An Innovative Management Model for the Development of Pedagogical Content Knowledge (PCK) for Teachers of Less Commonly Taught Languages (LCTLs) in Universities in Yunnan Province, China

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Abstract

This study investigates the development of Pedagogical Content Knowledge (PCK) among teachers of Less Commonly Taught Languages (LCTLs) in universities in Yunnan Province, China. Using a mixed-methods approach that integrates the Theory of Planned Behavior (TPB) and Ecological Systems Theory (EST), the research identifies key factors influencing PCK. It proposes an innovative management model for enhancing PCK among LCTL teachers. A sample of 243 LCTL teachers was surveyed, complemented by in-depth interviews with 34 teachers. Quantitative data were analyzed using Structural Equation Modeling (SEM), while qualitative data were analyzed with NVivo software.

The demographic analysis revealed a predominantly female sample (77.8%) with most teachers aged 31-40 (66.7%). Reliability analysis indicated strong measures consistency (Cronbach's alpha: 0.835-0.868). Significant correlations were found between PCK and teacher attitudes ($r = 0.344$, $p < 0.01$), efficacy ($r = 0.456$, $p < 0.01$), and environment ($r = 0.399$, $p < 0.01$). SEM results highlighted teacher efficacy (Standardized Estimate = 0.405, $p = 0.011$) and ecological environment (Standardized Estimate = 0.54, $p < 0.001$) as strong predictors of PCK development. The study confirms the critical impact of teacher efficacy, attitudes, and ecological environment on PCK development. An innovative management model is proposed, focusing, on promoting positive teacher attitudes, optimizing teacher ecosystems, enhancing teacher efficacy, and providing continuous professional development. These strategies aim to improve teaching quality and efficacy among LCTL teachers, ultimately benefiting foreign language education in Yunnan Province.

Keywords: Pedagogical Content Knowledge (PCK), Less Commonly Taught Languages (LCTLs), Teacher Efficacy, Ecological Systems

Introduction

The development of Pedagogical Content Knowledge (PCK) is crucial for the effectiveness of teachers, particularly those teaching Less Commonly Taught Languages (LCTLs) in Yunnan Province, China. This study explores the factors influencing PCK among these teachers to provide insights for both theoretical advancement and practical application in foreign language education.

Background

LCTLs include all languages other than the most commonly taught ones such as English, French, and Spanish. The Ministry of Education in China defines LCTLs as foreign languages other than the six official UN languages: Chinese, English, French, Russian, Arabic, and Spanish. Despite their importance, research on PCK development for LCTL teachers remains limited.

PCK, defined by Shulman (1986), encompasses the methods and strategies for teaching specific subject matter effectively, considering students' learning difficulties. It includes knowledge of effective representations of course content, student misconceptions, and potential challenges. Teachers of LCTLs require specialized knowledge that integrates subject matter and pedagogical content, serving as the core of their teaching expertise. Several factors influence PCK development, including teacher attitudes, ecological environments, and efficacy. Teacher attitudes reflect their approval or disapproval of PCK development, influencing their behavior towards professional growth. The teacher ecological environment includes classroom, school, and societal contexts that impact PCK development. Teacher efficacy refers to the confidence in mastering and effectively teaching subject-specific knowledge.

This study targets LCTLs teachers in Yunnan Province and involves a sample size of 243 teachers. The research period spans from 2022 to 2023, focusing on the development of PCK among these teachers.

Objective

1. To test the model of influencing factors in the development of PCK among LCTLs teachers, including the various variables and their relationships within the model.

2. To explain the results of the relationships between variables, in order to provide a more in-depth understanding of the influencing factors in the development of PCK among LCTLs teachers.

3. To construct an innovative management model to improve the PCK of LCTLs teachers.

Literature Review

Background Knowledge and the Emergence of PCK Concept

Pedagogical Content Knowledge (PCK) is a key element that differentiates effective teachers from mere subject matter experts. Shulman (1986) introduced PCK as part of "Content Knowledge," which includes "Subject Matter Knowledge" and "Curriculum Knowledge." It involves Knowledge of Representations and Knowledge of Learning Difficulties and Strategies to Overcome Them. Shulman later categorized PCK as one of seven major types of teacher knowledge, highlighting its integration of content and pedagogy. Cochran et al. (1993) critiqued Shulman's static view, proposing Pedagogical Content Knowing (PCKg). Hashweb (2005) introduced Teacher Pedagogical Constructions (TPCs), emphasizing PCK's evolution through practice and reflection. Mishra & Koehler (2006) incorporated technological knowledge into PCK, creating the Technological Pedagogical Content Knowledge (TPACK) framework. Grossman (1990) expanded PCK to include knowledge and beliefs about purposes and curriculum materials. Marks (1990) identified specific PCK categories in mathematics, while Park & Chen (2012) proposed the "Pentagon Model of Science Teacher PCK." The 2012 PCK Summit redefined PCK, integrating assessment, pedagogical, content, student, and curriculum knowledge, stressing its context-specific and individual nature.

Theoretical and Variable Review

This study employs the Theory of Planned Behavior (TPB) and Ecological Systems Theory (EST) to understand the development process of Pedagogical Content Knowledge (PCK) among teachers, particularly for less commonly taught languages (LCTLs).

The Theory of Planned Behavior (TPB), developed by Icek Ajzen in 1991 as an extension of the Theory of Reasoned Action (TRA) by Fishbein and Ajzen (1975), posits that individual behavior is primarily determined by behavioral intentions. These intentions are shaped by three key factors: attitudes toward the behavior, subjective norms, and perceived behavioral control. Attitude, as defined in social psychology, involves evaluating an object on a spectrum from extremely negative to extremely positive. This evaluation is influenced by behavioral beliefs and evaluations of the consequences associated with the behavior (Outcome Evaluations). Subjective norms refer to an individual's perception of social expectations and the opinions of significant others. Schiffman et al. (2013) categorize these reference groups into primary (e.g., family) and secondary (e.g., colleagues) groups, which exert varying degrees of influence on behavior. Perceived behavioral control reflects an individual's belief in their capability to perform a behavior, influenced by their control beliefs about facilitating or inhibiting factors (Ajzen, 2020).

Conceptually, perceived behavioral control overlaps with self-efficacy (Bandura, 1982), which pertains to beliefs in one's capability to successfully execute tasks.

Ecological Systems Theory (EST), proposed by Urie Bronfenbrenner in 1979, highlights the contextual nature of individual development within interconnected environmental systems. It categorizes influences into four levels: At the micro-system level, immediate environments like family, school, and peers shape development through direct interactions. The meso-system shows how interactions between these settings influence outcomes. Exo-system factors, like community resources and parental workplaces, indirectly impact development. Macro-system influences encompass societal and cultural norms. In education, EST bridges psychological and educational theories, guiding practices from early education onward. Research applications show its relevance: Paat (2013) explores cultural factors in immigrant children's educational development. Kelly and Coughlan (2019) link social and environmental contexts to adolescent mental health recovery. Lippard et al. (2017) highlight teacher-student relationships' role in child development. Wilson et al. (2002) demonstrate how school diversity supports student well-being.

Integrated Theoretical Framework

The development of teachers' Pedagogical Content Knowledge (PCK) is influenced by attitudes, subjective norms, perceived behavioral control (TPB), and broader educational and cultural contexts (EST). This study applies TPB and EST to explore factors influencing PCK development among LCTLs teachers in Yunnan Province universities. By integrating TPB's focus on individual intentions and EST's contextual approach, this framework examines how these factors impact PCK intentions and behavior, providing insights into teachers' professional growth and effectiveness in teaching less commonly taught languages.
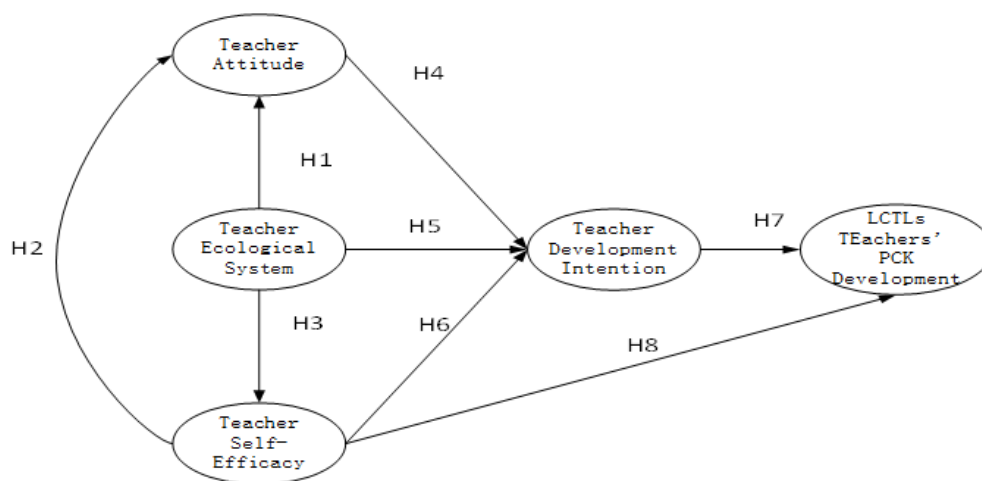

Figure1 Conceptual Framework

Methodology

The research integrates the Theory of Planned Behavior (TPB) and Ecological Systems Theory (EST). A mixed-methods approach was adopted, combining both quantitative and qualitative data collection methods to examine how individual intentions, as per TPB, and contextual influences, as described by EST, interact and impact PCK development among LCTLs teachers. The section details the integration of quantitative and qualitative methods, and the construction of the innovative management model.

Quantitative Methods

A structured questionnaire based on the Theory of Planned Behavior (TPB) and Ecological Systems Theory (EST) frameworks included Likert-scale items assessing attitudes, self-efficacy, ecological systems, and PCK intentions. Data from 243 LCTL teachers, who are involved in less-commonly taught language education and teaching at universities in Yunnan Province, underwent Structural Equation Modeling (SEM) analysis for hypothesis validation.

Qualitative Methods

In-depth interviews with 34 LCTL teachers provided insights into contextual factors influencing PCK development. NVivo software facilitated qualitative data analysis through open coding and theme extraction. The qualitative study utilized a sampling method to select 34 samples from the entire pool of teachers participating in the questionnaire survey, aiming for a detailed exploration of the relationships among key variables. Sample selection prioritized teachers who demonstrated notable characteristics in these key variables. By reaching out to potential participants, we obtained their consent for further in-depth interviews.

Innovative Management model Construction

An innovative management model was developed through focus group discussions with experts in LCTLs teaching, human resources, and psychology. Strategies aimed to enhance teacher training, efficacy, and optimize ecological systems in LCTLs contexts, with clear evaluation metrics for ongoing assessment.

Results

Building on the detailed research methodology, this chapter presents our findings on factors influencing Pedagogical Content Knowledge (PCK) development among teachers of less commonly taught languages (LCTLs) in Yunnan Province universities. The results follow a mixed-methods approach, beginning with quantitative analysis of questionnaire data, qualitative insights from interviews, and concluding with a synthesized management model. This approach aims to

provide a comprehensive understanding of PCK development influences and practical recommendations for improving teacher training and efficacy in LCTLs contexts.

1. Quantitative Data Results and Analysis

To gain a comprehensive understanding of the teachers participating in this study, we conducted a frequency analysis on sample demographics, including gender, age, years of teaching experience, current school affiliation, professional title, and educational background, based on 243 valid questionnaires. The results indicate that females outnumber males, the 31-40 age group comprises the highest proportion, those with 1-5 years of teaching experience dominate, undergraduate colleges are the most prevalent in school affiliation, lecturers hold the highest proportion in professional titles, and individuals with a master's degree constitute the majority in educational background.

(1) Reliability Analysis

Reliability analysis, also known as consistency or stability testing, is used to examine the consistency, reliability, and stability of a scale. Cronbach's **α** coefficient is commonly used for this analysis (Cronbach, 1951). Generally, if the reliability coefficient is: >0.9, it indicates excellent reliability; 0.8 -0.9, it indicates very good reliability; 0.7 - 0.8, it indicates good reliability; 0.6 - 0.7, it indicates acceptable reliability; < 0.6, it indicates that the scale needs revision.

These codes and abbreviations will be used in the subsequent results analysis and discussion sections to simplify the representation and reference of variables: Code. Int = Intentions; Att = Attitudes; Eff = Self-Efficacy; Env = Ecological Systems.

Table 1 Results of the Questionnaire Reliability Analysis

	Cronbach's Alpha	N of Items
Pck	0.868	12
Int	0.861	9
Att	0.851	8
Eff	0.835	8
Env	0.854	9

The above reliability analysis results show that the Cronbach's Alpha values for all indicators are greater than 0.7, indicating that the scale has good internal consistency reliability.

(2) Descriptive Statistics and Correlation Analysis

Descriptive statistics and correlation analysis were conducted to examine the relationships between key variables, with results presented in Tables 2 and 3.

Table 2 Descriptive Statistics for Variables

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Pck	243	1.42	5.00	3.47	0.655
Int	243	1.44	5.00	3.38	0.739
Att	243	1.13	4.88	3.29	0.768
Eff	243	1.38	4.75	3.37	0.777
Env	243	1.22	4.78	3.30	0.741

From the table above, it can be seen that the mean values of each variable range from 3.29 to 3.47, indicating that overall, the scores for each variable are above average. The standard deviations range from 0.655 to 0.777, suggesting a moderate level of data dispersion. The range of maximum and minimum values indicates that the scores for all variables cover the entire range of the scale.

Correlation analysis result

Table 3 Correlation Matrix for Variables

Variable	Pck	Int	Att	Eff	Env
Pck	1				
Int	0.388**	1			
Att	0.344**	0.493**	1		
Eff	0.456**	0.500**	0.431**	1	
Env	0.399**	0.476**	0.447**	0.361**	1

** Correlation is significant at the 0.01 level (2-tailed).

The above table shows that the correlation coefficients between all variables are positive and significant at the 0.01 level, indicating that there is a positive correlation between the variables. The correlation coefficients between Pck and Int, Att, Eff, and Env are 0.388, 0.344, 0.456, and 0.399, respectively, indicating that there is a moderate positive correlation between these variables. The correlation coefficients between Int and other variables (Att, Eff, and Env) are 0.493, 0.500, and 0.476, respectively, indicating that the correlation between Int and other variables is high.
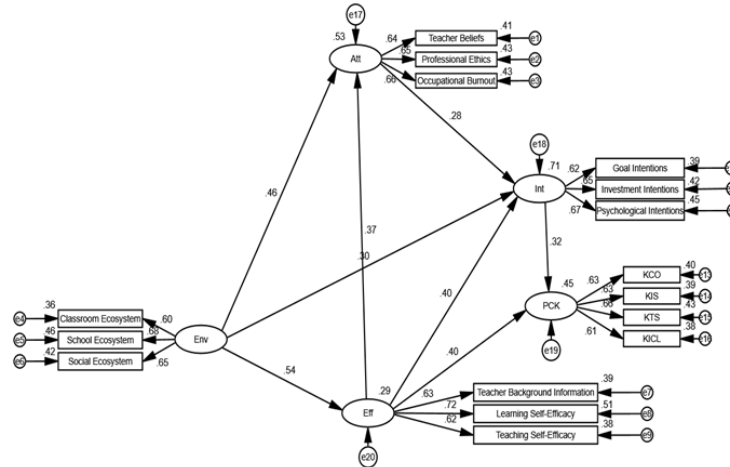
(3) Structural Equation Modeling (SEM)

To evaluate the adequacy of the model, we assess the fit indices that measure the model's overall performance. Table 4 provides key fit indices for the SEM analysis, offering insights into how well the model aligns with the data and whether it meets the acceptable thresholds for fit.

Table 4 Model Fit Indices for SEM Analysis

index	CMIN/DF	RMR	GFI	AGFI	IFI	TLI	CFI	RMSEA
judgment criteria	<3	<0.05	>0.9	>0.9	>0.9	>0.9	>0.9	<0.08
measurement result	1.209	0.039	0.946	0.924	0.98	0.974	0.979	0.029

From the table, the model's CMIN/DF is 1.209, RMR is 0.039, GFI is 0.946, AGFI is 0.924, IFI is 0.98, TLI is 0.974, CFI is 0.979, and RMSEA is 0.029. All model fit indices meet or exceed the threshold criteria, indicating that the model fits well in this study.

Figure 2 Structural Equation Modeling (SEM) Path Diagram

The SEM path diagram presented in Figure 2 visually depicts the relationships among the constructs within the model, including the path coefficients. This diagram provides a detailed view of how each variable interacts with others and how these interactions contribute to the overall model.

In order to further understand the relationship between latent variables, we estimated and verified the path coefficients. The specific results are as follows:

Table 5 Path Coefficients and Standardized Estimates for SEM Analysis

			Estimate	S.E.	C.R.	P	STD.Estimate
Eff	<---	Env	0.615	0.128	4.812	***	0.54
Att	<---	Env	0.539	0.144	3.739	***	0.461
Att	<---	Eff	0.376	0.118	3.185	0.001	0.367
Int	<---	Env	0.355	0.15	2.356	0.018	0.302
Int	<---	Att	0.284	0.14	2.026	0.043	0.283
Int	<---	Eff	0.408	0.124	3.289	0.001	0.397
PCK	<---	Int	0.3	0.145	2.068	0.039	0.318
PCK	<---	Eff	0.393	0.155	2.534	0.011	0.405

The table presents the path coefficients and their statistical significance. Specifically, the Standardized Estimate of Environment (Env) on Teacher Efficacy (Eff) is 0.615 (p < 0.001), on Attitude (Att) is 0.539 (p < 0.001), and on Intention (Int) is 0.355 (p = 0.018). The Standardized Estimate of Teacher Efficacy (Eff) on Attitude (Att) is 0.376 (p = 0.001) and on Intention (Int) is 0.408 (p = 0.001). The Standardized Estimate of Attitude (Att) on Intention (Int) is 0.284 (p = 0.043). The Standardized Estimate of Intention (Int) on Pedagogical Content Knowledge (PCK) is 0.300 (p = 0.039), and the Standardized Estimate of Teacher Efficacy (Eff) on PCK is 0.393 (p = 0.011).

Table 6 Hypothesis Testing Results

Relationship	Path Coefficient	Standardized Coefficient	P-Value	Conclusion
Teacher efficacy (Eff) and teacher ecosystem (Env)	0.615	0.54	< 0.001	Significant positive impact; good ecosystem improves efficacy
Teacher attitude (Att) and teacher ecosystem (Env)	0.539	0.461	< 0.001	Significant positive impact; ecosystem positively affects attitudes
Teacher attitude (Att) and teacher efficacy (Eff)	0.376	0.367	0.001	Significant positive impact; efficacy enhances attitudes
Teacher development intention (Int) and teacher ecosystem (Env)	0.355	0.302	0.018	Significant positive impact; good ecosystem enhances development intentions
Teacher development intention (Int) and teacher attitude (Att)	0.284	0.283	0.043	Significant positive impact; positive attitude enhances development intentions
Teacher development intention (Int) and teacher efficacy (Eff)	0.408	0.397	0.001	Significant positive impact; efficacy promotes development intentions
Teacher PCK (PCK) and teacher development intention (Int)	0.3	0.318	0.039	Significant positive impact; development intentions promote PCK development

Relationship	Path Coefficient	Standardized Coefficient	P-Value	Conclusion
Teacher PCK (PCK) and teacher efficacy (Eff)	0.393	0.405	0.011	Significant positive impact; efficacy affects PCK development

Based on the results of the Structural Equation Modeling (SEM) analysis, this study found that teacher efficacy (Eff) is significantly positively influenced by the teacher ecosystem (Env) (path coefficient = 0.615, standardized coefficient = 0.54, P < 0.001), indicating that a good ecosystem helps improve teachers' sense of efficacy. Teacher attitude (Att) is also significantly positively influenced by the teacher ecosystem (Env) (path coefficient = 0.539, standardized coefficient = 0.461, P < 0.001) and by teacher efficacy (Eff) (path coefficient = 0.376, standardized coefficient = 0.367, P = 0.001), showing that both the ecosystem and efficacy are important factors affecting teachers' professional attitudes. Teacher development intention (Int) is significantly positively influenced by the teacher ecosystem (Env) (path coefficient = 0.355, standardized coefficient = 0.302, P = 0.018), teacher attitude (Att) (path coefficient = 0.284, standardized coefficient = 0.283, P = 0.043), and teacher efficacy (Eff) (path coefficient = 0.408, standardized coefficient = 0.397, P = 0.001), indicating that these three factors are crucial in promoting teachers' development intention. Finally, teacher PCK (PCK) is significantly positively influenced by teacher development intention (Int) (path coefficient = 0.300, standardized coefficient = 0.318, P = 0.039) and teacher efficacy (Eff) (path coefficient = 0.393, standardized coefficient = 0.405, P = 0.011), demonstrating that teachers' development intention and efficacy are key factors in promoting their PCK development.

2. Qualitative Research Analysis

To better understand and support the Pedagogical Content Knowledge (PCK) development of less commonly taught language teachers, we analyzed extensive interview data using NVivo software. PCK involves integrating subject matter knowledge, teaching methods, and understanding of students. We examined key factors influencing PCK development, including teaching practices, beliefs, professional ethics, external environment, and personal experiences.

Through systematic coding and analysis, we aimed to uncover how these factors interact and affect teachers' teaching efficacy and professional growth. Our goal was to provide targeted recommendations and support to help teachers achieve greater success in their teaching.

In summary, our analysis revealed multi-dimensional factors in teachers' teaching practice and professional development, highlighting key paths and influences in PCK development. Specifically:

- Teacher Efficacy and Development: Reflect teachers' efforts in improving teaching methods, optimizing resource utilization, and formulating career development strategies.

- Personal Factors: Highlight the impact of teachers' beliefs, teaching experience, environmental support, and family support on teaching efficacy.

- Goal Aspects: Reveal teachers' insights and strategies in career development.

- Attitude and Psychological Intention: Reflect teachers' teaching beliefs and self-awareness.

- Investment and Goal Intention: Emphasize teachers' dedication and effort in career planning and teaching.

These findings provide a solid foundation for developing effective support and development strategies for teachers. To gain a deeper understanding of the specific issues affecting the development of PCK among less commonly taught language teachers in Yunnan Province, we collected a wealth of key insights and practical strategies through focus group discussions. These discussions provided a crucial basis for building an effective management model. The focus groups, consisting of 12 experts from the fields of less commonly taught languages, corporate human resource management, and psychology, engaged in in-depth discussions. Through this process, we developed a management model.
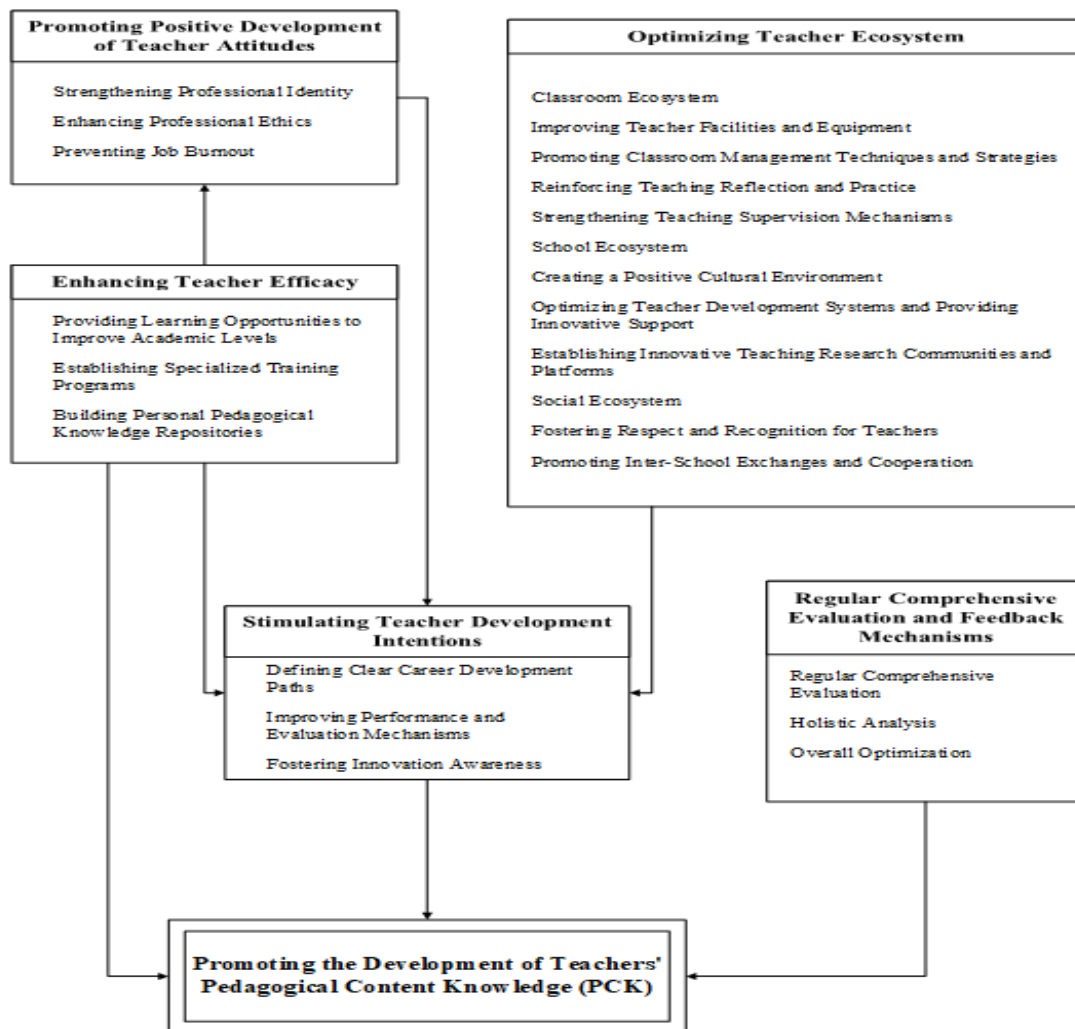
Figure 3 Innovative Management Model for Promoting the Development of Pedagogical Content Knowledge among Less commonly taught languages Teachers

3. Specific Content and Implementation Strategies of the Model

We outline four key aspects of the management model and their implementation strategies:

(1) Promoting Positive Teacher Attitudes

Strengthen teachers' professional identity by providing clear career paths and goals to encourage improvement in teaching skills. Enhance professional ethics to boost responsibility and commitment to student learning. Prevent burnout by creating a supportive work environment with incentives and opportunities for personal development.

(2) Optimizing Teacher Ecosystems

Improve classroom facilities and management techniques to enhance teaching efficiency and interaction. Encourage regular reflection and adjustment of teaching strategies. Implement supervision and feedback to refine teaching methods. Foster a positive school culture to inspire innovation and collaboration. Provide continuous support through innovative development paths, research communities, and digital platforms. Promote cross-school exchanges and respect for teachers to enhance their professional networks and recognition.

(3) Enhancing Teacher Efficacy

Offer diverse learning opportunities such as seminars, lectures, and exchanges to deepen understanding and share best practices. Develop tailored training programs to address specific needs and improve teaching methods. Create a knowledge repository using modern technologies like knowledge graphs to efficiently organize and access teaching materials.

(4) Inspiring Teacher Development Intentions

Provide clear career paths and planning to boost motivation and confidence. Implement a fair performance evaluation system with incentives for outstanding performance. Encourage innovation through workshops and activities to explore new teaching methods and technologies.

(5) Assessment and Feedback Mechanisms

Conduct regular assessments each semester or year to evaluate the model's effectiveness. Gather teacher feedback through surveys and interviews to understand their needs and suggestions. Analyze feedback to identify issues and areas for improvement, and make timely adjustments to ensure the model's ongoing success.

Summary of Key Findings

This study explored the development of Pedagogical Content Knowledge (PCK) among less commonly taught languages (LCTLs) teachers in Yunnan Province, China. It was found that experienced teachers generally develop stronger PCK due to their extensive practice, while newer teachers often struggle with integrating content and pedagogy, highlighting the need for specialized professional development. The research revealed that teachers with a positive attitude toward ongoing professional development tend to have better PCK. High self-efficacy also plays a crucial role, as teachers who believe in their abilities and are open to innovative practices show more significant PCK growth. Additionally, a supportive educational environment, including institutional support and peer collaboration, is important for PCK development. Qualitative insights further highlighted that teachers face challenges such as limited resources and insufficient professional development opportunities. However, institutional support and peer collaboration are essential in overcoming these obstacles. Continuous and targeted training, along

with intrinsic motivation, drives teachers' efforts to improve their PCK. Strategies developed through expert focus groups emphasized the need for a supportive environment and enhancing teachers' self-efficacy. Based on these findings, a management model was constructed to address the identified needs and enhance PCK among LCTLs teachers.

Discussion

In the following discussion, we examine the implications of the study's findings by focusing on several key aspects relevant to the development of Pedagogical Content Knowledge (PCK) among teachers of less commonly taught languages (LCTLs). We will address the development of PCK among both experienced and novice teachers, identify the significant factors influencing PCK growth, and present a proposed management model. Additionally, this section will highlight the innovations introduced by the study and their potential contributions to the field.

1. Development of PCK among LCTLs Teachers

Our findings reveal that experienced teachers often exhibit more developed PCK due to their extensive practice and reflection. Conversely, newer teachers face challenges in integrating content knowledge and pedagogy, underscoring the need for targeted professional development. This supports the notion that ongoing professional learning is vital for improving teaching skills, especially in the context of less commonly taught languages where resources and training are typically scarce.

2. Influencing Factors on PCK Development

The study identifies key factors influencing PCK development. Positive attitudes towards professional growth and high self-efficacy are significant contributors to better PCK. Furthermore, a supportive educational environment, including institutional support and peer collaboration, is crucial. These findings align with existing theories that highlight the importance of teacher attitudes and supportive systems in enhancing teaching effectiveness.

3. Construction of an Effective Management Model

We propose a management model based on our findings, which includes strategies for strengthening professional identity, optimizing teacher ecosystems, enhancing efficacy, and inspiring development intentions. The model leverages modern technologies, such as knowledge graphs, to improve resource management and emphasizes tailored professional development to address specific teacher needs. This comprehensive approach aims to tackle both individual and systemic factors impacting PCK.

4. Innovations and Contributions

Our study introduces several innovations:

    1) **Innovative Management Model:** A multi-faceted strategy to address various aspects of teacher development.

    2) **Modern Technologies:** Utilization of knowledge graphs for efficient organization and access to teaching materials.

    3) **Tailored Professional Development:** Focus on addressing specific needs for more effective training.

    4) **Teacher Ecosystems:** Emphasis on creating supportive environments to promote professional growth.

Suggestion for Future Research

Future research should investigate the long-term impacts of the proposed management model on PCK development and explore the needs of different teacher subgroups. Additionally, examining the influence of cultural and contextual factors can offer valuable insights for adapting the model to diverse educational settings.

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