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The Impact of Collaborative Leadership and Teacher Development on Student-Centered Learning in Chinese Primary Schools: A Mixed-Methods Study

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ABSTRACT: For fair education as aimed for in UN SDG 4, bridging the urban and rural schooling gap is key. This study looks at how cooperative leadership affects teacher development and student-centered learning in primary schools in China, striving for more equality in education. It uses teacher professional development as the link and explores how student-centered learning is carried out differently in urban and rural areas.

The method applied in this paper is an explanatory sequential mixed-method design. The quantitative dataset was gathered from 60 teachers working in four primary schools, including two urban and two rural, utilizing validated survey tools and questionnaires of 60 students to understand the context. Semi-structured interviews conducted with 12 administrators and teachers provided qualitative data. Correlation, hierarchical multiple regression and bootstrap analysis (5000 resamples) performed on SPSS 28.0 were used in quantitative analysis while thematic analysis with NVivo helped analyzing qualitative data.

There was a significant association between collaborative leadership and SCL (Pearson's r = 0.604, p<0.001) as well as TPD (Pearson's r = 0.582, p<0.001). TPD partially mediated the relation between the predictor and outcome variables, explaining 42.5% of its total effect. Urban schools demonstrated significantly better performance compared to rural schools regarding all three variables studied, where the difference between urban and rural schools was most pronounced concerning TPD (d=1.13). Qualitative results indicated that academic pressure and traditional hierarchy hindered SCL development and professional growth in rural schools.

The current study provides an empirically based mediation model and proves the importance of improving the system of TPD and professional communities of schools in rural areas within China's education policies' framework.

Keywords: Student-centred learning, Collaborative leadership, Teacher professional development, Urban–rural disparity, School, Chinese primary education, Mixed methods.

1. INTRODUCTION

The field of global education has seen many changes in reforms during the 21st century. One important change in such reforms relates to a move from teacher-led teaching to a student-centered learning (SCL) model. In terms of this learning model, more attention has been paid to developing students' critical thinking abilities, creative talents, team spirit, and learner autonomy [1]. To optimize

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their national education system, China has implemented this new teaching approach. Both the revised standards on curriculum teaching in the period from 2021 to 2022 and the Double Reduction policy enacted in 2021 can be seen as key steps toward implementing educational reforms. All these efforts are made to reduce excessive burdens on students' studies, improve their teaching quality in classrooms, and introduce the new learner-based teaching paradigm in China [2]. However, SCL implementation at schools across China may greatly differ due to different institutional environments. For example, numerous schools continue focusing on test-based teaching while adhering to strict hierarchical teaching management systems. In this context, teachers cannot enjoy their teaching freedom to introduce innovation [3].

It is impossible to implement SCL without the assistance of organizational maturity at the school level. Collaborative leadership and teacher professional development (TPD) serve as the two basic elements contributing to the success of classroom instruction reforms. The former allows for joint decision making among schools' administrative staff and teachers and also encourages a collective exploration of instructional strategies in addition to fostering a good organizational climate for education innovations [4]. On the other hand, systematic TPD facilitates the acquisition of specialized knowledge, development of teaching skills and professional values by teachers which are essential to maintain student-centered instructions [5]. Despite that the significance of both of the above two aspects in SCL practices has been confirmed by the academia, empirical investigations into the full mechanism involved are still limited within China.

Current scholarly studies related to this topic still contain several limitations. First, there have been very few studies employing systematic mediation models to investigate the integrated impact of collaborative leadership, teacher professional development, and student-centered learning. Second, many of the theoretical assumptions made in previous research come from Western education environments. These theories are unable to consider the characteristics of China's educational environment, such as huge class size, hierarchical management systems, and heavy exam pressure. Finally, previous studies tend to overlook the urban-rural difference in education, thus posing difficulties for exploring the regional differences in SCL implementation. Finally, existing research generally treats teacher professional development as a single undivided variable. It rarely separates TPD into three independent dimensions: professional knowledge, practical skills, and teaching attitudes, which greatly reduces the practical guiding value of relevant research findings.

Contributions of the study. First of all, in the academic literature, there were only studies of the simple connection between leadership practices and student performance in China before. This means that the present paper provides some empirical data on the complete chain involving collaborative leadership, professional development of teachers, and SCL at the primary schools in China. Secondly, in the international literature on the topic, researchers pay attention to the idea of SCL but conduct their studies based on the assumptions that such schools have small classes and a flat governance structure. In the present case, it means that the current study opens up a new direction, because it analyzes the SCL theory in very tough conditions, such as the exam-oriented approach in China that is accompanied by a strictly hierarchical governance system. Thirdly, the current study provides another level of analysis of the concept of teacher professional development through dividing this phenomenon into five dimensions. From the perspective of the Double Reduction policy, it compares rural and urban primary

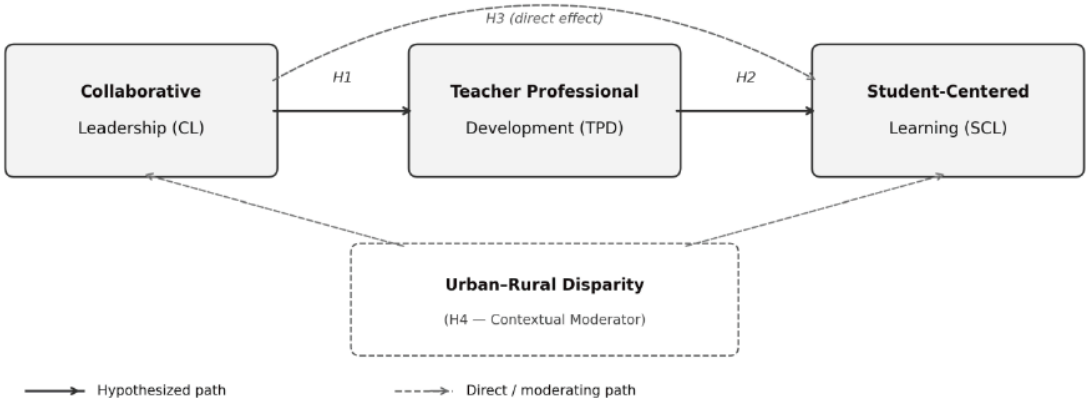

Figure 1: Research Theoretical Framwork.

schools in China, making theoretical and empirical contributions to the topic.

2. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1. Core Concepts

In student-centered learning, children get the opportunity to construct knowledge themselves by participating actively and developing individually. Instead of only remembering facts, children develop critical thinking skills and investigate topics thoroughly. Student-centered learning allows children to speak out and be included in the discussion. In contrast, collaborative leadership involves cooperation between school administrators, educators, and researchers who share ideas for improving teaching effectiveness for all students.Unlike top-down or principal-centred management, collaborative leadership distributes leadership practices and encourages collective wisdom. Teacher professional development (TPD) includes systematic training, collective lesson planning, peer observation, reflective teaching, and instructional coaching that improve teachers' professional knowledge, practical skills, and pedagogical beliefs. The urban-rural divide in education refers to persistent inequalities between urban and rural schools in resources, training opportunities, organisational support, family environment, and instructional quality.

2.2. Theoretical Foundations

2.2.1. Philosophical and Psychological Roots of SCL

The theoretical foundations of SCL are derived from progressivist education, constructivist learning theories, and motivational psychology. John Dewey's theory of progressive education runs counter to the traditional approach to education where learning takes place from above. Dewey's theory suggests that people learn through experiences and reflection [6]. The process of learning is associated with life situations when students ask questions, collaborate, and come up with solutions. The theory of "learning by doing" proposed by Dewey has laid the foundation for the student-centered approach.

The theory of cognitive constructivism proposed by Jean Piaget is an elaboration of the processes used by students to construct their knowledge through interaction with the environment [7]. It means that students do not merely receive information but actively construct their own knowledge by incorporating new information into existing knowledge. Such approach supports the student-centered approach to education because students construct their own knowledge.

Vygotsky's theory of social constructivism emphasizes that learning is a social process [8]. The concept of Zone of Proximal Development was introduced by Vygotsky, referring to the gap between a learner's ability to do something independently and with assistance. According to Vygotsky, learning is enhanced through communication, cooperation, and the guidance provided by more skilled individuals. In SCLs, educators act as facilitators who provide appropriate guidance and help students complete difficult assignments.

Self-Determination Theory (SDT) proposes an account of motivation based on SDT, which was developed by Ryan and Deci [9]. SDT states that autonomy, competence, and relatedness increase intrinsic motivation and commitment [10]. However, conventional test-focused classes usually stifle autonomy and ramp up stress. On the contrary, student-centered instruction nurtures choice and assistance, motivating students and helping them learn better, not to mention building better relationships.

2.2.2. Collaborative Leadership and School Governance

To provide the necessary conditions for the introduction of student-centered learning, it is essential to make changes at the educational institution as a whole rather than just at the level of individual teachers. In this regard, the collaboration between the heads of the school plays a vital role since it contributes greatly to implementing new methodologies.

Unlike the traditional leadership model that is usually characterized by the power and prestige of the school leaders, collaborative leadership is focused on cooperation and teamwork. Thus, this model implies not only participation of all members of the school community but also collaboration of different parties.

Instructional leadership, which is another important element of school management, involves actions taken by the school leaders. There are numerous studies that investigate the issues related to collaboration such as university business collaboration as regards employment.

Nevertheless, contrary to the Western institutions, in case of Chinese primary and secondary schools, there is a somewhat stricter system of teaching and research teams. Concerning the topic discussed in the current paper, collaborative leadership implies considering the school as a team wherein the school leaders assist their teachers in decision-making, etc.

2.3. Literature Review of Key Relationships

Studies show a direct connection between collaboration among the leadership team, professional development of teachers, and student-oriented instruction. The use of collaboration by school leaders creates an environment where teachers feel supported and have a say regarding instructional approaches chosen [13]. In addition, teachers benefit from exceptional professional development opportunities that will make it possible for the school to customize its programs [14].

In terms of teaching, high-quality professional development programs improve teachers' capabilities in the classroom. Relevant training makes teachers able to design interesting assignments for students, conduct interactive lessons, and provide individual assistance [15,16]. Such enhanced capabilities become an essential prerequisite of student-centered learning. Despite previous studies which have confirmed the importance of both factors under consideration, the vast majority of research focuses solely on the relationship between two variables at a time. Very few researchers consider the full-fledged chain from collaborative leadership via teacher professional development to student-centred learning. The empirical evidence supporting the role of teacher professional development in the above context is not enough according to previous studies [4,2]. Hence, it is the focus of this paper.

Studies about collaborative leadership in international educational settings concentrate on Western institutions. The theories that underpin this research operate successfully because they are compatible with small-class settings and flat organizational hierarchies. However, such approaches have limitations because of large classes, strict hierarchies, and intense examination anxiety. This results in the inability of teachers to act autonomously and engage students in collaboration. Furthermore, researchers typically ignore the role of culture in pedagogical practices.

However, the present study intends to rectify this problem. The goal is to adapt global theories regarding education to fit this new setting, which will encourage a learner-centered approach. Therefore, this paper addresses an existing problem by proposing useful frameworks simultaneously.

2.4. Urban-Rural Disparities in SCL Implementation

For a long time now, China's urban-rural disparity has hindered basic education development. Although much progress has been made in terms of improving financial investments in building infrastructures and equipment, the recruitment of quality teaching staff and parents' participation has remained extremely difficult [5,17]. It is really challenging to level off the education opportunities in urban versus rural schools.

Urban schools continue to perform better than rural schools in various respects.These schools are equipped with adequate financial funding, advanced teaching equipment, frequent high-standard professional training opportunities and stable teacher teams. On the contrary, rural primary schools are trapped in multiple developmental dilemmas. They suffer from insufficient educational resources, limited training channels, severe teacher turnover and underdeveloped collaborative teaching cultures. Furthermore, rural regions have a large number of left-behind children. Due to the absence of parents, these students rarely receive effective family guidance for autonomous and inquiry-based learning [18,3].

The cumulative disadvantages of rural schools hinder the implementation of collaborative leadership and lower the overall quality of student-centred learning. Despite the clear regional gaps, current academic works rarely analyse how urban-rural differences moderate the whole influential chain of leadership, teacher development and student-centred learning [19]. This research fills this research vacancy by conducting targeted analysis on urban-rural moderating effects.

2.5. Research Gaps

Current literature reveals several noticeable research gaps that this study intends to address. To begin with, only limited empirical work has validated the complete causal chain linking collaborative leadership, teacher professional development and student-centred learning. This issue is particularly prominent within the Chinese educational context, where mixed-methods investigations focusing on this three-variable pathway remain scarce. Second, majority of the theories developed about SCL and educational leadership are based on western educational systems that usually have small classroom environments and flat organizational structures. These kinds of theories cannot be generalized to the education system in China that comprises of larger classrooms and hierarchical schools. Third, many previous studies ignored differences between urban and rural environments and therefore failed to explain the reasons behind disparities in SCL implementation. Fourth, the majority of relevant studies conceptualise teacher

professional development as a holistic variable instead of separating it into knowledge, skill, and attitude dimensions. This simplified approach restricts researchers from identifying which specific components of TPD effectively facilitate student-centred teaching practices. Against these research deficiencies, this study aims to fill the aforementioned gaps and generate context-specific findings with reliable theoretical value and practical implications.

3. MATERIALS AND METHODS

The present research adopts an interpretive sequential mixed-methods design. This approach enables complementary advantages between quantitative and qualitative data, allowing the study to validate research hypotheses statistically and interpret educational phenomena from real contextual perspectives. In the first phase, the quantitative component is utilised to examine the correlations between collaborative leadership, teacher professional development and student-centred learning, as well as to identify urban–rural discrepancies across the sample. On the basis of numerical results, the subsequent qualitative phase further explores the practical challenges and underlying causes behind statistical trends. This integrated approach thus guarantees that the research results obtained will have both statistical reliability and context-based validity. The chapter provides detailed descriptions of the entire research design, profiles of the participants involved in the study, research tools utilized, data gathering techniques and data analysis approaches in order to meet the strict requirements set by Scopus journals.

3.1. Theoretical Basis of the Mixed-Methods Design

The mixed methods of research have become immensely useful for education-related matters nowadays, especially when dealing with subjects like equity, leadership, and pedagogy. This research method is ideally suited to deal with such challenging topics in school-based settings, which makes it very useful indeed. According to Creswell and Plano Clark [30], mixed-methods approach involves incorporating both numeric and subjective information from the participants into one study design. It can therefore be seen that this kind of research approach is useful in overcoming any weaknesses present in either of the approaches when used separately, making it possible to come up with credible results. Mixed-methods research design is categorised depending on the research process and the main objectives of the research.

The chosen methodology is that of interpretive sequential research design, where quantitative data will be gathered first, followed by qualitative data collection procedures. At the quantitative stage, statistics is applied to explore any hypothetical linkages between variables and to analyze differences across diverse categories of students. Qualitative research follows to help interpret the teachers' practical experience and understand the underlying reasons for such patterns of empirical data. This design is particularly relevant to conducting equity research,

Table 3.1: Basic Characteristics of the Four Participating Schools

Charecteristic	Urban School A	Urban School B	Rural School C	Rural School D	Selection Rationale
Location (Province)	Changsha, Hunan	Changsha, Hunan	Xiangxi, Hunan	Xiangxi, Hunan	Intra-provincial pairing controls for macro policy environment
Administrative Classification	Urban (city district)	Urban (city district)	Rural (township)	Rural (township)	Per MoE official designation
No. of Classes (Grades 1–6)	24 classes (~1,200 students)	18 classes (~900 students)	12 classes (~480 students)	9 classes (~360 students)	Captures variation in institutional scale
Teacher Qualifications (% with Bachelor's or above)	100%	97%	72%	65%	Reflects staffing quality gap
Annual Teacher Turnover Rate	<5%	<5%	~20%	~25%	Key structural disparity variable
TPD Access (in-person training days/year)	≥10 days	≥8 days	≤2 days (online only)	≤2 days (online only)	Core mediating variable in study
Designated Model/Demonstration School	Yes (municipal)	No	No	No	Ensures variation beyond demonstration schools
Formal Institutional Approval	Yes	Yes	Yes	Yes	Principal and district education bureau approval

Note: School names are anonymised as A–D. Figures are approximate, based on school records and principal interviews conducted at the time of data collection.

since purely quantitative data does not provide much information about the context of urban and rural education, as well as how certain teacher behaviors affect their practice in class. Even though quantitative findings demonstrate some development patterns, only qualitative interviewing will help identify contextual challenges not described by the numbers. As a result, researchers may move from statistical data description to explaining what causes observed patterns. This methodology meets all requirements of indexed academic journals in education.

3.2. Participants and How They Were Chosen

Participants came from four primary schools in Hunan Province, China. Two schools were urban and the other two rural, going by the Chinese Ministry of Education's definitions.Urban schools were in city districts, while rural schools were in townships or villages. Researchers carefully picked all four to get a good mix based on resources and conditions, using purposive sampling. We obtained approval from each school principal and the district authorities before collecting data.

There were big differences between the schools when it came to size, staff stability, training access, and teaching environments. Take a look at Table **3.1** for the details.

In the case of the quantitative study, a target sampling technique was adopted. The sample size comprised of 60 teachers in all, where 30 teachers each belonged to the urban and rural categories and all participated in the three questionnaires concerning collaborative leadership, TPD, and SCL. Only the teachers' data was analyzed statistically.

A total of 60 students ranging from grade 4 to 6 (30 students urban and 30 rural) were sampled for context. Questions included family support, home conditions for learning, and parent participation. The student sample was used to provide context and help design the interview questions but will not be statistically analyzed.

A power analysis indicated 60 participants were sufficient to detect significant relationships among the variables being tested at a high level of confidence.

The qualitative sample consisted of 12 individuals selected strategically: six principals and six teachers who have participated in SCTL. Principals offered general insights about school leadership and reform. Teachers offered their daily experiences in teaching and training and challenges associated with this form of pedagogy. Interviews continued until saturation was attained.

3.3. Ethics Approval and Considerations

The study received ethics approval from the university. Participants gave written consent, agreed to use anonymous coded IDs, and could leave at any time. Both school and participant identities were fully anonymized, so no one could be identified.

3.4. Tools and Testing for Quality

Prior to the primary analysis, pilot testing was conducted on 10% of respondents to ensure that the questions were clear and logical and that the scales were reliable. Data from the pilot phase were excluded from the final analysis. Reliability and validity of primary tools demonstrated excellent statistics and consistency (Cronbach's alpha was higher than 0.85).

3.4.1. Collaborative Leadership Scale

This instrument was adapted from the work of Hallinger and Wang [27], and later validated by Amzat *et al*. [23]. It is commonly employed in research concerning educational leadership all around the world. The original instrument consisted of 22 items across four dimensions – shared decision making, teachers' collaboration and professional interaction, resource management, and democratic leadership with a supportive culture. In this case, the instrument has been adjusted in order to be more relevant for Chinese elementary schools. Two irrelevant items have been excluded, resulting in 20 items.

3.4.2. Teacher Professional Development Scale

This instrument was developed by Richter and Richter [15]. The instrument contained 18 items and five factors: reflective teaching, lesson and curriculum planning, collaborative learning among peers, participation in professional training programs, and teaching innovation. After deleting two items which were not relevant to student-centeredness, an 16-item instrument was developed. It also used a 5-point answer scale.

3.4.3 Student-Centred Learning (SCL) Scale

This scale was adapted from Weimer [28] and updated by Tseng *et al*. [29]. It is commonly used in research on classroom changes. The original had 17 questions in four parts: student independence and active learning, inquiry-based interaction, personalized support, and varied assessment. Two questions were changed to suit younger primary students, resulting in 15 questions. Answers were on a 5-point scale.

Table 3.3: Reliability and Validity Statistics of Research Measurement Scales

Scale	KMO	Bartlett's Test (p)	Cronbach's α
Collaborative Leadership Scale	0.820	< 0.001	0.910
Teacher Professional Development Scale	0.841	< 0.001	0.883
Student-Centred Learning Scale	0.817	< 0.001	0.864

3.4.4. Summary of Reliability and Validity

Table **3.3** shows the reliability and validity results for the three scales. The KMO values ranged from 0.817 to 0.841, and Bartlett's test showed significant results ($p < 0.001$), confirming the data was good for factor analysis. Cronbach's alpha values ranged from 0.864 to 0.910, all above the 0.80 standard, showing strong internal consistency. Overall, these tests confirmed the scales were reliable and valid for formal data analysis.

All scales showed excellent internal consistency and construct validity, suitable for formal statistical analysis (see Table **3.2**).

3.5. Semi-Structured Interview Design

Qualitative data were collected through one-on-one semi-structured interviews lasting 25–40 minutes. Interviews were audio-recorded with consent and transcribed verbatim. The interview guide was developed based on the research framework and preliminary quantitative results.

Main Interview Questions

1. Could you briefly describe your experience in school management or classroom teaching and your understanding of collaborative leadership?
2. How is collaborative leadership implemented in your school? What differences have you observed between urban and rural schools?
3. What types of professional development activities are available to teachers? How do these activities support your ability to implement student-centred teaching?
4. What is the current situation of student-centred learning in your daily teaching? What facilitators and barriers have you experienced?
5. In your view, how does collaborative leadership influence teacher professional development and further affect the quality of student-centred instruction?
6. What suggestions would you provide to improve SCL implementation, especially in reducing urban–rural gaps?

Probes were used to deepen responses. Theoretical saturation was formally assessed after each interview and confirmed after the 12th interview, when no new themes emerged.

3.6. Data Analysis Procedures and Methodological Justification

Quantitative data were analysed using SPSS 28.0. Qualitative data were coded and thematically analysed using NVivo 12.

3.6.1. Quantitative Analysis

The data analysis of quantitative data was done using SPSS 28.0. It involved descriptive analysis, Pearson correlation, independent t-test between rural and urban groups, hierarchical regression for mediation analysis, and Bootstrap resampling for confirming mediation.

3.6.2. Why Use Hierarchical Regression Instead of SEM

We picked hierarchical regression over structural equation modeling because we only have a sample size of 60 teachers, and the minimum for SEM is around 200. Plus, the hierarchical method lets us clearly enter predictor variables one step at a time, making it great for our simple mediation analysis.

3.6.3. Bootstrap Settings

In line with the recommendations made by Preacher and Hayes [31], the current analysis used a bootstrap sample size of 5000 along with 95% bias-corrected confidence intervals. The mediating variable was said to be statistically significant when the value zero did not appear in the confidence intervals.

3.6.4. Qualitative Thematic Analysis

The qualitative data were analyzed through the use of thematic analysis following Braun and Clarke [32] six steps: Familiarization with data; Initial Coding; Theme

generation; Reviewing themes; Defining and naming themes; and Producing reports. In order to achieve reliability in the process of coding, two researchers coded the data independently of each other. The intercoder reliability coefficient was higher than 0.85.

3.7. Trustworthiness and Rigor

There were various ways that rigour and credibility of the study was achieved. Some of the methods employed include the use of reliable scales, attainment of data saturation, ensuring consistency through double independent coding, adhering to stringent ethical considerations, and clear documentation of all statistical processes. Together, these steps enhance the credibility and dependability of the research findings.

4. RESULTS

4.1. Participant Details

In total, there were 60 teachers (30 in urban and 30 in rural areas) and 60 students (grades 4-6, evenly divided between urban and rural areas). However, student data were used for describing backgrounds but not in any statistic test. In urban areas, teachers were better educated with 28% having a master's degree or above, compared to 3% in rural areas; meanwhile, they received higher-quality professional trainings. 15 out of 30 rural students were left-behind children with parents working elsewhere while 8 out of 30 urban students were directly guided by their parents in studying.

All 12 interviewees had more than 8 years of teaching experience. On average, principals in rural areas had worked as administrators for 25 years.

4.2. Quantitative Findings

All constructs were measured using a scale of 1 to 5. Scores averaged between 3.38 and 4.08. Teacher professional development had the highest average score (mean=3.77), followed by learner-centeredness which had a slightly smaller average score (mean=3.67). Urban schools performed significantly better than rural schools in all areas, with p values less than 0.001 for all comparisons (Table **4.1**). The greatest difference was observed in teacher professional development, which had an effect size of 1.13.

The correlations indicated highly significant relationships between all the variables tested, all at $p< 0.001$. The highest correlation was observed between teacher development and student-centered learning ($r = 0.634$), followed by the relationship between collaborative leadership and student-centered learning ($r = 0.604$) and collaborative leadership and teacher development ($r = 0.582$). It was also noted that there was no problem with multicollinearity (see Table **4.2**).

A hierarchical multiple regression (Table **4.3**) was performed to test whether teacher development mediated the effect of collaborative leadership on SCL. In Model 1, where only collaborative leadership is included, it was able to explain 36.5% of the variance in SCL ($\beta = 0.604$, $p < 0.001$). After including teacher development in Model 3, however, the direct effect of collaborative leadership on SCL became $\beta = 0.347$ while becoming still significant, and the coefficient for teacher development was $\beta = 0.441$, also being significant ($p < 0.001$). The total variance explained reached 45.3%, which means $\Delta R^2 =$

Table 4.1: Descriptive Statistics and Urban–Rural Comparison (Teachers, n=60)

Variable	Urban (n=30) M (SD)	Rural (n=30) M (SD)	t-value	p-value	Cohen's d
Collaborative Leadership	4.15 (0.48)	3.62 (0.55)	4.21***	<0.001	1.03
Teacher Development	4.08 (0.51)	3.45 (0.61)	4.68***	<0.001	1.13
Student-Centered Learning	3.95 (0.53)	3.38 (0.58)	4.15***	<0.001	1.03

Note: *** $p < 0.001$; M = Mean, SD = Standard Deviation

Table 4.2: Pearson Correlation Matrix

Variables	1. Collaborative Leadership	2. Teacher Development	3. Student-Centered Learning
1. Collaborative Leadership	1	0.582***	0.604***
2. Teacher Development	0.582***	1	0.634***
3. Student-Centered Learning	0.604***	0.634***	1

Note: *** $p < 0.001$

Table 4.3: Hierarchical Regression Analysis Results

Predictor	Model 1 (DV: SCL) β	Model 2 (DV: Teacher Dev) β	Model 3 (DV: SCL) β
Collaborative Leadership	0.604***	0.582***	0.347***
Teacher Development	—	—	0.441***
R^2	0.365	0.339	0.453
ΔR^2	—	—	0.088
F-value	33.25***	29.67***	24.08***

Note: *** $p < 0.001$; β = Standardised coefficient; SCL = Student-Centered Learning

Table 4.4: Mediation Effect Decomposition (Bootstrap, n = 5,000)

Effect Type	Coefficient	95% CI	Proportion
Total Effect	0.604***	[0.442, 0.766]	100%
Direct Effect	0.347***	[0.167, 0.527]	57.5%
Indirect Effect	0.257***	[0.158, 0.376]	42.5%

Note: CI = Confidence Interval; Indirect effect = Collaborative Leadership → Teacher Development → SCL; *** $p < 0.001$

0.088. Bootstrapping with 5,000 samples showed partial mediation (Table **4.4**).

4.3. Qualitative Findings

4.3.1. Factors That Help or Hinder Collaborative Leadership (RQ3)

There are three system levels that encourage collaboration. Institutionally, periodic meetings, such as the bi-weekly Teachers' Councils of urban School A, clearly define a place for collective decision-making on curricular issues. Individually, school heads see themselves as facilitators rather than decision-makers. Urban school heads are more skilled at delegation of managerial duties. Policy-wise, national policies such as the "double reduction" policy have made collaborative leadership a necessity.

The major issue of having a hierarchical culture still dominates. In fact, when speaking with a teacher from a rural area, he mentioned that all veteran teachers prefer to have the school's head decide everything; therefore, young teachers do not share any of their views. The dominant hierarchical culture is even pronounced in rural settings due to fewer resources.

> "Many senior teachers still think the principal should decide everything. Younger teachers just follow orders and don't want to speak out."

An urban principal said:

> "We don't make decisions alone in the principal's office. Big teaching changes must be agreed on by teachers first so they can be done well."

4.3.2. Reasons for Urban-Rural Differences (RQ4)

These three major discrepancies could be cited as reasons for why urban and rural schools are different concerning SCL. First, there is a huge difference regarding their technology – in contrast with rural schools which don't have sufficient technological means, urban schools boast high-quality equipment. Second, there are obvious discrepancies regarding training – urban teachers are provided with higher-quality training in person than rural teachers who are primarily taught theoretical knowledge on the Internet. Third, parental involvement varies greatly: urban parents are generally more educated and supportive of SCL; whereas in most rural areas, many students suffer from neglecting parental involvement.

A rural principal said:

> "Our school has only one computer room. We can't do project learning like urban schools."

A rural teacher added:

> "Most training is online theory. What we learn doesn't help in big classes with left-behind children."

4.3.3. Teachers' Challenges in Using SCL

All teachers unanimously agreed upon such critical obstacles to SCL as examinations, large class sizes, lack of training, and parents' resistance as summarized in

Table **4.6**. Rural teachers experience much greater pressure and encounter more misconceptions from parents.

A rural teacher said:

> "We must keep exam scores high. If we spend too much time on inquiry activities, grades drop and parents complain."

4.4. Mixed Methods Integration

Within the context of this mixed methods study, there was a systematic way of combining qualitative and quantitative data within the explanatory sequential model employed. The first step involved analyzing the quantitative findings to determine any anomalies or significant patterns that needed to be explained. Quantitative data, including correlations, regressions, and urban-rural effect sizes, were used to explain patterns in the data. The interview schedule was thus designed based on findings from the quantitative analysis: one of the key findings was the anomalously large TPD effect size (d=1.13). Moreover, high levels of leadership in the presence of moderate scores of student connectedness in one of the urban schools was specifically identified in the qualitative phase. The second phase then involved interpreting quantitative findings based on thematic findings obtained during the interviews.

It was revealed that the largest gap is in the area of teacher development with a Cohen's d of 1.13, which is consistent with the opinions expressed by interviewees concerning the inequality of opportunities for professional training. The conclusion drawn here indicates that teacher development is the key factor of educational inequality. Also, both sources prove the relationship between collaborative leadership and learner-centeredness in connection with professional development of teachers. Specifically, one of the sources presents the results of regression analysis, while another one provides evidence in the form of examples. Importantly, the design used clarifies the results obtained previously when one of the urban schools received a high score for collaborative leadership but performed averagely on learner-centeredness.

One of the interviewed teachers said, "We have weekly meetings where the principal establishes the agenda beforehand. Our ideas may be taken into account, but they have no effect at all."

This is one major advantage of using explanatory sequential integration whereby quantitative outcomes detect the outliers in order to direct qualitative studies, and thereafter, qualitative discoveries can help in further analyzing the statistics. In this approach, you begin with quantifying, detecting patterns and outliers, then doing a qualitative analysis and lastly verifying the outcomes. The study becomes more valid through combining data with actual evidence, thereby highlighting problems which could have gone unnoticed.

5. DISCUSSION

This will involve evaluating the study outcomes and comparing them to global and Chinese studies conducted between 2021 and 2026. We will also assess the theoretical and practical importance of these outcomes. Additionally, we will explain the differences within the L-Dev-SCL framework.

5.1. Teacher Development Partly Explains the Leadership–SCL Link

Collaborative leadership and the study of school climate appear to have a strong relationship, and teachers' professional development is responsible for 42.5 percent of this relationship. This corroborates findings from other studies that point out that for sustainable changes in instruction, there is need for institutional commitment and support. That's supported by references [20, 21, 14]. Collaborative leadership creates structural prerequisites for the implementation of effective SCL, which include shared decision-making powers, joint resource management, and professional culture of educators. Similar results have been achieved in China by means of

Table 4.6: Teachers' Perceptions of SCL Implementation Challenges

Theme	Urban Teachers	Rural Teachers	Frequency
Large class size	Mentioned	Strongly emphasized	5/6
Insufficient training	Occasionally	Frequently	6/6
Exam pressure	Mentioned	Dominant concern	6/6
Parental resistance	Rare	Common	4/6

adopting distributed leadership principles in education [22,13].

The most significant theoretical implication is the emergence of a partially mediating relationship, which stands out from full mediators often witnessed within Western-style education systems [23,24,10]. Despite having a solid and robust governance structure in place, school principals in China still possess the ability to engage in direct promotion of SCL via means of policy compatibility, accountability systems, and administrative oversight, even within environments where teachers have not yet attained full professional preparedness [25,4]. Through the confirmation of this locally relevant model, the current study adds to the global body of knowledge concerning Confucian-informed education systems. More importantly, as compared to the vast majority of other domestic works that focus exclusively on bivariate correlations, this particular study confirms the whole sequence of relationships: leadership–TPD–SCL.

The current study looked at TPD as a single idea for regression analysis, aligned with the main goal, and didn't split its five parts: reflective teaching, planning lessons and the curriculum, peer collaborative learning, structured pro training, and instructive change. Based on Chinese primary education, theory suggests that peer collaborative learning and reflective teaching have the strongest impact on student-centered learning. In China, the formal school system speeds up theoretical ideas becoming student-centered teaching through observations and post-lesson chats. Off-campus training can be out of touch with real classroom problems, though, making it less helpful.To figure out how much each part of TPD affects learning, future studies need to measure their specific influences differently.

5.2. Teacher Development Is the Main Urban–Rural Equity Gap

Secondly, another interesting observation highlights the presence of significant discrepancies between urban and rural regions regarding teacher professional development (d = 1.13). It is worth mentioning that such a measure represents the largest difference in performance recorded across all the variables under consideration in the study. In truth, this observation supports the current trend in the recent scientific literature that "soft" problems associated with the level of professional development of educators are of even greater importance for education inequalities in comparison to infrastructural issues [18,19,16]. Indeed, teachers at rural schools typically experience such problems as professional isolation, poor access to high-quality PD courses, and insufficient interaction. Thus, they have little desire to promote SCL in education.

The presented finding is consistent with the results from previous studies indicating that principals' leadership behaviours strongly influence teachers' attitudes towards professional success and engagement into teaching practices based on the principles of sustainable development. [34]

Thus, the present study adds to the current body of knowledge through its findings about unequal professional development of educators. No amount of better equipment can make up for proper professional development of teachers. Rural principals are often more concerned with administrative than teacher professional matters [26]. As one rural teacher put it, "Most training is just online theory. What we learn doesn't help with big classes full of left-behind children." This comment really sums up the main issue with professional training for teachers, which is likely causing the big achievement gap between urban and rural areas seen in this study (d = 1.13).

5.3. Superficial Collaboration: A Major Problem in Rural Schools

The most significant new discovery is that most rural schools suffer from superficial collaboration. Superficial collaboration occurs when there is teamwork that does not include actual instructional conversation, reflection, and problem-solving. Most teachers participate in such teams simply because they want to comply with school inspection requirements, rather than engage in productive professional discussion. This type of collaboration resembles "symbolic professional learning communities" in rural schools in China [17].

Superficial collaboration impedes teacher development and widens the urban-rural achievement gap even further. Since teachers cannot fully internalize and modify SCL due to lack of proper reflection and collaboration, this article highlights superficial collaboration as an important factor behind the existence of inequality, which was overlooked in previous research.

This study suggests five ways to tell the difference between shallow teamwork and real professional collaboration. First, check how much meeting time is actually spent on meaningful teaching talks, not just bureaucracy. Also, look at how often teachers offer up new ideas during group activities and the quality of their reflections in journals. Next, see if they put their group-agreed-upon plans into practice. Finally, note how many join outside workshops voluntarily.

Principals have options too, like setting strict agendas to focus talks, putting in place rules for observing each other's classes with proper feedback, and using this teamwork in overall teacher reviews. These moves aim to push past mere rule-following towards true, useful collaboration.

5.4. Theoretical and Practical Implications

5.4.1. Theoretical Implications

The present research provides validation of an integrated and situational theory-driven framework of collaborative leadership → teacher development → SCL. The partially mediating process offers another dimension of analyzing leadership impact in hierarchical educational organizations. Nominal collaboration has been recognized, thus adding to the existing literature on professional learning communities and educational equity.

5.4.2. Practical Implications

School principals need to focus more on leading instruction and nurturing true professional learning communities, instead of just managing tasks. This would help prevent collaborations from being shallow. We should target teacher training, especially for those in rural areas, to include mentorship. We could also ease test pressure on teachers by revamping how we evaluate students. To make learning more student-centered, we need to change how we assess students. That means ditching the heavy reliance on high-stakes tests and switching to a mix of formative and performance-based assessments. This approach could increase interaction and collaboration in the classroom. Analyzing the portfolios, rubrics, and peer reviews of projects can reveal the critical thinking process as well as continued learning, instead of only using grades. That will also take off some of the stress for both parties and simplify everything for educators and students. That way, it will be evident that our priorities lie in helping students learn and meet their needs.

In order for that to happen, it will be necessary to invest further in the professional development programs for educators. After speaking with one of the teachers, it turned out that online courses are not effective due to ignoring many factors, such as excessive class size and the location of the children coming from the countryside.

6. CONCLUSION

6.1. Summary of Major Findings

The research on collaborative leadership, TPD, and SCL in Chinese primary schools in both urban and rural settings highlights several critical findings. Namely, collaborative leadership contributes greatly to student-centered learning and makes it possible to increase SCL level by 42.5%. Additionally, TPD is implemented uniquely in both environments, proving the significance of teacher competencies when it comes to equal education. Moreover, false collaboration acts negatively on the reform process, particularly in rural areas.

6.2. Policy and Theory Implications

Equal education implies policy changes rather than construction of new educational institutions. The latter should be funded by money spent on constructing more schools. In addition, improving the teacher development process can make an enormous contribution. It is critical to assist rural educational leaders to motivate their employees. Communication between urban and rural educators is essential; however, such cooperation should be sincere.

There are several approaches that will contribute to professional development of rural teachers. Firstly, it is necessary to establish the exchange program for urban and rural educators providing additional bonuses for each one in terms of their initial job. Second, start a hands-on training scheme that mixes online and in-person lessons to tackle real classroom issues.. Next, give continuous, specialized leadership courses for rural school heads. Lastly, create a solid stream of funding from the state aimed at footing the bill for teacher development programs in rural settings. Lastly, develop a two-tier support network for new rural teachers that connects mentors locally, online, and from nearby urban centers. Theoretically, this work offers a model linking leadership, TPD, and SCL to the rural context. It highlights 'superficial collaboration' as a fresh reason for educational disparities, going beyond just the usual lack of resources.

In sum, a plan for school leaders and policy makers should have three parts: governance, focusing on genuine professional learning communities; professional development, which is specific and aimed at rural teachers; and improving classroom practices through supported lesson study and better assessments.

6.3. Limitations

In addition, while it is true that the statistical power for the quantitative teacher sample (n = 60) reached a satisfactory level (statistical power = 0.82) through

G*Power analysis a priori, the study was actually done as a pilot study with a comparatively smaller sample size. In total, there were only four primary schools involved in this study together with 12 interviewees, which might affect its generalizability. Secondly, this study employed convenience and purposive sampling techniques without randomization, resulting in low generalizability and lack of representation. Thirdly, as a cross-sectional study, this research fails to demonstrate any cause-and-effect relationship and longitudinal effects as well. Moreover, all data were obtained from the self-administered questionnaires, making it vulnerable to social desirability bias. Besides, this study does not consider potential confounding variables such as the teachers' ages, gender, and years of experience. Furthermore, it lacks in the categorization of components of teachers' professional development. Based on the findings, it is evident that the current education policy should be adjusted so as to ensure equality among learners from different communities. As opposed to allocating resources towards infrastructure, emphasis needs to be laid on the development of highly skilled teachers with regard to local demands, especially in rural schools. The assistance of rural school managers in developing these teachers and establishing strong relations between rural and urban teachers is critical.

6.4. Future Directions

There are four essential elements that have to be considered so as to improve professional development of rural teachers. First, swap programs can be instituted where urban and rural teachers exchange roles depending on their rank, and receive corresponding compensation. Second, practical courses should be offered which incorporate both virtual and physical lessons addressing practical problems faced by the educators. Third, continuous specialized courses have to be offered to rural school managers. Oops, that is five points, the last of which is very important. Fourth, constant support has to be provided by the government in terms of funding for the above programs. These steps show how collaborative leadership and ongoing teacher training can foster shared creative leadership in the long run. Researchers may further consider using classroom observation or other forms of objective information to ensure less subjectivity. The models being tested may take into account variables such as teacher age, gender, teaching experience, and province to address issues relating to potential confounding factors. Moreover, breaking teacher professional development into different components will facilitate further understanding of the impact of each factor on SCL.

Subsequent research can also break down the aggregated TPD construct into its five original sub-dimensions－reflective teaching, lesson planning, peer collaborative learning, professional training, and teaching innovation–to separately look at their direct and indirect effects on SCL. This helps identify the most influential TPD component within China’s basic education setup to promote sustainable development education in all aspects as researched by researchers from diverse backgrounds [35].

List of Abbreviations

SCL	Student-Centred Learning
TPD	Teacher Professional Development
SDG	Sustainable Development Goal
SDT	Self-Determination Theory
SEM	Structural Equation Modelling
PLC	Professional Learning Community
CI	Confidence Interval
SD	Standard Deviation
RQ	Research Question

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CONFLICT OF INTEREST

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AUTHOR CONTRIBUTION FORM

Author Name	Role / Contribution
Yu Yinuo	Conceptualization, Methodology, Formal Analysis, Investigation, Writing – Original Draft, Writing – Review & Editing
Wang Yun	Literature Review, Qualitative Analysis, Data Curation, Writing – Review & Editing, Resources

Ng Khar Thoe	Supervision, Validation, Methodology Review, Writing – Review & Editing, Project Administration, Final Approval
Wang Siran	Expert consultation, international perspective in sustainable education
Kamolrat Intaratat	methodological advice, critical review, editorial support

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