

Continuing Professional Development of Rural Teachers in Border Areas of Yunnan Province, China

Xuejun Wang^{1,2} & Peng-Fei Chen^{1,*}

¹Chinese International College, Dhurakij Pundit University, Bangkok, Thailand

²College of Arts and Sciences Kunming, China

*Correspondence: Chinese International College, Dhurakij Pundit University, Bangkok, Thailand. E-mail: blissfulalice@gmail.com

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Abstract

Rural educators working in border regions of Yunnan Province possess distinct cultural characteristics, and their continuing professional development (CPD) carries great importance for both individual career growth and the stable development of border-area education. By conducting empirical investigations, this research seeks to clarify how digital literacy shapes teachers' CPD, as well as how teachers' social capital moderates this linkage. Grounded in CPD theory, questionnaire data were gathered from 561 rural border teachers across Yunnan. Statistical findings reveal that gender, years of teaching, academic qualifications, and teaching levels are significantly associated with variations in CPD, digital literacy, and social capital. Specifically, male teachers, instructors with 11-20 years of experience, those with higher degrees, and middle school teachers scored higher. Digital literacy positively and significantly predicts CPD, while social capital strengthens this positive linkage. In short, stronger social capital enhances the positive influence of digital literacy on teachers' professional development.

Keywords: cross-border ethnic areas of Yunnan province china, teachers' continuing professional development, digital literacy, teachers' social capital

1. Introduction

Digital transformation restructures education, making digital teaching abilities essential for teacher development (Shafira et al., 2024). China released national teacher digital competency standards with five core dimensions in 2022 (D. Wu et al., 2023). Border rural teachers lack equipment and targeted training, rarely applying digital tools and falling further behind in self-learning (W. Zhao, 2024; Soekamto et al., 2022).

Yunnan borders Myanmar, Laos and Vietnam with a 4,060-kilometer boundary and 25 border counties. This region undertakes border governance and inclusive ethnic education missions (H. Liu et al., 2022). Border rural education balances regional educational resources, promotes ethnic unity and safeguards border stability. Teachers' comprehensive ability determines local education quality and policy implementation (Jaramillo-Neira et al., 2025; Yu & He, 2024). Dozens of ethnic groups reside here, creating barriers: Mandarin-only textbooks, varied educational concepts and gender norms restricting female teachers' training access (Peterson et al., 2020; Tambak et al., 2022; Yu & He, 2024). Remote location, underdeveloped economy and ethnic traditions create mismatched offline training without follow-up guidance, weakening teachers' digital skills and learning motivation (D. Wang, 2023).

Teacher professional growth includes lifelong learning, knowledge renewal, teaching reflection and collective lesson preparation, supporting adaptation to educational reforms (Friedman, 2023; Njenga, 2023). Teachers' social resources refer to trust-based partnerships and shared teaching standards that facilitate experience exchange and ability improvement (Demir, 2021; Mailizar et al., 2022).

This research selects grassroots teachers from Yunnan's 25 border township and village schools to explore correlations between digital teaching ability, professional growth and the moderating role of social resources. It focuses specifically on border rural teachers, complements inland rural education research and provides digital teaching integration strategies for ethnic border schools (Verbovskiy & Bozhenko, 2025).

2. Literature Review

CPD (Continuing Professional Development) refers to practitioners' dynamic lifelong learning process to refresh knowledge and polish practical skills after employment. It emphasizes attributes such as goal orientation, contextual adaptation, and lifelong learning (Friedman, 2023), and is defined as the process by which professionals continually update their knowledge, improve their skills, and enhance their competencies through lifelong learning after entering the workforce (Mlambo et al., 2021). Its theoretical framework designs targeted localized learning that combines cognition, emotion and values, requiring ethical and critical teaching reflection (Njenga, 2023). It is multi-objective learning with diverse content and flexible implementation modes (Dudina, 2024).

2.1 Continuing Professional Development Theory

Teacher CPD covers competence-improving learning activities with localized and goal-focused traits (Hagedoorn et al., 2025). Njenga (2023) deemed teachers' goal-oriented adult learners, with individual and environmental factors determining training outcomes. External factors involve digital education policies and campus atmosphere; internal factors mainly include teachers' digital competency (Lindfors et al., 2021; Mailizar et al., 2022). Teachers' social resources boost environmental adaptability via mutual trust and team cooperation (Atkins, 2018). To sum up, CPD is a structured dynamic process integrating cognition, emotion and values to realize teacher growth (Friedman, 2023).

2.2 Rural Border Education

Rural zones are suburban peripheral areas with sparse population, agriculture-based economies and unique social structures (Kovach, 2023). Rural instructors serve township, village and community primary and secondary campuses (Z. Wei, 2023). This paper targets Yunnan's border territories adjacent to Vietnam, Myanmar and Laos (Hu & Wang, 2023). Border rural teachers act as core drivers of local educational progress (Jin, 2025). Official data records Yunnan has 1,252 border schools covering 640,600 enrolled students (China Education Daily, 2025). Their career growth is hindered by remote locations, uneven economic levels and cultural perceptions, alongside severe ICT learning barriers (Yil et al., 2024; Jia & Yaofen, 2024). Restrictions include salary disparities, low social recognition, cross-cultural adaptation difficulties and overwork that trigger occupational exhaustion (D. Wang, 2023). Current training overstresses abstract theories, neglects multilingual multicultural barriers and lacks post-training guidance (Wuripe, 2025; Yu & He, 2024). Nearly all teaching materials use only Mandarin, creating learning obstacles for ethnic minority teachers (Yu & He, 2024). Border teachers undertake extra administrative work including cross-border student file management, multi-department coordination and patriotism education that inland teachers do not handle (D. Wang, 2023; Yu & He, 2024).

2.3 Continuing Professional Development

Teacher professional growth is a lifelong process to upgrade teaching skills and update educational concepts through self-study, school training and peer exchanges. Three core components form this process: updating subject knowledge and teaching skills, reflecting on classroom practice and collaborative learning with peers (de Vries et al., 2013). In reality, rural teachers lack systematic training resources, and most training content fails to match daily teaching demands (Wuripe, 2025).

2.4 Teachers' Social Capital

Social resources originated in sociology and later expanded to politics, economics and behavioral science research (Y. Xiao et al., 2025). Coleman (1988) first applied this concept to education research, defining it as structural social resources that improve individual work efficiency. For teachers, social resources cover resources, trust and cooperative bonds from formal and informal professional connections, boosting career growth, lowering turnover and lifting student grades (Demir, 2021). Scholars divide this construct into three dimensions: structural, relational and cognitive layers (R. Lee, 2009; Mani, 2019).

2.5 Teacher Digital Literacy

Digital competency means the ability to search, judge, create and share digital information, integrating thinking, technical and communication capabilities (Greene & Crompton, 2024; Pangrazio et al., 2020). For instructors, digital competency integrates technology, subject knowledge and teaching methods with critical thinking, digital ethics and innovative classroom design (Sánchez-Cruzado et al., 2021). Rural teachers only hold medium-low digital competency due to insufficient digital awareness and operation skills (M. Tang et al., 2025; Y. Xu, 2024). This paper adopts this integrated definition covering five layers: digital awareness, operation skills, classroom application, digital ethics and vocational growth (Dou & Zhao, 2023).

2.6 Hypotheses

Diversified training lifts teacher competency, which is affected by personal and environmental factors (Njenga, 2023). Such learning includes organized, semi-organized and self-guided modes, relying on self-reflection and peer communication (Abakah, 2023). Rural teachers suffer isolation and resource shortages, with training rarely fitting their actual demands (Wuripe, 2025). Digital platforms create new upgrading chances (Habibulloh, 2025). Remote location and poor IT skills cut training efficiency in border counties (Yu & He, 2024; Jin, 2025). Peer cooperation stays shallow in border schools (Romero & Vasilopoulos, 2020). Digital teaching integration improves teachers' comprehensive skills (Mirza & Nakonechnikova, 2025). Gender, tenure, degree and teaching phase impact training results (Y. Ji, 2023; Y. Zhi & H. Yang, 2024). Based on the above, the following hypotheses are proposed:

H1: There are significant differences in continuing professional development among border rural teachers with different background variables (gender, teaching experience, educational background, and teaching levels).

H1a: Teachers' continuing professional development differs significantly by gender.

H1b: Teachers' continuing professional development differs significantly by teaching experience.

H1c: Teachers' continuing professional development differs significantly by educational background.

H1d: Teachers' continuing professional development differs significantly by teaching levels.

Teacher social resources fall into internal and external categories (Y. Xiao et al., 2025). Teacher social resources boost career growth, lower turnover and improve student performance (Demir, 2021). External resources supply new information; internal ones rely on mutual trust and unified teaching targets (Adler & Kwon, 2002; Darling-Hammond & McLaughlin, 2011). Insufficient trust in rural campuses blocks teacher cooperation (J. Wu et al., 2025). Teacher learning communities cultivate social resources and strengthen staff sense of belonging (H. Zhang et al., 2024; Osmond-Johnson & Fuhrmann, 2022). Female teachers depend more on social resources, males on cultural accumulation (Grinshtain & Addi-Raccah, 2020). Young teachers prefer digital communication, senior staff choose offline traditional learning (Castéra et al., 2020; Y. Zeng et al., 2025). Based on the above, the following hypotheses are proposed:

H2: There are significant differences in teacher social capital among border rural teachers with different background variables (gender, teaching experience, educational background, and teaching levels).

H2a: Teachers' social capital differs significantly by gender.

H2b: Teachers' social capital differs significantly by teaching experience.

H2c: Teachers' social capital differs significantly by educational background.

H2d: Teachers' social capital differs significantly by teaching levels.

Teacher digital competency is the core of educational digital reform (Falloon, 2020). China's national standard divides it into five dimensions as mentioned above (L. Zhang, 2026). Rural teachers fall behind due to insufficient digital infrastructure and targeted training (Soekamto et al., 2022; W. Zhao, 2024). AI and big data can lift digital ability, yet few studies build exclusive models for ethnic rural border areas (Basilotta-Gómez-Pablos et al., 2022; Zhang & Su, 2025). Border rural teachers lack digital infrastructure and customized skill training (Enstein et al., 2024; Soekamto et al., 2022). Males own stronger digital skills, females excel at classroom teaching (Orakova et al., 2024). Young and highly educated teachers hold higher digital competency (Gökdas & Çam, 2022; Suzer & Koç, 2024). Based on the above, the following hypotheses are proposed:

H3: There are significant differences in digital literacy among border rural teachers with different background variables (gender, teaching experience, educational background, and teaching levels).

H3a: Teachers' digital competency differs significantly by gender.

H3b: Teachers' digital competency differs significantly by teaching experience.

H3c: Teachers' digital competency differs significantly by educational background.

H3d: Teachers' digital competency differs significantly by teaching levels.

Digital competency acts as the foundation of teacher career growth; its deficiency becomes a key bottleneck (Fernández Batanero et al., 2025). High digital competency diversifies teaching modes and motivates teachers to join training (Elsayary, 2023; Mirza & Nakonechnikova, 2025). It positively forecasts teachers' recognition and long-term use of online training (Mailizar et al., 2022). Digital capability directly boosts teacher growth and student learning results (Suyitno & Dalhari, 2025). Rural teachers' hardware and skill shortages restrict digital tools for

self-improvement (Soekamto et al., 2022; Y. Xu, 2024). Border teachers receive fewer skill-upgrading chances than inland rural peers (Rofiah et al., 2024). Based on the above, the following hypotheses are proposed:

H4: Digital literacy has a significant positive impact on continuing professional development.

Teacher social resources adjust the correlation between digital competency and professional growth (Levi-Faur et al., 2021). Structural social resources (teacher networks, information exchange) boost cooperation and online training participation (Yoon et al., 2020). Social resources can also mediate the improvement of teachers' digital ability (Lo et al., 2024). Peer collaboration moderates the digital literacy-CPD link (Dahri et al., 2021). Organizational support is critical for CPD outcomes (J. Chen et al., 2025). Interpersonal empathy and trust also play adjusting roles in this correlation (Muhidin, 2025). Based on the above, the following hypotheses are proposed:

H5: Teacher social capital plays a significant positive moderating role between digital literacy and continuing professional development.

3. Methods

This study, grounded in CPD theory, examines how digital literacy affects CPD, with social capital as a moderator. Background variables (gender, experience, education, teaching levels) also influence these relationships (Shi et al., 2023; Suzer & Koç, 2024; Y. Zhang et al., 2025).

3.1 Participants

Purposive sampling collected primary and secondary teachers from Yunnan's 25 border county township and village schools. Online questionnaires were distributed through Wenjuanxing, WeChat, QQ and DingTalk for teachers to complete in spare time. A pilot test preceded formal research: 350 questionnaires issued, 332 valid complete responses recovered. 620 questionnaires were issued formally; invalid incomplete or repetitive copies were eliminated, leaving 561 valid samples with a 90.5% recovery rate.

3.2 Research Instruments

Three mature, validated scales-the Continuing Professional Development Scale, the Digital Literacy Scale, and the Teacher Social Capital Scale-were employed in this study, using a 5-point Likert scale (1=Totally Disagree, 5=Totally Agree), and were translated through back-translation (Y. Zhao et al., 2024). The 332 pilot respondents were used to test item quality, reliability and validity of each scale.

3.2.1 Continuing Professional Development Scale

Designed by de Vries et al. (2013), this 40-item scale includes three dimensions: knowledge upgrading, teaching reflection and peer cooperation. Item analysis showed C.R. values from 7.372 to 11.524 (>3), item-total correlations from .445 to .569 ($>.400$), and communalities from .445 to .673 ($>.200$). EFA extracted three factors explaining 54.534% total variance, verifying structural validity (Xue & Mansor, 2025). Overall Cronbach's alpha was .924, with dimension α values of .915, .935, and .940, all exceeding .700 (Jiang et al., 2024).

3.2.2 Digital Literacy Scale

Alom and Ramalingappa's (2025) 42-item scale covers four dimensions: information sharing, digital creation, resource access and network safety. Item analysis showed C.R. values from 6.800 to 11.284 (>3), item-total correlations from .437 to .592 ($>.400$ except S4: .399), and communalities from .467 to .647 ($>.200$). EFA four factors explain 54.727% variance, with qualified structural validity (Xue & Mansor, 2025). Overall Cronbach's alpha was .935, with dimension α values of .872, .927, .915, and .914, all exceeding .700 (Jiang et al., 2024).

3.2.3 Teacher Social Capital Scale

Developed by Mani (2019), this scale comprises 24 items across three dimensions: social structure (8 items), mutual understanding (8 items), and the nature and quality of interpersonal relationships (8 items). Item analysis showed C.R. values from 7.427 to 12.646 (>3), item-total correlations from .489 to .620 ($>.400$), and communalities from .506 to .651 ($>.200$). EFA extracted three factors explaining 57.379% of variance (Xue & Mansor, 2025). Overall Cronbach's alpha was .894, with dimension α values of .889, .893, and .895, all exceeding .700 (Jiang et al., 2024). All items were retained after pilot testing.

4. Results

This paper sequentially conducted demographic analysis, descriptive statistics, reliability test, CFA and discriminant validity inspection. One-way ANOVA verified H1-H3; correlation and hierarchical regression tested H4-H5.

4.1 Demographic Structure Analysis

Table 1. Demographic Information ($n=561$)

Category	Option	Frequency	Percentage (%)
Gender	Male	213	37.968%
	Female	348	62.032%
Teaching Experience	5 years and below	139	24.777%
	6–10 years	192	34.225%
	11–20 years	114	20.321%
	21–30 years	72	12.834%
	31 years and above	44	7.843%
Highest Educational Background	Secondary Normal School / Secondary Vocational School	34	6.061%
	Associate Degree	122	21.747%
	Bachelor's Degree	366	65.241%
	Master's Degree or Above	39	6.952%
Teaching levels	Primary School	195	34.759%
	Middle School	225	40.107%
	High School	79	14.082%
	Vocational High School	62	11.052%

As shown in Table 1 the 561 valid samples cover teachers of different gender, tenure, degree and school stage, with sound representativeness. Female teachers accounted for 62.032% (348), significantly outnumbering males 37.968% (213). Teachers with 6-10 years of experience formed the largest group (34.225%). Bachelor's degree holders dominated (65.241%), and junior high school teachers accounted for the highest proportion (40.107%).

4.2 Descriptive Statistics

Table 2. Descriptive Statistics ($n=561$)

Variables	Mean (M)	Standard Deviation (SD)
Continuing Professional Development (CPD)	3.531	0.680
Digital Literacy	3.380	0.678
Teachers Social Capital	3.464	0.795

As shown in Table 2, descriptive statistics showed CPD overall mean of 3.531 ($SD=0.680$), digital literacy mean of 3.380 ($SD=0.678$), and social capital mean of 3.464 ($SD=0.795$). All means exceeded the midpoint of 3, indicating moderately high levels across all dimensions.

4.3 Reliability Analysis

Table 3. Reliability Analysis

Scale	Number of Items	Cronbach's alpha
Continuing Professional Development (CPD)	40	.964
Digital Literacy	42	.964
Teacher Social Capital	24	.950

As shown in Table 3, reliability analysis showed all three scales demonstrated excellent internal consistency. The CPD scale (40 items) had an overall α of .964, the Digital Literacy scale (42 items) had .964, and the Social Capital scale (24 items) had .950. All Cronbach's α values exceeded the .900 threshold, indicating high internal consistency, good reliability, and stable measurement of the constructs (Tavakol & Dennick, 2011).

4.4 Confirmatory Factor Analysis (CFA)

Table 4. CFA Summary

Variables	C.R.	AVE	χ^2/df	RMSEA	CFI	TLI	IFI
CPD	.929-.950	.544-.551	1.577	.032	.969	.968	.970
Digital Literacy	.909-.948	.567-.590	1.546	.031	.971	.970	.972
Teacher Social Capital	.935-.944	.643-.677	1.701	.035	.983	.981	.983

As shown in Table 4, to test the factor structure, reliability, and validity of each scale, this study conducted CFA on all three scales. Results showed that all scales performed well across indicators. For the CPD scale, standardized factor loadings ranged from .717 to .774, CR from .929 to .950, and AVE from .544 to .551, with fit indices of $\chi^2/df=1.577$, RMSEA=.032, CFI=.969, TLI=.968, IFI=.970, GFI=.905, NFI=.921, PNFI=.870. For the Digital Literacy scale, standardized regression weights ranged from .729 to .802, CR from .909 to .948, and AVE from .567 to .590, with fit indices of $\chi^2/df=1.546$, RMSEA=.031, CFI=.971, TLI=.970, IFI=.972, GFI=.905, NFI=.923, PNFI=.872. For the Teacher Social Capital scale, standardized regression weights ranged from .776 to .844, CR from .935 to .944, and AVE from .643 to .677, with fit indices of $\chi^2/df=1.701$, RMSEA=.035, CFI=.983, GFI=.942, NFI=.960, TLI=.981, IFI=.983, PNFI=.866 (Yalın-Uçar et al., 2023; Zhang & Wang, 2024). Overall, the measurement models demonstrated good fit, reasonable structural validity, and strong stability, providing a reliable basis for subsequent structural analysis.

4.5 Difference Analysis

4.5.1 Gender Differences

Table 5. Independent Samples *t*-Test Results by Gender

Variables	Gender	<i>M</i>	<i>SD</i>	<i>t</i>	<i>p</i>
CPD	Male	3.620	0.690	2.443	.015
	Female	3.476	0.669		
Digital Literacy	Male	3.475	0.674	2.611	.009
	Female	3.322	0.675		
Teacher Social Capital	Male	3.558	0.844	2.141	.033
	Female	3.406	0.758		

As shown in Table 5, difference analysis revealed significant variations in CPD, digital literacy, and teacher social capital across gender, teaching experience, educational background, and teaching levels. Independent *t*-tests showed that male teachers scored significantly higher than females in all three variables (CPD: $t=2.443$, $p=.015$; digital literacy: $t=2.611$, $p=.009$; social capital: $t=2.141$, $p=.033$).

4.5.2 Teaching Experience Differences

As shown in Table 6, one-way ANOVA with Scheffé post-hoc tests further identified experience-related disparities: teachers with 11-20 years of experience outperformed those with 31+ years in CPD ($M=3.742$ vs. 3.320, $F=4.203$, $p=.002$), exceeded the 21-30 year group in digital literacy ($M=3.593$ vs. 3.264, $F=4.109$, $p=.003$), and surpassed the 31+ year group in social capital ($M=3.560$ vs. 3.121, $F=3.107$, $p=.015$). Notably, teachers with under 20 years of experience consistently performed better across all three dimensions than their more senior counterparts.

Table 6. One-Way ANOVA Results by Teaching Experience

Variables	Years of Experience	<i>M</i>	<i>SD</i>	<i>F</i>	<i>p</i>
CPD	1	3.505	0.653	4.203	.002
	2	3.492	0.696		
	3	3.742	0.660		
	4	3.479	0.705		
	5	3.320	0.606		
Digital Literacy	1	3.308	0.606	4.109	.003
	2	3.374	0.707		
	3	3.593	0.703		
	4	3.264	0.722		
	5	3.273	0.515		
Teacher Social Capital	1	3.405	0.738	3.107	.015
	2	3.536	0.774		
	3	3.560	0.914		
	4	3.442	0.771		
	5	3.121	0.679		

Note: 1=5 years and below, 2=6-10 years, 3=11-20 years, 4=21-30 years, 5=31 years and above.

4.5.2 Educational Background Differences

Table 7. One-Way ANOVA Results by Educational Background

Variable	Educational Background	<i>M</i>	<i>SD</i>	<i>F</i>	<i>p</i>
CPD	1	3.128	0.651	5.623	.001
	2	3.556	0.696		
	3	3.536	0.667		
	4	3.758	0.661		
Digital Literacy	1	2.724	0.736	13.431	.000
	2	3.376	0.721		
	3	3.417	0.627		
	4	3.621	0.653		
Teacher Social Capital	1	3.223	0.474	2.994	.030
	2	3.421	0.799		
	3	3.469	0.808		
	4	3.760	0.814		

Note: 1=Secondary Normal School / Secondary Vocational School, 2=Associate Degree, 3=Bachelor's Degree, 4=Master's Degree or Above.

As shown in Table 7, educational background also exerted a significant influence: master's degree holders scored highest in CPD ($F=5.623$, $p=.001$) and digital literacy ($F=13.431$, $p=.000$), while secondary normal school graduates scored lowest, with the pattern holding for social capital as well ($F=2.994$, $p=.030$).

4.5.3 Teaching levels Differences

Table 8. One-Way ANOVA Results by Teaching levels

Variable	Teaching levels	<i>M</i>	<i>SD</i>	<i>F</i>	<i>p</i>
CPD	1	3.439	0.701	3.190	.023
	2	3.506	0.690		
	3	3.613	0.696		
	4	3.280	0.715		
Digital Literacy	1	3.367	0.719	4.644	.003
	2	3.304	0.733		
	3	3.442	0.703		
	4	3.038	0.683		
Teacher Social Capital	1	3.445	0.782	4.318	.005
	2	3.507	0.811		
	3	3.460	0.825		
	4	3.120	0.690		

Note: 1=Primary School, 2=Middle School, 3=High School, 4=Vocational High School.

As shown in Table 8, teaching levels produced similar distinctions: high school teachers outperformed vocational high school teachers in CPD ($M=3.613$ vs. 3.280 , $F=3.190$, $p=.023$) and digital literacy ($M=3.442$ vs. 3.038 , $F=4.644$, $p=.003$), while middle school teachers led in social capital ($M=3.507$ vs. 3.120 , $F=4.318$, $p=.005$).

Overall, these findings underscore that male teachers, mid-career educators (11-20 years), those with advanced degrees, and high school instructors consistently demonstrated higher competency levels, whereas female teachers, veteran educators (31+ years), those with lower qualifications, and vocational high school teachers lagged behind. Such disparities highlight the critical role of demographic and contextual factors in shaping teachers' professional development outcomes.

4.6 Correlation Analysis

Table 9. Correlation Analysis Matrix

Variables	CPD	Digital Literacy	Teacher Social Capital
CPD	1		
Digital Literacy	.648***	1	
Teacher Social Capital	.548***	.478***	1

Note: ** $p < .001$.

As shown in Table 9, based on Pearson correlation coefficient, this study analyzed the relationships among teachers' CPD, Digital Literacy and Social Capital. The results showed that there were significant positive correlations among all three variables. The correlation coefficient between CPD and Digital Literacy was .648, indicating a strong positive correlation between the two. Similarly, the correlation coefficient between Teacher Social Capital and CPD was .548, showing a significant positive correlation. In addition, the correlation coefficient between Teacher Social Capital and Digital Literacy was .478, also showing a significant positive correlation. All correlation coefficients were greater than zero, further confirming the positive correlation between these variables.

4.7 Moderating Effect

Continuous professional development acts as the dependent variable of this study, which is continuous quantitative data and requires no data transformation. To eliminate inconsistent measurement units and prevent multicollinearity between variables, the independent variable digital literacy and moderating variable teacher social capital were processed through mean centering. Four individual background factors (gender, teaching service length, academic degree and teaching levels.) were set as control variables and coded with dummy variables, eliminating the interference of personal characteristic differences on the correlation between core research variables (Wurm & Reitan, 2025).

Table 10. Regression Analysis

Variables	Model 1	Model 2	Model 3
	β	β	β
Gender	-.037	-.023	-.024
Teaching Experience	-.026	-.005	-.007
Educational Background	-.019	-.023	-.023
Teaching levels	.051	.069*	.065*
Digital Literacy	.653***	.509***	.500***
Teacher Social Capital		.312***	.275***
Digital Literacy $\times$ Teacher Social Capital			.086*
R^2	.425	.499	.504
Adj. R^2	.419	.493	.498
F -value	81.890***	91.905***	80.423***

Note: Dependent Variable=Continuing Professional Development (CPD). * $p < .05$; ** $p < .01$; *** $p < .001$.

As shown in Table 10, hierarchical regression analysis outputs show Model 1 took CPD as the dependent variable, incorporating four control variables (gender, teaching experience, educational background, and teaching levels) and the independent variable digital literacy. The results showed that digital literacy had a significant positive predictive effect on CPD ($\beta=.653$, $p<.001$), with the model explaining 42.5% of the variance ($R^2=.425$). This indicates that teachers with higher levels of digital literacy tend to have higher levels of CPD. Model 2 added the moderating variable teacher social capital to Model 1. The results showed that both digital literacy ($\beta=.509$, $p<.001$) and teacher social capital ($\beta=.312$, $p<.001$) had significant positive predictive effects on CPD. The model's explanatory power increased to 49.9% ($R^2=.499$), indicating that teacher social capital significantly enhances the model's explanatory capacity. Model 3 added the interaction term between digital literacy and teacher social capital to Model 2. The results showed that the interaction term had a significant predictive effect on CPD ($\beta=.086$, $p<.05$), and the model's explanatory power further increased to 50.4% ($R^2=.504$). This finding indicates that teacher social capital plays a significant positive moderating role between digital literacy and CPD—that is, the higher the level of teacher social capital, the stronger the promoting effect of digital literacy on CPD.

Table 8. Moderator Analysis

Moderator Level	Regression Coefficient	SE	t	p	95% CI	
Mean	.501	.035	14.219	.000	.432	.571
High Level (+1 SD)	.581	.045	12.893	.000	.493	.670
Low Level (-1 SD)	.422	.050	8.465	.000	.324	.519

As shown in Table 8, the moderating effect was further tested by Model 1 of PROCESS macro (Version 4.1), using bootstrap sampling method with 5,000 resamples. The results of simple slope analysis showed that the effect of the independent variable (Digital Literacy) on the dependent variable (Continuing Professional Development) was significantly different under different levels of the moderating variable (Teacher Social Capital).

5. Discussion

Border teachers show gender gaps in professional growth, with males scoring higher to support H1a (Tambak et al., 2022). Tenure creates gaps: 11-20-year teachers outperform 30+ year seniors (H1b supported). Mid-career teachers take part in learning more actively, while seniors lack external support (Lap, 2021; R. Li et al., 2022). Education level also shaped CPD outcomes. Postgraduate degree holders outscored less-educated peers (H1c supported), consistent with Y. Ji (2023). School stage matters: high school teachers outperform vocational teachers to support H1d, as high school staff face heavier knowledge renewal pressure while vocational teachers prioritize practical skills (Feng, 2024; Yang et al., 2024).

Males hold higher digital competency than females, supporting H2a (Orakova et al., 2024). 11-20 year teachers master digital tools better than 21-30 year staff, supporting H2b; mid-career teachers adapt faster to digital equipment (Gökdas & Çam, 2022). Postgraduates have stronger digital ability than secondary vocational teachers, supporting H2c (Suzer & Koç, 2024). High school teachers rank highest in all digital competency indicators, supporting H2d (García-Delgado et al., 2023).

Males own richer social resources to support H3a (Grinshtain & Addi-Raccah, 2020), possibly because males join more external academic exchanges in border areas. Seniors with over 30 years' service have fewer social resources than mid-career teachers, supporting H3b; social resources first rise then decline with working years (Berhanu, 2025; Demir, 2021). Postgraduates hold richer social resources, supporting H3c (Mani, 2019). Junior high teachers own more interpersonal resources than vocational teachers, supporting H3d (Opoku et al., 2020).

To conclude, four demographic factors affect all three variables; male, mid-career, postgraduate and high school teachers score higher, consistent with existing studies and local border ethnic features.

Digital competency positively forecasts border teachers' professional growth to support H4 (Mirza & Nakonechnikova, 2025; Suyitno & Dalhari, 2025). Digital skills optimize lesson planning, online resource application, classroom management, student evaluation and peer academic exchanges to drive career growth. Mid-career teachers rank highest in both indicators, while senior teachers achieve the lowest scores. Postgraduates outperform low-qualified teachers on both variables; digital ability connects closely with academic foundation (Suzer & Koç, 2024).

Results confirm social resources positively moderate the digital competency-growth correlation, supporting H5 (Dahri et al., 2021; Mailizar et al., 2022). Stronger professional ties magnify the career benefits of digital abilities. Each of social capital's three dimensions-structural, relational, and cognitive-contributes uniquely to this process (Muhidin, 2025; Owens et al., 2023; Rehm & Notten, 2016).

6. Conclusions

This study examined connections among digital literacy, social capital, and CPD among rural border teachers in Yunnan, China. Four demographic factors create obvious score gaps across all three core variables. Male teachers, mid-career educators (11-20 years), postgraduate degree holders, and high school staff generally performed better. Conversely, female teachers, veterans with 31+ years, less-educated teachers, and vocational school educators scored lower. Regression data confirm digital competency positively predicts professional growth, and social resources strengthen this promotion effect. Sufficient teacher social resources amplify digital competency's positive impact on career improvement.

7. Implications

7.1 Theoretical Contributions

This research supplements theoretical research on border rural teachers' vocational growth. Digital competency is redefined as a core resource breaking geographic isolation for border teachers' self-improvement, rather than simple technical skill. Border teachers face more cultural and linguistic barriers, weaker digital infrastructure and fewer training opportunities, so digital skill upgrading brings greater marginal benefits. Social resources' moderating effect expands professional growth theory: digital skill training alone cannot fully stimulate teachers' self-upgrading willingness. Border teachers have smaller peer networks and face larger cross-school cooperation barriers than inland rural teachers. It verifies peer support and resource sharing are critical for their growth, expanding professional growth theory's application to remote multi-ethnic border zones.

7.2 Practical Contributions

This research supplies operable suggestions for education administrators and school leaders. Digital infrastructure construction and teacher cooperation systems need synchronous promotion. Customized training shall cover disadvantaged groups (female, 20+ year senior, vocational teachers) to narrow internal capacity gaps. Specifically, female teachers would benefit from flexible online CPD schedules with recorded courses for convenient viewing. Mutual mentoring systems can connect senior and young teachers: seniors share teaching experience, young staff provide digital skill guidance (Berhanu, 2025). For vocational teachers, industry-oriented CPD and school-enterprise collaboration programs linking professional development to vocational skills and industry requirements should be offered. Education bureaus can arrange mobile digital training teams to provide regular offline tutoring for frontline border teachers.

8. Limitations and Recommendations

This paper puts forward practical upgrading suggestions, yet two major limitations exist. First, samples only cover Yunnan border teachers, limiting cross-regional generalization of research results. Subsequent research can expand sampling to multi-region multi-ethnic teachers to improve external validity. Second, data only come from questionnaires; follow-up studies can mix interviews and classroom observation to enrich research data.

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