Establishing Reliable Measures for Examining the Mediating Role of Teachers' Innovative Leadership in Transformational Leadership and Continuing Professional Development: A Pilot Study in China

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ABSTRACT

The rapid changes in today's educational environment require teachers to pursue continuing professional development to effectively respond to evolving educational demands and challenges. This is crucial for enhancing teaching quality and adapting to educational transformations. Therefore, based on a comprehensive literature review and theoretical analysis, this study identified relevant constructs and variables. Reliable measurement scales were then adapted and culturally calibrated to examine the impact of Principal's Transformational Leadership (PTL) on Teacher Continuing Professional Development (TCPD) and to assess the mediating role of Teacher Innovative Leadership (TIL). The study selects 125 demonstrative high school teachers from Guangxi, China, as a sample. Data were collected through a questionnaire survey. Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) were used to test the construct validity of the questionnaire. Cronbach's Alpha coefficient was also used to evaluate the internal consistency of the questionnaire. The results show good discrimination among the constructs. The internal consistency of the questionnaire was high (Cronbach's Alpha coefficient greater than 0.9). This indicates excellent reliability and validity. In total, the questionnaire was confirmed as effective and reliable, successfully retaining 62 out of the original 69 items. This pilot study verified the validity of the measurement tools. It laid a foundation for subsequent formal research. It also provided preliminary evidence for further exploration of the relationship between PTL, TIL, and TCPD. The successful implementation of this pilot study provides theoretical support for further research on educational leadership and teachers' professional development. It also provides a reference for principals on how to effectively inspire and support teachers' innovation and development in practice.

Keywords: Principal's transformational leadership, teachers' innovative leadership, teacher continuing professional development, Chinese Demonstrative High Schools.

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INTRODUCTION

Teaching is a challenging profession involving various tasks such as classroom responsibilities, campus collaboration, and administrative duties (Carver, 2018). Teacher professional development is crucial for meeting these demands and fulfilling educational responsibilities (Bragg et al., 2021). Teacher professional learning is widely recognized in school improvement research, as high-quality teaching is essential for student learning. A school culture that supports continuous teacher development has become globally recognized for promoting sustainable student education (Galtseva et al., 2020). Without organizational structures, values, and norms that support teacher learning, schools struggle to meet evolving and ambitious student learning goals (Nabella et al., 2022). Extensive research shows a critical link between teacher competence and the leadership style of school leaders, focusing on strategic factors that influence professional learning (Oppi et al., 2023).

Additional literature emphasizes that leadership behavior, particularly transformational leadership, is crucial for Teachers' Continuing Professional Development (TCPD) (Darling-Hammond et al., 2017). This study examined two strategic factors influencing teacher professional learning: Principals' Transformational Leadership (PTL) and Teachers' Innovative Leadership (TIL). For nearly half a century, research has concluded that principals play a key role and significantly impact both teacher and student learning (Sancar et al., 2021). Researchers have identified the positive impact of learning centered leadership (such as instructional leadership and transnational leadership) on TCPD (Li et al., 2022). Correspondingly, current research has identified the efforts of principal leadership in motivating and supporting teacher learning (Nkundabakura et al., 2024).

The education system in China has undergone large-scale educational reforms over the past decades, highlighting the necessity of involving and supporting TCPD (Sancar et al., 2021). Yet, various conceptual models have been studied in educational leadership research, transformational leadership is one of the main methods as it is considered an ideal leadership that is relevant to the challenges of education in the 21st century (Fairman et al., 2022). The *Thirteenth Five Year Plan for the Development of National Education* issued in 2017 clearly stated that it supports school leaders to fulfill their duties in accordance with laws and regulations, encourages bold exploration and innovation in practice, and forms teaching characteristics and educational styles. This study examined the correlation between the style of PTL and TCPD. Besides, this study also explored the mediating role of TIL. Thus, it is worth further exploring whether the teaching leadership style of principals can lead teachers to achieve school teaching goals, and how teachers can improve their own teaching quality and professional practice.

THEORETICAL BACKGROUND

Leadership is the ability to influence others to achieve their goals. The theory of transformational leadership has become a hot topic in contemporary leadership theory since its inception. During the Reconstruction Movement in the West, transformational leadership was introduced in education to drive school reform. This study's theoretical model is based on research exploring the relationship between principal change leadership and teacher professional development (Rahmi et al., 2019). Additionally, leadership is essential for teacher achievement and is a crucial factor in school progress (Jacob et al.,

2020). School leadership significantly influences school organizational characteristics and positively impacts teaching quality and student learning (Leithwood et al., 2021). Previous research on principal leadership and teacher professional development (Freeman et al., 2023) suggests that leadership practices directly impact teacher learning and indirectly influence organizational characteristics such as trust, collaboration, self-efficacy, collective efficacy, and commitment. This study proposes that PTL directly and indirectly impacts TCPD, mediated by TIL. Furthermore, the model examines whether the impact of leadership on teachers' professional development is direct, indirect, or both, and how TIL dimensions interact with PTL to create these effects. The conceptual model situates principal leadership and teacher continuing professional development within the school context (as shown in Figure 1).

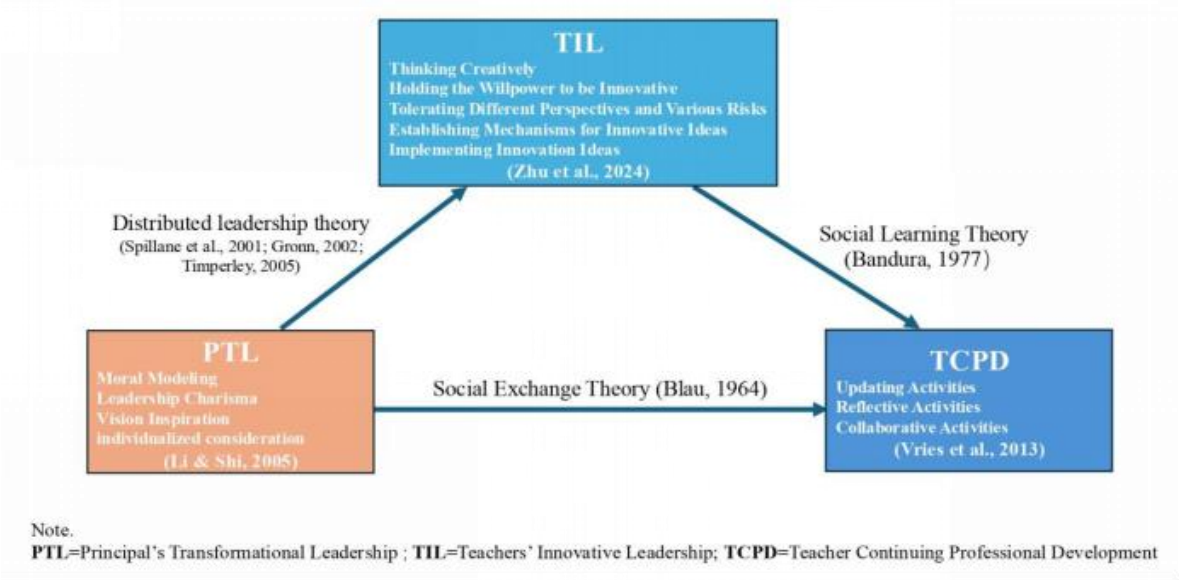

Figure 1*:* Theoretical Framework

In the educational context, the principal's transformational leadership style can be deeply understood through transformational leadership theory, distributed leadership theory, and social learning theory. First, the principal's transformational leadership style can be understood in depth based on multiple theories. These include transformational leadership theory, distributed leadership theory, and social learning theory. Transformational leadership theory emphasizes that leaders inspire followers' enthusiasm and creativity through motivation and individualized consideration. This approach aims to drive progress and innovation throughout the organization (Zhu, 2024). In the context of school management, the principal, as a transformational leader, encourages teachers to participate actively in school reforms and innovations. This can effectively stimulate teachers' intrinsic motivation and improve their work enthusiasm and innovation abilities. In addition, distributed leadership theory provides significant theoretical support for transformational leadership. According to Spillane et al. (2001) and Gronn (2002), distributed leadership emphasizes the sharing of leadership functions and responsibilities. It extends leadership functions across the entire school organization to foster collaboration and collective intelligence. This leadership style enhances trust and cooperation among teachers through teamwork and shared responsibility. It also encourages teachers to actively participate in school decision-making and innovation activities through empowerment and support. Through distributed leadership, principals can use flexible leadership strategies in different contexts. This enables teachers to take on more creative roles in everyday teaching and school management, thereby improving

their innovative leadership abilities (Timperley, 2005). In summary, the combination of transformational leadership and distributed leadership not only help enhance teachers' job satisfaction but also improves the overall innovation and adaptability of the school.

Secondly, social learning theory also provides an explanatory framework for how the principal's transformational leadership affects teachers' innovative leadership and continuous professional development. According to Bandura's social learning theory (1977, 1986), teachers can learn new behaviors and skills through observation, imitation, and interaction. In a school context, the principal's transformational leadership can create a supportive and open learning environment. This allows teachers to learn new skills and strategies by observing the successful practices and innovations of their colleagues. This process of social learning can enhance teachers' self-efficacy and motivate them to participate more actively in innovation activities. It also encourages them to explore more opportunities for professional development (Schunk, 2012).Moreover, social exchange theory (Blau, 1964) also provides important theoretical support for understanding the impact of principals' transformational leadership on teachers' continuous professional development. Under this theoretical framework, principals build trust relationships by meeting teachers' emotional and psychological needs. This trust motivates teachers to invest more effort in their professional development. This social exchange process, based on trust and reciprocity, helps enhance teachers' job satisfaction and self-efficacy. It also fosters their loyalty to the school and their professional commitment (Cropanzano & Mitchell, 2005; Levinson, 2017).Therefore, social learning and social exchange theories together reveal how teachers achieve continuous professional development through mutual learning and trust relationships. They also explain how teachers can enhance their professional abilities and innovative mindset under the transformational leadership of the principal.

RESEARCH METHOD

This study used exemplary high school teachers in Guangxi, China, as the sample. A total of 125 valid questionnaires were collected. Data collection took place from September to October 2024. A survey was conducted to obtain teachers' perceptions and evaluations of the relationship between PTL, TIL, and TCPD. The study aimed to reveal the direct and indirect effects of principal leadership style on teachers continuing professional development. It also analyzed the mediating role of teacher innovative leadership.

The questionnaire used in this study was adapted from validated scales and adjusted to fit the Chinese educational context. The questionnaire consisted of two parts: A and B. Part A collected demographic information about respondents and their principals, including gender, age, education level, professional title, and years of teaching experience. Part B contained 69 questions. These questions measured three key dimensions: PTL, TIL, and TCPD. PTL was measured based on the scale by Li & Shi (2005). TIL referred to the framework proposed by Zhu et al. (2024). TCPD was measured based on the scale by Vries et al. (2013). Each question in the questionnaire used a seven-point scale (1 = strongly disagree, 7 = strongly agree). This captured teachers' genuine perceptions of principal leadership style, teacher innovative leadership, and professional development.

To ensure the face validity of the questionnaire, seven experts in the field of educational management were invited to review and evaluate it. Based on expert feedback, we adjusted some items. For example, in the dimension of moral modeling, redundant or overly similar items, such as "My principal is willing to sacrifice personal interests for the benefit of the school," were removed. Items like "My principal prioritizes the collective and others' interests above personal benefits" were retained. Refinement of descriptions of innovative leadership: Items such as "I have the ambition to pursue change" and "I have the challenging spirit and courage to reinvent the routine" were revised. They were changed to "I have the ambition to pursue educational reform" and "I have a challenging spirit and the courage to reinvent teaching routines." In addition, based on the analysis of the item content validity index (I-CVI), some items that did not meet the recommended standards for Factor Loading values were deleted. To ensure construct validity, the study employed Exploratory Factor Analysis (EFA) using principal component extraction and Varimax rotation. The factor loadings for all retained items were greater than 0.50, indicating a high correlation between each item and its corresponding construct. Subsequently, Confirmatory Factor Analysis (CFA) was conducted to further confirm the construct validity of the questionnaire. This included convergent validity and discriminant validity, and ensured the model fit met the standards.

The data collection for this study was conducted from September to October 2024 in Guangxi. A total of 150 questionnaires were distributed, and 125 valid questionnaires were collected. The effective response rate was 83.3%.Before distributing the questionnaires, all participants were informed of the purpose of the study. They were assured that their responses would be kept strictly confidential. Participation was entirely voluntary, and informed consent was obtained from all participants. This study strictly adhered to academic ethical standards. Before data collection, the purpose of the study and the voluntary nature of participation were explained in detail to all participants. Their personal information was kept strictly confidential and used only for academic research purposes. This study was approved by the Ethics Committee of the affiliated institution.

EXPERIMENTAL RESULTS AND DISCUSSION

A total of 125 valid questionnaires were collected. In terms of gender distribution, females accounted for 52% (65 people), while males accounted for 48% (60 people). Regarding age distribution, the majority of teachers were aged 30-39 (51 people), followed by those aged 25-30 (39 people). For educational qualifications, 62 teachers held a bachelor's degree, and 35 teachers had a college diploma. Most teachers held an intermediate professional title (71 people), followed by those with a junior title (33 people). The majority of teachers had 6-10 years of teaching experience, totaling 46 people. Additionally, teachers in private schools (66 people) slightly outnumbered those in public schools (59 people). The study results are presented in four parts. These include Cronbach's alpha coefficient, EFA, CFA, and reliability index values.

Exploratory Factor Analysis

Table 1. Total Number of Items at Each Stage of Questionnaire Construction

No.	Scale	Initial Number of Item	Item for Final Survey
1	PTL (Principal's Transformational Leadership)	24	21
2	TIL (Teachers' Innovative Leadership)	23	23
3	TCPD (Teacher Continuing Professional Development)	22	18
	Total	69	62

Before conducting statistical factor analysis on PTL, TIL, and TCPD, the data suitability was assessed. Some items were removed, as shown in Table 1. Seven items were deleted from the original 69 items, retaining 62 valid items.According to Table 2, the communalities for PTL, TIL, and TCPD indicate that 21, 23, and 18 items respectively exceeded the threshold of 0.5. This also means the sample size is acceptable (Mohamad et al., 2024). The Kaiser-Meyer-Olkin values for PTL, TIL, and TCPD were 0.893, 0.891, and 0.899 respectively, exceeding the minimum value of 0.6 for good factor analysis (Lee et al., 2024). On the other hand, Bartlett's test of sphericity showed a sufficient significance level of correlation among items at $p < .05$ (Niniel et al., 2023).

Table 2: KMO and Bartlett's Test

Options		PTL	TIL	TCPD
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.893	.891	.899
Bartlett's Test of Sphericity	Approx. Chi-Square	2833.780	2564.801	2272.935
	df	276	253	231
	Sig.	.000	.000	.000

Table 3: Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
The Total Variance Explained of PTL (n=125)									
1	9.568	39.868	39.868	9.568	39.868	39.868	5.097	21.238	21.238
2	3.334	13.890	53.758	3.334	13.890	53.758	4.290	17.873	39.111
3	2.874	11.974	65.732	2.874	11.974	65.732	4.233	17.594	56.705
4	2.033	8.472	74.204	2.033	8.472	74.204	4.200	17.499	74.204
The Total Variance Explained of TIL (n=125)									
1	9.038	39.297	39.297	9.038	39.297	39.297	4.128	17.948	17.948
2	3.352	14.573	53.871	3.352	14.573	53.871	4.072	17.705	35.652
3	2.313	10.055	63.925	2.313	10.055	63.925	3.968	17.253	52.905
4	2.198	9.557	73.482	2.198	9.557	73.482	3.327	14.465	67.370

5	1.906	8.287	81.769	1.906	8.287	81.769	3.312	14.399	81.769
The Total Variance Explained of TCPD (n=145)									
1	8.081	36.730	36.730	8.081	36.730	36.730	5.018	22.809	22.809
2	3.881	17.639	54.369	3.881	17.639	54.369	4.955	22.567	45.377
3	2.821	12.823	67.192	2.821	12.823	67.192	4.799	21.815	67.192

Additionally, according to the data shown in Table 3, the total variance explained in the exploratory factor analysis of PTL, TIL, and TCPD provides an in-depth understanding of the data structure. For PTL, the four factors explained a cumulative variance of 74.204%, indicating a strong explanatory power for the PTL structure.For TIL, the five factors explained a cumulative variance of 81.769%, showing high explanatory power for TIL. In the case of TCPD, the total variance explained was 67.192% of the cumulative variance. This indicates that the respective factors of PTL, TIL, and TCPD have high structural explanatory power, demonstrating good data fit.The rotated factor loadings show a more balanced explanation among the factors. This helps to avoid the concentration effect of a single factor's explanatory power, thereby enhancing the robustness of the model.

Confirmatory Factor Analysis

This experiment conducted a step-by-step analysis of the convergent and discriminant validity of each construct. The test of convergent validity shown in Table 4 indicates that the CR (Composite Reliability) and AVE (Average Variance Extracted) of all constructs met the standards proposed by Moses & Kim (2015). Specifically, CR values were greater than 0.7, and AVE values were greater than 0.5.This indicates that the items of each construct have high consistency in measurement and can explain most of the variance. For example, the CR value of CLAT was 0.952, and the AVE was 0.766. This means that the items effectively reflect the latent characteristics of the construct. In addition, the CR value of MRMD was as high as 0.962, and the AVE was 0.809, further proving strong consistency in its measurement. These results indicate that the measurement model of this study performs well in terms of reliability and validity (Sideridis et al., 2019).

Table 4: Convergent validity and composite reliability

Construct	Item	Loading	CR	AVE
CLAT	CLAT01	0.869	0.952	0.766
	CLAT02	0.86		
	CLAT03	0.896		
	CLAT04	0.842		
	CLAT05	0.908		
	CLAT06	0.876		
EMII	EMII01	0.867	0.931	0.772
	EMII02	0.907		
	EMII03	0.866		
	EMII04	0.873		
HWTI	HWTI01	0.849	0.931	0.73
	HWTI02	0.841		
	HWTI03	0.87		

	HWTI04	0.849		
	HWTI05	0.863		
IDCS	IDCS01	0.884	0.95	0.793
	IDCS02	0.878		
	IDCS03	0.917		
	IDCS04	0.885		
	IDCS05	0.889		
IMII	IMII01	0.881	0.928	0.764
	IMII02	0.839		
	IMII03	0.873		
	IMII04	0.903		
LDCM	LDCM01	0.882	0.947	0.783
	LDCM02	0.871		
	LDCM03	0.893		
	LDCM04	0.918		
	LDCM05	0.859		
MRMD	MRMD01	0.877	0.962	0.809
	MRMD02	0.882		
	MRMD03	0.914		
	MRMD04	0.918		
	MRMD05	0.894		
	MRMD06	0.912		
RFAT	RFAT01	0.873	0.955	0.78
	RFAT02	0.89		
	RFAT03	0.857		
	RFAT04	0.893		
	RFAT05	0.896		
	RFAT06	0.889		
TDPR	TDPR01	0.916	0.941	0.763
	TDPR02	0.875		
	TDPR03	0.87		
	TDPR04	0.84		
	TDPR05	0.864		
TKCT	TKCT01	0.85	0.943	0.769
	TKCT02	0.904		
	TKCT03	0.897		
	TKCT04	0.865		
	TKCT05	0.866		
UDAT	UDAT01	0.871	0.948	0.751
	UDAT02	0.832		
	UDAT03	0.909		
	UDAT04	0.896		
	UDAT05	0.859		

	UDAT06	0.83		
	VSIP01	0.897		
	VSIP02	0.868		
VSIP	VSIP03	0.878	0.95	0.791
	VSIP04	0.894		
	VSIP05	0.91		

In the test of discriminant validity, Table 5 presents the correlation matrix between the constructs. The values on the diagonal represent the square root of the AVE of each construct. According to the criterion proposed by Fornell and Larcker (1981), the square root of the AVE of each construct should be greater than its correlation with any other construct (Gomez & Stavropoulos, 2018).The results show that, for example, the correlation coefficient between MRMD and VSIP is 0.491. This is lower than the square root of their respective AVEs (MRMD is 0.899, VSIP is 0.889). This indicates good discriminant validity between these two constructs. Similarly, the correlation coefficient between IDCS and TKCT is 0.061, showing significant statistical independence between these two constructs. In addition, the correlation coefficient between IMII and EMII is 0.314, which is also lower than their respective AVE square roots. This further supports the discriminant validity of the model.

Table 5: Discriminant validity

	MRMD	VSIP	LDCM	IDCS	TKCT	HWTI	TDPR	EMII	IMII	UDAT	RFAT	CLAT
MRMD	0.899											
VSIP	0.491	0.889										
LDCM	0.382	0.384	0.885									
IDCS	0.293	0.478	0.324	0.891								
TKCT	0.379	0.478	0.179	0.061	0.877							
HWTI	0.231	0.226	0.293	0.157	0.295	0.855						
TDPR	0.379	0.436	0.287	0.256	0.486	0.34	0.875					
EMII	0.435	0.397	0.331	0.203	0.382	0.407	0.417	0.889				
IMII	0.266	0.305	0.36	0.292	0.309	0.469	0.342	0.314	0.883			
UDAT	0.169	0.359	0.294	0.509	0.16	0.336	0.306	0.263	0.44	0.847		
RFAT	0.376	0.323	0.287	0.258	0.324	0.226	0.361	0.304	0.414	0.383	0.883	
CLAT	0.385	0.317	0.259	0.067	0.457	0.397	0.482	0.454	0.313	0.222	0.394	0.876

These results indicate that the constructs in this study have high reliability and validity in measurement. The constructs also exhibit good discriminant validity. By meeting the Fornell-Larcker criteria and reliability indicators, these results lay a solid foundation for subsequent structural equation modeling analysis. This finding is consistent with the requirements of measurement models in the existing literature (Hamid et al., 2017).

Reliability Index

Table 7: All items selected in the final survey, their initial constructs, factor loadings, and Cronbach's Alpha

Selected Items of TIL for Final Survey, Its Initial Construct, Factor Loading and Cronbach's Alpha					
Construct	Item Code	Item	Factor Loading	Cronbach's Alpha	Cronbach's Alpha
TKCT	TKCT02	I am good at drawing on experiences from teaching practice to generate new ideas.	.884	.943	
	TKCT05	I am able to think from many different angles.	.866		
	TKCT01	I am capable of proposing unique or novel ideas.	.865		
	TKCT03	I am able to think ahead, to predict the potential change and development of work.	.849		
	TKCT04	I can approach questions creatively and present innovative ideas and solutions.	.847		
TDPR	TDPR05	I can tolerate mistakes and failures in the process of teaching innovation.	.864	.941	
	TDPR03	I encourage colleagues to do the work according to their own views and ways of doing things.	.863		
	TDPR01	I am open and inclusive, listening to suggestions from multiple sources.	.858		
	TDPR02	I am receptive to opinions different from my own.	.856		
	TDPR04	I can tolerate the potential risks that come with teaching innovation.	.815		
HWTI	HWTI01	I have the ambition to pursue educational reform.	.863	.930	.929
	HWTI03	I can be unconventional and seek distinctive teaching concepts or methods.	.855		
	HWTI05	I make every effort to ensure the realization of teaching innovation.	.848		
	HWTI04	I believe so firmly in the value of teaching innovation that I dare to face questioning.	.833		
	HWTI02	I have a challenging spirit and the courage to reinvent teaching routines.	.823		
IMII	IMII04	I actively try to transform innovative ideas into practical usage.	.881	.927	
	IMII01	I make feasible educational plans to implement innovative ideas.	.868		
	IMII02	I regularly evaluate the implementation progress of the innovative teaching ideas.	.855		
	IMII03	I actively communicate with colleagues and school management to gain their support for implementing innovative ideas.	.854		
EMII	EMII02	I provide colleagues with opportunities to learn new knowledge and explore new things.	.901	.930	
	EMII03	I establish platforms for colleagues to communicate and discuss.	.862		
	EMII04	I expand/develop various mechanisms and channels to obtain creative teaching ideas.	.861		
	EMII01	I organize professional exchange activities to share new ideas and practices.	.815		
Selected Items of PTL for Final Survey, Its Initial Construct, Factor Loading and Cronbach's Alpha					
RMD	MRMD04	My principal prioritizes the collective and others' interests above personal benefits.	.902	.962	.937
	MRMD01	My principal is honest and selfless, not seeking personal gain.	.895		
	MRMD03	My principal works with dedication without concern for personal gain or loss.	.883		
	MRMD06	My principal shares in both the difficulties and successes with the teachers.	.867		
	MRMD05	My principal does not claim others' achievements as their own.	.867		
	MRMD02	My principal endures hardships first and enjoys benefits last.	.861		
IDCS	IDCS05	My principal is concerned with the growth and development of the teachers.	.905	.947	
	IDCS03	My principal frequently shows concern for the work, life, and family situations of teachers.	.903		
	IDCS06	My principal creates opportunities for teachers to showcase their talents.	.884		
	IDCS01	My principal considers the personal circumstances of teachers during interactions.	.866		
	IDCS02	My principal is willing to help teachers with difficulties in their personal or family lives.	.829		
LDCM	LDCM04	My principal is deeply engaged in their work, consistently maintaining high enthusiasm.	.900	.950	
	LDCM03	My principal loves their work and has a strong sense of career ambition.	.888		
	LDCM06	My principal is adept at handling difficult situations.	.869		
	LDCM02	My principal is open-minded and possesses a strong sense of innovation.	.865		

	LDCM01	My principal has strong professional abilities.	.864		
VSIP	VISP04	My principal paints a compelling picture of the future for everyone.	.872	.949	
	VISP05	My principal provides teachers with clear goals and directions for their efforts.	.871		
	VISP03	My principal explains the long-term significance of the work being done.	.849		
	VISP01	My principal helps teachers understand the school's future prospects.	.847		
	VISP02	My principal clearly communicates the school's development philosophy and goals to the teachers.	.802		
		Selected Items of TCPD for Final Survey, Its Initial Construct, Factor Loading and Cronbach's Alpha			
RFAT	RFAT05	I study products from students to understand how my approach has worked.	.894	.947	
	RFAT04	I ask my colleagues to attend some of my lessons to get feedback on my teaching.	.880		
	RFAT01	After class, I reflect on my lessons.	.872		
	RFAT02	I discuss my students' experiences in my classes with them to improve my teaching practice.	.870		
	RFAT06	I use student performance data to, where needed, adjust my teaching.	.867		
	RFAT03	I observe my colleagues' lessons to learn from them.	.845		
CLAT	CLAT04	I discuss improvements and innovation in education at my school with colleagues.	.900	.951	.925
	CLAT03	I share new teaching ideas with my colleagues.	.888		
	CLAT07	I study student performance data with colleagues.	.885		
	CLAT09	I experiment with new teaching methods with colleagues.	.884		
	CLAT01	I talk about teaching problems with colleagues.	.873		
	CLAT05	I develop new curricula with my colleagues.	.839		
UDAT	UDAT03	I read professional journals or academic literature.	.898	.955	
	UDAT04	I visit digital communities related to my subject area.	.888		
	UDAT01	I read the latest educational materials.	.888		
	UDAT05	I participate in professional development activities inside and outside of school (e.g., courses, workshops, training sessions, conferences, summer courses, online).	.866		
	UDAT02	I read materials related to educational reform and educational practices (e.g., through newspapers, television, the internet).	.856		
	UDAT06	I visit conferences and meetings pertaining to my subject matter or hosted by my professional association.	.836		

The reliability test of this study was based on questionnaire survey data, analyzed using SPSS software. Cronbach's Alpha coefficient was used in reliability analysis to evaluate the internal consistency of each construct. According to Wigley (2011), questionnaires with Cronbach's Alpha values between 0.80 and 0.95 have high reliability. Questionnaires with values between 0.65 and 0.79 are also considered acceptable measurement tools. Mosmuller et al. (2017) also pointed out that items with Cronbach's Alpha values between 0.61 and 1.00 have good dependability. Furthermore, Popa (2020) suggested that Cronbach's Alpha should reach or exceed 0.70. The closer it is to 1, the higher the reliability of the scale. Therefore, to ensure the quality and consistency of the questionnaire data, this study adopted rigorous reliability analysis standards.

Table 7 shows the reliability analysis results of the final questionnaire. The TKCT construct contains five items, with a Cronbach's Alpha value of 0.943. This indicates high consistency in evaluating teachers' innovative thinking abilities. The Cronbach's Alpha coefficient for the TDPR construct is 0.941, reflecting stability in measuring teachers' openness to diverse opinions. The Alpha value for the HWTI construct is 0.930, further demonstrating measurement reliability in teachers' pursuit of educational innovation. The reliability coefficient for the IMII construct is 0.927, indicating consistency in measuring teachers' ability to turn innovative ideas into practical applications. The reliability analysis result of EMII also reached 0.930, showing reliability in evaluating innovative interactions among teachers.

In the principal leadership constructs, the MRMD construct has a Cronbach's Alpha value of 0.962. This indicates extremely high internal consistency in measuring principals' moral behavior and dedication. The Alpha value for the IDCS construct is 0.947, indicating high reliability in evaluating principals' support for individual teacher development. The reliability coefficient for the LDCM construct is 0.950, proving the consistency of the measurement tool for principals' work engagement and professional motivation. The Alpha value for the VSIP construct is 0.949, showing stability in measuring principals' vision-setting for the school and motivating teachers.

In the construct of Teachers' Continuing Professional Development, the Alpha value of RFAT was 0.947. This indicates a high level of consistency in measuring teachers' reflective and feedback-driven teaching practices. The reliability of CLAT was 0.951, indicating stability in measuring teachers' collaborative learning and teaching. The Alpha coefficient of the UDAT construct reached 0.955, further proving the high consistency in measuring teachers' participation in professional development activities.

In summary, the Cronbach's Alpha coefficient for all constructs in this study exceeded 0.9. This indicates that the questionnaire has very high reliability, meeting the reliability standards proposed by Hair (2021). This shows that the questionnaire can accurately capture the core characteristics of each construct, laying a solid foundation for subsequent structural equation modeling analysis.Based on these analysis results, it can be concluded that the measurement tool used in this study has high reliability in practice. It can also provide valuable data support for research in the field of education.

SUMMARY

This study, as a pilot study, marks the initial exploration and practice by the researchers before moving to the formal research stage. The implementation of the pilot study clarified a set of conditions that must be met to ensure high validity and reliability of future research results. It laid a solid foundation for subsequent formal research. The success of the pilot study paves the way for the formal study, which will further reveal how PTL and TIL work together to influence TCPD, promote teachers' professional growth, and contribute to the overall development of the school. This process not only contributes to the development of relevant theories but also provides clearer guidance for educational practice.

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