confucianvalues prioritize classroom expertise and moral character, with teachers deriving leadership legitimacy fromsubject mastery and ethical conduct[27]. These differences underscore the need for inclusive and culturallysensitive theoretical frameworks that account for varied educational traditions.

Cultural traditions in China play a significant role in shaping teacher leadership. Deep respect forseniority often results in experienced teachers being prioritized for leadership positions, while early-careerteachers are discouraged from assuming such roles[11,28]. Furthermore, hierarchical social expectations limitthe scope of teacher participation in leadership activities beyond instructional responsibilities[25,29].Consequently, leadership identity is formed through a complex interplay of personal beliefs, school-levelorganizational factors, and broader cultural norms[25]. In higher education, cultural values such as harmonyand socialism contribute to flatter organizational structures, which emphasize collaboration rather thanhierarchical authority[30]. Within this context, collegial relationships and a positive school climate are vital tofostering teacher leadership[12]. These insights call for the design of leadership development programmes thatare both culturally responsive and contextually relevant[31-32].

Recent studies in Chinese schools have also highlighted the importance of organizational culture inshaping teacher leadership. Empirical evidence shows that clan and adhocracy cultures positively influenceteacher leadership, while hierarchical and market-oriented cultures have adverse

effects[33]. Othercontributing factors include individual teacher attributes, school culture, and principal leadership practices.Supportive professional environments, coupled with strong instructional leadership from school principals,have been shown to elevate early-career teachers' aspirations to assume leadership roles[12]. A healthy schoolculture is therefore essential to nurturing leadership behaviours and sustaining them over time[28].

Distributed leadership approaches have also been linked to the growth of teacher leadership. Studiesreveal that distributed leadership has a direct impact on teacher leadership and an indirect influence onorganizational learning and teachers' self-efficacy[34]. Teachers often exhibit leadership more frequentlywithin the classroom than in formal institutional settings[35]. Formal leaders tend to influence broadpedagogical norms, while informal teacher leaders shape specific instructional strategies[36]. Informalcollaboration and interpersonal relationships remain central to the enactment of teacher leadership[5]. Virtualcommunities of practice also facilitate teacher leadership by enabling professional agency and sharedleadership responsibilities[37]. Furthermore, departmental structures in schools provide natural settings fordistributed leadership to flourish, with department heads often serving as teacher leaders[38]. Spillane et al.[39]argue that distributed leadership should be viewed as a practice embedded in and extended across multipleorganizational and situational contexts.

Teacher leadership has been theorised through multiple perspectives, most notably distributedleadership, transformational leadership, and identity-based frameworks. In this study, distributed leadershipTheory [38] serves as the primary foundation, as it conceptualises leadership as a practice stretched acrossleaders, followers, and organisational settings. This perspective underscores collaboration, interaction, andshared responsibility, reflecting the non-hierarchical character of teacher leadership. Complementing this,transformational leadership theory introduces a psychological dimension by emphasising the role ofmotivation, inspiration, and identity formation in shaping leadership practices. Taken together, theseframeworks offer a comprehensive lens for understanding teacher leadership that integrates its structuralenactment with its transformative potential.

Table 1. Mapping of teacher leadership constructs to theoretical bases

Construct	Distributed Leadership Basis	Transformational Leadership Basis
Self-Awareness	Recognising one's role and responsibilities in collective leadership practices	Reflecting on personal values, emotions, and strengths to build authentic influence
Leading Change	Mobilising collective capacity across the school for reform initiatives	Inspiring and motivating others to embrace innovation and move beyond established practices
Communication	Facilitating dialogue, negotiation, and shared sense-making across organisational levels	Using inspirational communication to articulate vision and foster collective commitment
Diversity	Engaging diverse expertise and perspectives in collaborative decision-making	Valuing individual differences and providing individualised consideration
Instructional Proficiency	Sharing pedagogical expertise through mentoring, co-teaching, and collaborative planning	Stimulating professional growth and modelling high expectations for teaching practice
Continuous Improvement	Embedding improvement as a shared responsibility within school communities	Encouraging innovation and reflective practice that leads to sustainable change
Self-Organisation	Structuring one's contributions within wider distributed systems of responsibility	Demonstrating autonomy and proactive behaviour that inspires and empowers others

As summarised in Table 1, the study's constructs Self-Awareness, Leading Change, Communication,Diversity, Instructional Proficiency, Continuous Improvement, and Self-Organisation are

mapped ontothese two theoretical bases. Distributed leadership explains the collaborative and systemic dimensions, suchas recognising collective responsibilities, mobilising change, and embedding school-wide improvement.Transformational leadership, meanwhile, accounts for how teachers inspire innovation, model professionalgrowth, and construct leadership identities. This dual-theory mapping portrays teacher leadership both as ashared practice and a transformational process, establishing the theoretical foundation for this study.

To further understand the structural dimensions of teacher leadership, researchers have increasinglyrelied on Confirmatory Factor Analysis (CFA) to validate theoretical models across different cultural andinstitutional contexts. In Malaysia, Yusof et al.[40] validated a three-factor structure, while Karmani [41]proposed a four-factor framework. Similarly, in the United States, Angelle and DeHart found that teacherleadership is best represented by four distinct dimensions. In China, Wang and Xia [42] and Sun et al.[43]developed culturally appropriate instruments for early childhood education and private universities,respectively, identifying four- and seven-domain models. In a broader Asian context, Akkaraputtapong etal.[44]validated a five-factor model among in-service teachers. Other contributions to the field include theconstruction of typologies of teacher leadership[45] and investigations into its role in facilitating professionalgrowth and school development[46].

In conclusion, literature positions teacher leadership as a multifaceted and context-dependent construct.Western models commonly focus on shared decision-making and instructional transformation, whereasEastern models prioritize ethical leadership and content expertise. In China, while research into teacherleadership continues to expand, ongoing challenges such as policy ambiguity, lack of formal training, andlimited cross-institutional studies remain. Addressing these issues through empirical validation, culturallygrounded theoretical development, and inclusive leadership training can significantly advance the field andempower teachers as catalysts for sustainable educational reform.

3. Materials and methods

This quantitative study uses a cross-sectional survey design. This research design is chosen because ofthe ability to investigate almost all problems and questions and save time and money. Data can be directlywere collected from the research sample to obtain the study variables information. The data were collected using a five-point scale questionnaire distributed online with 43 measurement items and distributed to 300 randomly selected nurses from nursing colleges in Shandong province. Items were adapted from existing teacher leadership scale and newly modification for nursing education context. The adaptation processincludedforward–backward translation, interviews with 12 nursing educators, and an expert panel of fivespecialists (two in nursing education, two in educational leadership, one in psychometrics) to ensurecultural and sectoral relevance. Pretests confirmed item clarity and content validity before surveyadministration. After the normality test only 266 respondents were accepted for further analysis.Although random sampling was employed from three nursing colleges in Shandong, the final sample(N=266) was predominantly female (95.1%) and clustered in certain age groups, reflecting the genderedworkforce composition of Chinese nursing education. This limits broader generalizability. Future researchshould test the model across provinces, genders, and institutional types using multi-group invarianceanalysis.The ratio of sample size (266) to items (42) is slightly below the 10:1 benchmark [47].While modelfit indices are acceptable, replication with larger samples is recommended to confirm the stability of thestructure of the factor. Rated on a five-point Likert Scale, the questionnaire underwent thorough validation, and reliability checks to ensure accuracy and robustness in measuring teachers' leadership. Initial validation included face validity and content validity through consultations with

statisticians and field experts. Additionally, internal consistencies were assessed using Cronbach's alpha (α) values, aiming for a minimum of 0.7.

The data analysis for this study was conducted using IBM SPSS and Structural Equation Modeling(SEM), specifically through the application of Confirmatory Factor Analysis (CFA) to validate thedimensional structure of the constructs. CFA was employed to assess unidimensionality, construct validity,convergent validity, discriminant validity, and reliability[47-48]. For unidimensionality, factor loadings below0.50 were rejected[48-49]. Ideally, each item should load at 0.708 or higher; however, external loadings of 0.40and above are acceptable under certain conditions [50].

Convergent validity was established when the Average Variance Extracted (AVE) exceeded 0.50, whilediscriminant validity was confirmed when the square root of the AVE for each construct was greater than thecorrelations between constructs[48-49]. Construct validity was evaluated through overall model fit indices,including Chi-Square (CMIN), Comparative Fit Index (CFI), Root Mean Square Error of Approximation(RMSEA), Parsimony-Adjusted Normed Fit Index (PNFI), and Parsimony Comparative Fit Index (PCFI).Acceptable thresholds included a non-significant Chi-Square ($p > 0.05$), CFI values above 0.90 (valuesbetween 0.80 and 0.89 are marginally acceptable), RMSEA less than 0.08 (acceptable up to 0.10), and PNFIand PCFI values exceeding 0.50[51- 52].

Reliability was assessed using Composite Reliability (CR), with values greater than 0.708 consideredacceptable for established items, while values above 0.60 were deemed sufficient for newly developed items[49]. All items were required to demonstrate positive and unidirectional loading. Together, these criteriaensured that the measurement model possessed strong psychometric properties for use in subsequentstructural analyses.

4. Results

The study sample comprised 266 respondents, predominantly female (95.1%), with males representingonly 4.9%. The majority were aged between 41–50 years (48.9%), followed by 31–40 years (32.0%), 51–60years (15.8%), and above 60 years (3.4%). Most participants held a bachelor's degree (44.4%), while othershad master's degrees (22.9%), PhD (3.0%), or other qualifications (29.7%). In terms of teaching experience,43.6% had 5 years or less, 24.1% had 6–10 years, 25.6% had 11–20 years, and 6.8% had more than 20 years.The current roles of the participants included clinical instructors (38.7%), nurse educators at universities orschools (10.9%), and other positions (50.4%).

4.1. The reliability analysis of teacher leadership scale

This study assessed the internal consistency reliability of seven key constructs related to teacherleadership namely Self-Awareness (SA), Leading Change (LC), Communication (CM), Diversity (DV),Instructional Proficiency and leadership (IP), Continuous Improvement (CI), and Self-Organisation (SO).Cronbach's Alpha coefficients were calculated for each construct to evaluate the extent to which the itemswithin each scale consistently measured their respective latent variables using SPSS, with the resultspresented in Table 1.

Table 2. The reliability analysis of teacher leadership

Construct	No. of Items	Cronbach's Alpha	Interpretation
Self-Awareness (SA)	6	0.872	Excellent
Leading Change (LC)	6	0.897	Excellent
Communication (CM)	6	0.901	Excellent

Construct	No. of Items	Cronbach's Alpha	Interpretation
Diversity (DV)	6	0.931	Excellent
Instructional Proficiency and Leadership (IP)	6	0.837	Good
Continuous Improvement (CI)	6	0.963	Outstanding
Self-Organisation (SO)	6	0.951	Outstanding

Table 2. (*Continued*)

Based on table 1, the results demonstrate strong reliability across all constructs. Cronbach's Alphavalues ranged from 0.837 to 0.963, indicating acceptable to outstanding internal consistency. Specifically, theconstructs of Self-Awareness (α = 0.872), Leading Change (α = 0.897), Communication (α = 0.901), andDiversity (α = 0.931) all achieved alpha values above 0.85, falling within the "Excellent" range according toconventional interpretation guidelines. These results reflect a high degree of interrelatedness within each ofthese scales. Instructional Proficiency (IP), while slightly lower, still demonstrated strong reliability with aCronbach's Alpha of 0.837, which is categorized as "Good." This suggests that the scale is adequatelyreliable, though future refinement could potentially enhance its measurement precision. The most reliableinternal consistency was observed in the constructs of Continuous Improvement (α = 0.963) andSelf-Organisation (α = 0.951), both of which fall into the Outstanding category. Such high alpha valuesindicate a very strong correlation among items, affirming the cohesiveness and reliability of themeasurements for these constructs.In conclusion, the reliability analysis confirms that all seven constructsused in this study demonstrate acceptable to outstanding levels of internal consistency. This supports the useof these constructs in further statistical analysis, such as Confirmatory Factor Analysis (CFA) and StructuralEquation Modeling (SEM), as reliable indicators of teacher leadership dimensions.

4.2. Exploratory factor analysis and confirmatory factor analysis

Although this study primarily employed CFA to validate the proposed model, exploratory factor analysis (EFA) was conducted in the pretest stage (N=50) to refine items. EFA results indicated a seven-factor solution consistent with theoretical expectations, supporting the use of CFA in the main analysis.To examine the suitability of the data for factor analysis, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's Test of Sphericity were conducted. The results indicated that the KMO value was .920, which exceeds the recommended minimum value of .60[54] (Kaiser, 1974) and falls within the outstanding category as shown in Table2. This demonstrates that the patterns of correlations are compact, and the sample is highly adequate for factor analysis.In addition, Bartlett's Test of Sphericity was statistically significant, $\chi^2(21) = 1679.41$, $p < .001$, indicating that the correlation matrix is not an identity matrix. This confirms that sufficient correlations exist among the items to justify factor analysis.Taken together, these results suggest that the dataset is highly appropriate for factor extraction, and the subsequent factor analysis is expected to yield reliable and valid results.

Table 3. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**.920**
Bartlett's Test of Sphericity	Approx. Chi-Square	1679.407
	df	21
	Sig.	<.001

Next, factor analysis was done to validate the construct and indicators proposed in the teachers' leadership l,as shown in Table 2. Overall, the 42 proposed item indicators obtained a factor loading higher than 0.5 andall functions showed the standard load value, AVE, and CR required in measuring the function of the teacherleadership.

Table 4. Standard factor loading, convergent validity, composite reliability and discriminant validity

Construct	FL	AVE	CR	√AVE
Self-Awareness	0.602 - 0.815	0.651	0.916	0.807
Leading Change	0.712 – 0.792	0.546	0.881	0.739
Communication	0.695 – 0.832	0.567	0.884	0.753
Diversity	0.780 – 0.832	0.505	0.892	0.778
Instructional proficiency and leadership	*0.346 – 0.930	0.595	0.872	0.778
Continuous improvement	0.820 - 0908	0.756	0.951	0.870
Self-organisation	0.800 – 0.939	0.799	0.945	0.894

*Note:*Remark: Item IP3 was deleted due of low factor loading.*

Generally, all constructs met the criteria for factor loading (FL), composite reliability (CR), averagevariance extracted (AVE), and the square root of AVE (√AVE). The Instructional Proficiency and Leadership(IP) construct initially contained an item (IP3) with a low factor loading (0.346), which was subsequentlyremoved to improve model fit. The values FL, C.R, AVE and √AVE for constructs SA(FL = 0.602–0.815,

AVE = 0.651, CR = 0.916, √AVE = 0.807), LC (FL = 0.712–0.792, AVE = 0.546, CR = 0.881, √AVE =

0.739), CM (FL = 0.695–0.832, AVE = 0.567, CR = 0.867, √AVE = 0.753), DV (FL = 0.780–0.832, AVE =
0.505, CR = 0.892, √AVE = 0.710), IP (FL = 0.456–0.930, AVE = 0.595, CR = 0.872, √AVE = 0.772), CI
(FL = 0.820–0.908, AVE = 0.756, CR = 0.951, √AVE = 0.870) and SO (FL = 0.800 – 0.939, AVE = 0.799,
C.R = 0.945 , √AVE = 0.894). The item "I have a reputation for being competent in the classroom" (IP3) was removed due to a low factor loading (0.35). Panel review indicated contextual misfit in nursing education, leadership is perceived as extending beyond classroom competence to clinical supervision and role modeling. Its removal improved the Instructional Proficiency construct's validity. After deleted the IP3 item
the values of AVE, CR and √AVE are increase for instructional proficiency and leadership construct (IP (FL = 0.508–0.930, AVE = 0.625, CR = 0.878, √AVE = 0.791).

The next step of CFA is to check convergent validity. Convergent validity is a method for determiningthe validity of concepts and measuring construct claims. This approach can be considered successful whenall items in the measurement models are significant. Convergent validity is assessed using the AverageVariance Extracted (AVE) value, which must be more than 0.50 (AVE > 0.50). Items that do not have loadingfactors above 0.50 should be excluded. In this investigation, all dimensions' AVE values are above theminimum threshold of 0.50, as shown in Table 2. The construct of self- organization (SO) had the highestAVE value of 0.799, while the construct of Diversity (DV) had the lowest at 0.505. As a result, we canconclude that the convergent validity of the model was achieved and accepted.

Next, discriminant validity was assessed using the Fornell-Larcker criterion, whereby the square root ofthe Average Variance Extracted (√AVE) for each construct should be greater than its correlations with

anyother construct in the model . The table 3 below summarises the comparison between √AVE values (on thediagonal) and inter-construct correlations (off-diagonal).

Table 5. Summary of correlation value between constructs (bold values are √AVE values)

SO	CI	IP	DV	CM	LC	SA
0.894						
0.878	0.870					
0.700	0.754	0.791				
0.763	0.821	0.782	0.778			
0.734	0.79	0.753	0.821	0.753		
0.686	0.739	0.576	0.767	0.739	0.739	
0.707	0.68	0.726	0.791	0.761	0.711	0.807

Refering to table 3, the √AVE values for each construct are as follows, Self-Organisation (SO) = 0.894,Continuous Improvement (CI) = 0.870, Instructional Proficiency and Leadership (IP) = 0.791, Diversity (DV)240 = 0.778, Communication (CM) = 0.753, Leading Change (LC) = 0.739, and Self-Awareness (SA) = 0.807.Upon examining the table, it is evident that all constructs meet the Fornell-Larcker criterion. Forexample, the √AVE of Self-Organisation (0.894) exceeds its correlations with CI (0.878), IP (0.763), DV(0.734), CM (0.686), LC (0.707), and SA (0.707). Similarly, Continuous Improvement demonstrates a √AVEof 0.870, which is higher than its correlations with SO (0.878), IP (0.821), DV (0.79), CM (0.739), LC (0.68),and SA (0.68).

Moreover, constructs such as IP, DV, and CM also demonstrate acceptable discriminant validity, wheretheir √AVE values (IP = 0.791, DV = 0.778, CM = 0.753) are greater than all inter-construct correlations.Significantly, even the lowest √AVE value (for LC = 0.739) remains greater than its highest correlation(0.739 with both CM and SA), meeting the minimum threshold.

In conclusion, all constructs in the model exhibit satisfactory discriminant validity as per theFornell-Larcker criterion. This finding confirms that each construct is empirically distinct and capturesphenomena not represented by other constructs in the model. This suggests that each construct demonstratesgood convergent validity, as the CR values indicate that the indicators for each construct are reliablymeasuring the same underlying concept.

Finally, to evaluate construct validity there are several criteria to determine the fitness of the modelwhich are called as root mean square error of approximation (RMSEA), comparative fit index (CFI) and Chisquare/degrees of freedom (Chisq/df). These criteria must be concurrent so that the measured models willreach the required level of the fit indexs.

As shown in Table 4, The results of the model fit indices for the Teachers' Leadership Model indicate anacceptable level of model-data fit based on established thresholds. The absolute fit index, RMSEA (RootMean Square Error of Approximation), is 0.073, which falls within the acceptable range of less than 0.08,suggesting a reasonable error of approximation. The incremental fit index, CFI (Comparative Fit Index), is0.907, exceeding the minimum recommended value of 0.90, indicating a good fit when compared to a nullmodel. Furthermore, the parsimonious fit index, represented by the Chi-square/df ratio, is 2.408, which iswell within the acceptable threshold of less than 5.0. Collectively, these results demonstrate that the modelachieves an adequate level of goodness-of-fit across all categories, affirming the structural soundness of the

Teachers' Leadership Model for further analysis.

Table 6. Teachers' Leadership Model Fitness Index

Category	Index	Index value	Result
Absolute fit	RMSEA	0.073	The required level is achieved
Incremental fit	CFI	0.907	The required level is achieved
Parsimonious fit	Chisq/df	2.408	The required level is achieved

Finally, the nursing teachers' leadership measurement model was successfully developed and validated with7constructs and 42 indicator items representing the behavior as show in figure 1.

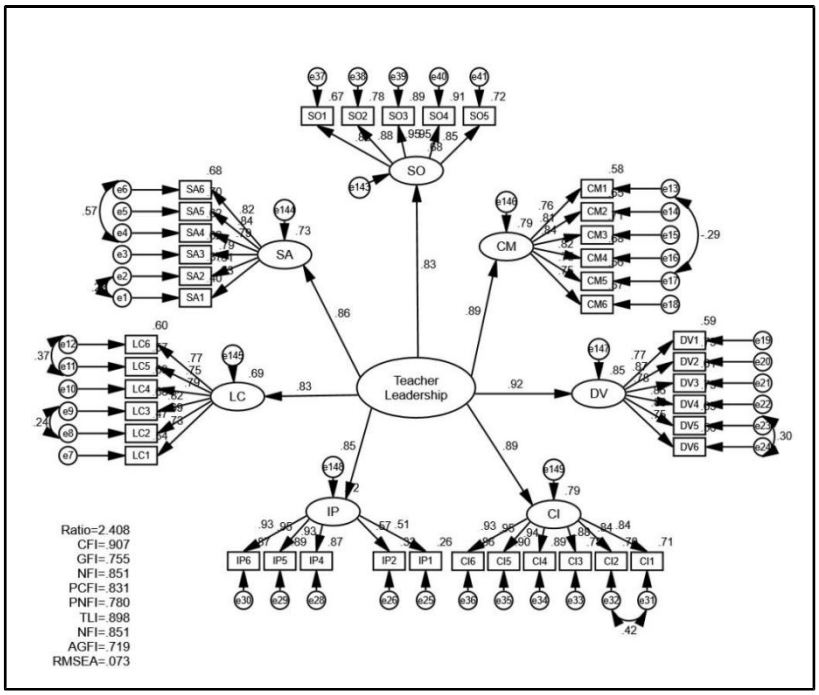


Figure 1. The final nursing teacher leadership measurement model

Thus, from the final model it can be concluded that the validity of the seven proposed constructs ofteacher leadership is acceptable. The following table 5 shows the indicators or behaviors accepted in teacherleadership for Nursing Educators in Shandong Province, China.

Table 7. Indicators or behaviors accepted in teachers leadership

Constructs	Suggested behaviours	Rejected behaviour	Accepted behaviours
Self Awareness	6	0	6
Leading Change	6	0	6
Communication	6	0	6
Diversity	6	0	6
Instructional proficiency and leadership	6	1	5
Continuous Improvement	6	0	6
Self Organisation	6	0	6
Total	42	1	41

5. Discussion

The findings of this study provide strong empirical support for the reliability and validity of amultidimensional Teacher Leadership measurement model for nursing educators in Shandong Province,China. The model encompasses seven theoretically grounded constructs namely Self-Awareness, LeadingChange, Communication, Diversity, Instructional Proficiency and Leadership, Continuous Improvement, andSelf-Organisation and each of which demonstrated acceptable to outstanding internal consistency, withCronbach's alpha values ranging from 0.837 to 0.963. These results align with previous research indicatingthat leadership behaviors among educators are multifaceted and interrelated, particularly in professionaldisciplines such as nursing[2-4].

Confirmatory Factor Analysis (CFA) further reinforced the robustness of the model. All constructs metthe required thresholds for factor loadings, Composite Reliability (CR), and Average Variance Extracted(AVE), with AVE values exceeding the 0.50 criterion and CR values consistently above 0.87. Notably, theconstruct of Instructional Proficiency and Leadership required the removal of one item (IP3) due to a lowfactor loading (0.346), which subsequently improved its overall convergent validity. These results supportthe structural coherence of the model and its applicability in evaluating leadership behaviors specific to thenursing education context.

Furthermore, the discriminant validity assessment using the Fornell-Larcker criterion confirmed thateach construct was empirically distinct. The square root of AVE (√AVE) values for all constructs exceededinter-construct correlations, demonstrating clear conceptual separation among the dimensions of teacherleadership. The constructs of Self-Organisation and Continuous Improvement exhibited particularly high√AVE values (0.894 and 0.870, respectively), suggesting strong construct integrity and minimal conceptualoverlap.

The model's structural adequacy was further supported by the goodness-of-fit indices. The modelshowed acceptable fit across all categories, including RMSEA (0.073), CFI (0.907), and Chi-square/df(2.408), all of which fall within recommended thresholds [53]. This affirms the suitability of the proposedmeasurement model for evaluating teacher leadership practices in nursing education, particularly in theChinese cultural context, where leadership hierarchies and collectivist norms shape professional roles .

Overall, the findings suggest that nursing educators in China exhibit a strong foundation in leadershipbehaviors, especially in communication, continuous improvement, and change leadership. However, theslightly lower reliability in the instructional proficiency domain highlights the need for targeted professionaldevelopment to enhance pedagogical competence. This is particularly important in nursing education, whereeducators must serve not only as instructors, but also as clinical and ethical role models.

6. ConclusionThis study successfully developed and validated a comprehensive Teacher Leadership measurementmodel comprising seven constructs and 42 behavioral indicators, of which 41 were empirically supported.The model demonstrates strong internal consistency as well as significant convergent and discriminantvalidity, and acceptable model fit indices, confirming its relevance for assessing teacher leadership amongnursing educators in China.Unlike prior Chinese teacher leadership scales [42-43], this model is sector-specific to nursing education, incorporating clinical competencies, ethical modelling,and continuous improvement. This adds domain relevance and extends teacher leadership measurement into professional health education.

The study contributes to the growing body of literature on teacher leadership by offering acontext-specific model tailored to the nursing education sector. It underscores the need to equip educatorswith competencies beyond instructional delivery, particularly in change leadership, self-organisation, andcontinuous improvement. Future studies are encouraged to replicate this model across other provinces andeducational contexts to improve generalizability and explore the impact of teacher leadership on studentlearning and institutional performance.

Conflict of interest

The authors declare no conflict of interest.

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Appendix

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.920
Bartlett's Test of Sphericity	Approx. Chi-Square	1679.407
	df	21
	Sig.	<.001

Standardized Regression Weights: (Group number 1 - Default model)

			Estimate
SO	<---	Teacher_Leadership	.826
LC	<---	Teacher_Leadership	.831
CM	<---	Teacher_Leadership	.889
DV	<---	Teacher_Leadership	.923
CI	<---	Teacher_Leadership	.889
IP	<---	Teacher_Leadership	.847
SA	<---	Teacher_Leadership	.856
SA1	<---	SA	.629
SA2	<---	SA	.610
SA3	<---	SA	.790
SA4	<---	SA	.790
SA5	<---	SA	.837
SA6	<---	SA	.822
LC1	<---	LC	.735
LC2	<---	LC	.689
LC3	<---	LC	.823
LC4	<---	LC	.792
LC5	<---	LC	.753
LC6	<---	LC	.775
CM1	<---	CM	.763
CM2	<---	CM	.808
CM3	<---	CM	.841
CM4	<---	CM	.822
CM5	<---	CM	.750
CM6	<---	CM	.754

			Estimate
DV1	<---	DV	.770
DV2	<---	DV	.866
DV3	<---	DV	.780
DV4	<---	DV	.864
DV5	<---	DV	.805
DV6	<---	DV	.750
IP1	<---	IP	.507
IP2	<---	IP	.573
IP4	<---	IP	.933
IP5	<---	IP	.946
IP6	<---	IP	.933
CI1	<---	CI	.844
CI2	<---	CI	.836
CI3	<---	CI	.885
CI4	<---	CI	.944
CI5	<---	CI	.949
CI6	<---	CI	.926
SO1	<---	SO	.821
SO2	<---	SO	.884
SO3	<---	SO	.946
SO4	<---	SO	.954
SO5	<---	SO	.849

(*Continued*)