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Collaborative Leadership and Teacher Autonomy: Drivers of School Improvement in Zhengzhou's Vocational High Schools

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Abstract: As vocational high schools in Zhengzhou, China, face increasing pressure to meet local industry demands for skilled workers, enhancing school performance has become a critical goal. Collaborative leadership and teacher autonomy have been identified as key factors that could drive improvements in these schools. This study aims to investigate the influence of collaborative leadership and teacher autonomy on school improvement in Zhengzhou's vocational high schools, specifically examining how these factors interact and contribute to educational outcomes. Using a quantitative research approach, data were collected from a representative sample of 360 teachers across 25 vocational high schools in Zhengzhou, with analysis conducted through Structural Equation Modeling (SEM) to assess both direct and indirect relationships between variables. Findings indicate that collaborative leadership has a strong positive impact on school improvement, both directly and indirectly, through its effect on teacher autonomy. Teacher autonomy was also shown to have a significant positive effect on school performance, highlighting its role as a mediator in the relationship between collaborative leadership and school improvement. This study contributes to the understanding of leadership and autonomy in vocational education, suggesting that policies promoting collaborative leadership and teacher empowerment could enhance the effectiveness of vocational schools in Zhengzhou and similar urban contexts in China.

Key words: Collaborative leadership, teacher autonomy, school improvement, vocational high schools, Zhengzhou city

1. Introduction

In recent years, educational reforms in China have increasingly focused on improving the quality and effectiveness of vocational high schools, as these institutions play a crucial role in preparing students for technical and skill-based careers (Wang, 2024). As Zhengzhou City experiences rapid economic growth and industrial development, there is a growing demand for a skilled workforce (Wang & Tomaney, 2019). This demand places vocational high schools under pressure to enhance their teaching standards, curricula, and student outcomes to meet the needs of local industries. However, achieving these goals requires more than curricular adjustments and resource investment. Effective school leadership and teacher autonomy have emerged as essential factors influencing school improvement, as they create an environment that fosters innovation, commitment, and a collaborative approach to addressing educational challenges (Day et al., 2020; Pineda-Baez et al., 2020).

Collaborative leadership, a model in which school leaders engage teachers, staff, and other stakeholders in decision-making processes, has been identified as a promising approach to fostering positive school outcomes (Bhutto et al., 2024). Unlike traditional hierarchical leadership models, collaborative leadership encourages shared responsibility and promotes a culture of mutual respect and inclusivity (Egitim, 2021). In vocational high schools, where teachers often need to adapt teaching methods to fit practical skills training, collaborative leadership can provide teachers with the support and resources necessary to develop and implement effective pedagogical strategies (Stosich, 2020). By involving teachers in the decision-making process, school leaders can tap into their insights and experiences, which can lead to more relevant and practical improvements in the school's operations and teaching practices (Patrick, 2022).

In addition to collaborative leadership, teacher autonomy is another critical factor for school improvement, especially in the vocational education context. Teacher autonomy refers to the freedom educators have to make decisions about their teaching methods, classroom management, and lesson planning, within the framework of the school's overall objectives and standards (Brouskelis, 2024). When teachers are granted autonomy, they are more likely to take ownership

of their work, exhibit higher levels of job satisfaction, and implement innovative teaching techniques tailored to their students' needs (Worth et al., 2020). This is important in vocational education, where the alignment of teaching with real-world applications is essential. Studies have shown that when school teachers have greater autonomy, they can better customize their approaches to engage students, promote skill development, and respond flexibly to industry demands (Guo & Wang, 2021).

Despite the recognized importance of vocational high schools in supporting the local economy and addressing workforce needs, many of these institutions in Zhengzhou City continue to face challenges in improving educational outcomes and institutional effectiveness. While collaborative leadership and teacher autonomy have been individually associated with school improvement in various educational settings, there is limited understanding of how these two factors operate in combination within vocational high schools in China. Collaborative leadership has been shown to create a supportive environment where teachers can contribute meaningfully to school decisions (Hamid et al., 2024), and teacher autonomy has been linked to higher job satisfaction and a greater commitment to student-centered learning (Lima, 2023). Yet, how these factors interact to influence school improvement specifically in vocational high schools remains largely unexplored.

In the vocational education context, teachers face unique challenges, such as balancing theoretical instruction with practical training and keeping up with the demands of evolving industries. Collaborative leadership can support teachers in overcoming these challenges by fostering a team-oriented environment, while teacher autonomy enables them to adapt their teaching practices to better suit their students' needs (Bhutto et al., 2024). However, vocational high schools in Zhengzhou often operate within a traditional, hierarchical leadership structure, which may inhibit both collaboration and autonomy. Consequently, there is a need to understand how a shift towards collaborative leadership and greater teacher autonomy could impact the effectiveness of vocational high schools in Zhengzhou.

Specifically, few studies have examined how these two factors influence educational outcomes in the context of Zhengzhou's vocational high schools, where teachers face unique challenges associated with technical and skills-based education. Therefore, this study aims to investigate the relationship between collaborative leadership, teacher autonomy, and school improvement in vocational high schools in Zhengzhou City, China. By exploring this relationship, the study seeks to provide insights that could inform policy and administrative practices aimed at enhancing the quality of vocational education in Zhengzhou and similar urban areas in China.

2. Literature review

2.1 Studies on collaborative leadership and school improvement

Research has consistently demonstrated that collaborative leadership positively impacts school improvement. Nadeem (2024) conducted a study examining the relationship between collaborative leadership practices and overall school performance and found that schools with leaders who practiced collaboration, encouraged input from teachers, and fostered a shared sense of purpose showed significant improvement in student outcomes and staff satisfaction. By involving teachers and staff in decision-making processes, these leaders were able to create a supportive environment that motivated educators to work together toward common goals. The study highlighted that collaborative leadership practices built a sense of collective responsibility and commitment among teachers, which, in turn, improved classroom instruction and student performance metrics. The study concluded that collaborative leadership was an essential factor in school improvement, as it harnessed the diverse strengths of the educational staff and fostered an atmosphere of mutual support and professional growth.

Stosich et al. (2024) conducted a study across several schools to assess how collaborative leadership contributed to sustained school improvement. The research emphasized that the schools with the highest levels of improvement consistently practiced collaborative leadership. Leaders in these schools established formal and informal structures that enabled teachers, support staff, and administrators to participate actively in decision-making. By regularly consulting with staff, organizing collaborative planning sessions, and establishing cross-functional teams, these leaders created a culture of inclusiveness and shared accountability. The study found that this collaborative culture led to a continuous cycle of reflection and adaptation, as teachers and staff worked together to identify areas for improvement and implement effective strategies. The findings suggested that collaborative leadership not only contributed to short-term gains in school performance but also facilitated long-term improvement by embedding a proactive and adaptable mindset within the school culture.

Furthermore, Haruna & Omuya (2022) examined the role of collaborative leadership in improving school climate and student engagement in underperforming schools. The study revealed that collaborative leadership was instrumental in turning around schools that previously faced challenges in both academic performance and student morale. Through interviews with school leaders, teachers, and students, the study identified that collaborative leaders actively involved teachers in shaping school policies and engaged students in discussions about their learning experiences. By fostering open communication and shared decision-making, these leaders helped build a more positive school climate, where students felt valued and teachers felt supported. The research indicated that the improvements in school climate and student engagement directly correlated with better attendance rates, reduced behavioral issues, and ultimately higher academic achievement. The study concluded that collaborative leadership created a foundation for meaningful school

improvement by strengthening relationships and promoting a unified vision for success among all stakeholders within the school.

These studies underscore the positive influence of collaborative leadership on school improvement. Through practices that encourage shared decision-making, build a sense of community, and promote a culture of accountability, collaborative leadership has been shown to enhance both the academic and social environment of schools, leading to better outcomes for students and greater satisfaction for teachers and staff.

2.2 Studies on Collaborative Leadership and Teacher Autonomy

Numerous studies have investigated the positive influence of collaborative leadership on teacher autonomy, suggesting that collaborative leadership approaches empower teachers and foster a professional environment that enhances their sense of independence in decision-making.

Liu et al. (2021) found that collaborative leadership directly contributes to an increase in teacher autonomy by promoting a culture of mutual respect and shared decision-making. In this study, the principal and school leaders engaged teachers in regular, structured dialogues about curriculum development, classroom management, and instructional practices. The research highlighted how this approach helped teachers feel more ownership over their work and more confident in their professional judgment. The study concluded that, by involving teachers in key decisions, collaborative leaders allow them to exercise greater discretion in their instructional choices, thereby reinforcing their autonomy in the classroom.

Ma & Marion (2024) examined the impact of collaborative leadership on teacher autonomy in a mixed-methods study involving in-depth interviews and surveys with teachers across schools. The study found that when school leaders adopted a collaborative leadership style, teachers reported higher levels of autonomy, especially in terms of curriculum design and instructional strategies. The study noted that collaborative leadership practices, such as regular team meetings, shared goal-setting, and open communication channels, created an environment where teachers felt more empowered to make pedagogical decisions without needing excessive approval from administrators. This empowerment, according to the study, encouraged teachers to innovate and tailor their approaches to meet the specific needs of their students. The study concluded that collaborative leadership is instrumental in fostering an environment that values teacher input, which in turn reinforces teachers' sense of autonomy and professional agency.

Lin (2022) further underscored the positive relationship between collaborative leadership and teacher autonomy, finding that collaborative leadership practices can transform a school's organizational culture to one that prioritizes teacher independence. The study found that, as teachers were increasingly involved in decision-making processes regarding school policies, assessment methods, and professional development initiatives, their sense of autonomy grew significantly. The study highlighted that the key to this increase in autonomy was the leaders' consistent efforts to include teachers in strategic discussions and provide them with the flexibility to implement changes based on their professional insights. According to the study, this collaborative approach helped reduce the top-down pressures that teachers often face, thereby promoting an organizational culture where teacher autonomy is respected and valued.

These studies indicate a positive relationship between collaborative leadership and teacher autonomy, emphasizing the role of collaborative practices in enhancing teachers' sense of independence and professional empowerment within the school environment.

2.3 Studies on Teacher Autonomy and School Improvement

Research on the relationship between teacher autonomy and school improvement has consistently highlighted the positive effects that increased autonomy can have on a school's overall performance.

Hashim et al. (2022) conducted a study across schools and found that when teachers were granted greater autonomy in their instructional practices, schools demonstrated significant improvements in student achievement scores, teacher retention rates, and overall school climate. The research suggests that when teachers are empowered to make decisions about their instructional methods, they are more likely to innovate in ways that engage students and foster deeper learning. This study emphasizes that teacher autonomy leads to a sense of ownership and accountability, which contributes to a more motivated and effective teaching staff. The study concludes that promoting autonomy in teaching decisions not only benefits educators by improving job satisfaction, but also positively impacts students and contributes to a more successful and adaptive school environment.

Ugarte et al. (2022) investigated the effects of teacher autonomy on school improvement and revealed that schools where teachers had greater control over curriculum development, classroom management strategies, and assessment practices experienced a steady increase in student performance and a marked decrease in behavioral issues over a five-year period. The study argues that teacher autonomy allows educators to tailor their approaches to meet the specific needs of their students, fostering a learning environment that is more responsive and personalized. According to the study, this flexibility enables teachers to implement innovative teaching techniques and adapt their methods based on student feedback and learning outcomes, resulting in a dynamic learning atmosphere. The study underscores that when teachers have the freedom to adapt their methods to suit their students, school improvement becomes more sustainable and consistent.

Rechsteiner et al. (2022) further reinforces the positive impact of teacher autonomy on school improvement. The

study analyzed the correlation between teacher autonomy and both academic and non-academic outcomes. The study found that in schools where teachers had a high degree of control over instructional decisions, there was a significant increase in student engagement and extracurricular participation, as well as improvements in standardized test scores. The study argues that autonomy fosters a culture of trust and professionalism, where teachers feel respected and are motivated to go beyond standard teaching practices to support their students. This sense of trust, the study explains, encourages teachers to take calculated risks and develop creative solutions to the challenges they face, ultimately benefiting the entire school community. The study concluded that empowering teachers by granting them autonomy is a key driver of school improvement, as it not only enhances teaching quality but also contributes to a more cohesive and supportive school culture.

These studies indicate that granting teachers greater decision-making power in instructional practices leads to better student achievement, higher teacher retention, and improved school climates. Autonomy allows teachers to innovate and personalize learning, fostering deeper student engagement and reducing behavioral issues. This empowerment enhances job satisfaction among teachers, encourages creative problem-solving, and builds a culture of trust and professionalism within schools. In conclusion, teacher autonomy is pivotal in driving sustainable school improvement by creating a more adaptive, responsive, and successful educational environment.

3. Research Methodology

To investigate the influence of collaborative leadership and teacher autonomy on school improvement in vocational high schools in Zhengzhou City, China, this study employs a quantitative research methodology. The selection of a quantitative approach is guided by the study's objective to measure and analyze the relationships between variables in a systematic and statistically valid manner. Quantitative research allows for the collection of numerical data that can be objectively analyzed to identify patterns, correlations, and potential causal links. This methodology is particularly suitable for studying large sample sizes, which enhances the generalizability of the findings. By using structured data collection instruments, the study can gather comprehensive data on teachers' perceptions of collaborative leadership, their levels of autonomy, and their views on school improvement. The quantitative approach thus provides a clear and rigorous framework for testing the research hypotheses and contributes to a more precise understanding of how collaborative leadership and teacher autonomy interact to influence school improvement in this context.

The rationale for selecting a quantitative research method lies in its ability to produce statistically reliable data that can be generalized across the population. Given the large population of teachers across vocational high schools in Zhengzhou, a quantitative approach enables the researcher to analyze patterns and relationships within the data in a way that qualitative methods would not allow. Furthermore, this study aims to provide evidence-based insights that can inform policy and administrative decisions in vocational education. Quantitative research, through structured and replicable data collection and analysis, aligns well with this objective. It allows the researcher to quantify the extent of collaborative leadership and teacher autonomy in vocational high schools and assess their statistical impact on school improvement. This approach also enables the use of advanced statistical techniques, such as Structural Equation Modeling (SEM), to examine complex relationships between variables, which would be challenging to analyze using qualitative methods alone. Thus, the quantitative approach is essential for achieving the goals of the study and ensuring the validity and reliability of its findings.

The study is conducted across 25 vocational high schools in Zhengzhou City, China, which employ a total of 5,626 teachers. Given the large population of teachers, the study utilizes random sampling to select a representative sample of 360 teachers for participation. The sample size was determined based on statistical considerations, using the Raosoft sample size calculator to ensure a margin of error and confidence level appropriate for a study of this scope. Random sampling is chosen to minimize selection bias and ensure that the sample reflects the diversity of the teacher population in these schools. By selecting 360 teachers from the total population of 5,626, the study can gather data that is statistically representative of the larger teacher workforce in Zhengzhou's vocational high schools. This sample size is also adequate for conducting SEM analysis, which requires a sufficient number of participants to produce stable and reliable estimates of the relationships between variables. The initial distribution encompassed 360 questionnaires aimed at capturing a comprehensive range of responses regarding collaborative leadership practices and their perceived outcomes. Upon completion of the data collection phase from October 25 to November 25, 2024, the study achieved a retrieval of 352 filled questionnaires. This subset was reviewed to ensure the reliability and relevance of the data, leading to the exclusion of two surveys due to incomplete or inconsistent responses. Consequently, the study proceeded with a robust dataset of 350 valid questionnaires.

To collect data, the study employs a survey instrument based on a Likert-5 scale, which is adapted and designed from established scales used in previous research on collaborative leadership, teacher autonomy, and school improvement. The Likert-5 scale, ranging from "strongly disagree" to "strongly agree", allows for the capture of varying degrees of agreement or disagreement with statements related to each of the key variables of the study.

For data analysis, the study adopts two main statistical techniques: descriptive statistics and Structural Equation Modeling (SEM) path analysis. Descriptive statistics, including measures of central tendency and dispersion, are used to summarize the basic characteristics of the data and provide an overview of teachers' perceptions of collaborative leadership, autonomy, and school improvement in Zhengzhou's vocational high schools. Descriptive statistics help to

illustrate the general trends and patterns within the data, setting the stage for more in-depth analysis.

The core analytical technique, SEM path analysis, is then used to examine the relationships between collaborative leadership, teacher autonomy, and school improvement. SEM is a powerful statistical tool that allows for the modeling of complex relationships between multiple variables, including both direct and indirect effects. In this study, SEM path analysis is applied to test the hypothesized relationships between collaborative leadership and teacher autonomy, as well as their combined influence on school improvement. By using SEM, the study can assess not only the direct impact of collaborative leadership on school improvement, but also the potential mediating effect of teacher autonomy. This approach provides a more comprehensive understanding of the interaction between these variables and how they collectively contribute to school improvement in vocational high schools. The use of SEM path analysis thus enables the study to draw more nuanced and robust conclusions about the role of leadership and autonomy in educational improvement.

The study utilizes the figure flow of the research process in Fig. 1 to investigate the relationship among variables of the study, including collaborative leadership, teacher autonomy and school improvement in Zhengzhou's vocational high schools.
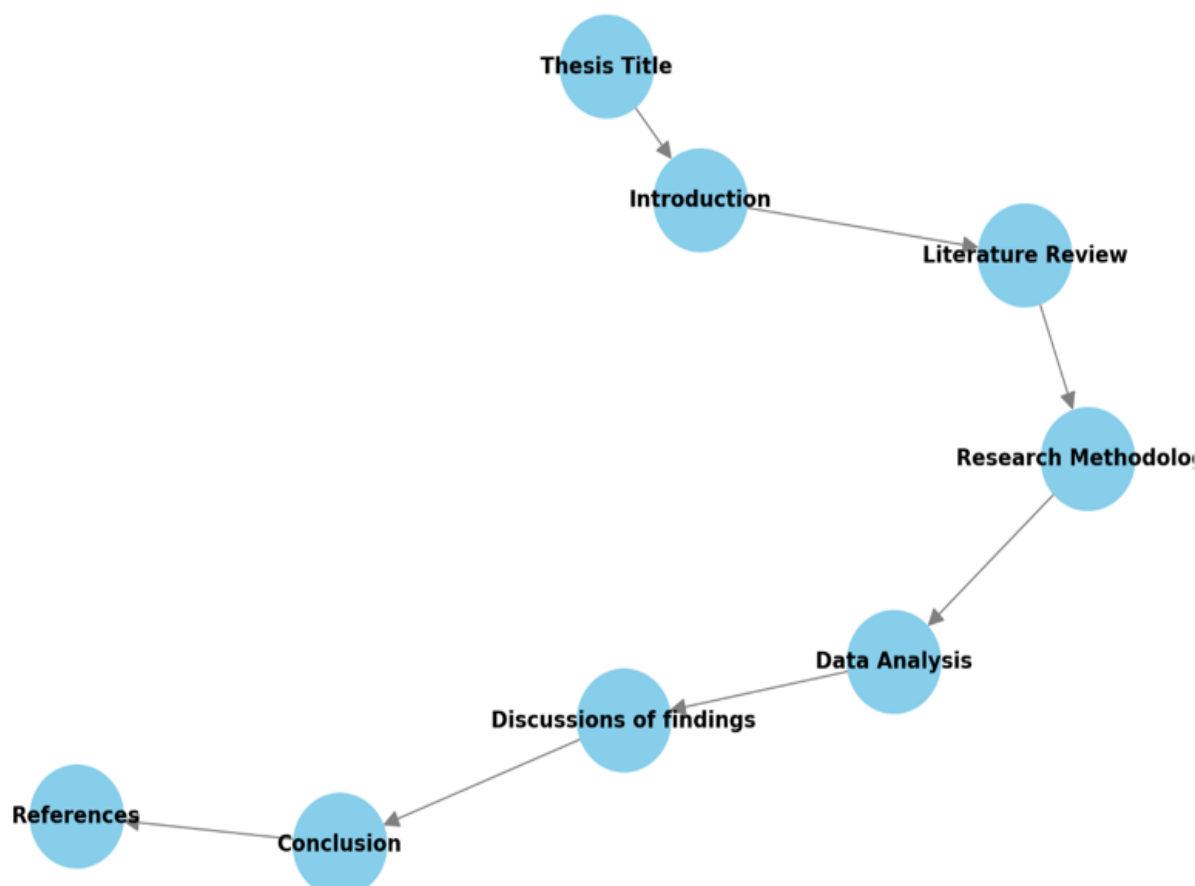

Figure 1: Research process

4. Data analysis

In this study, Structural Equation Modeling path analysis was utilized to examine the relationships posited within the conceptual framework. The path analysis results are displayed in the Table 1.

Table 1: Specific SEM path analysis results

Path	Estimate	S.E.	C.R.	P-value	Std Path coefficient
Collaborative leadership--->School improvement	0.625	0.060	10.417	***	0.521
Collaborative leadership---> Teacher autonomy	0.571	0.058	9.845	***	0.468

Teacher autonomy--->School improvement	0.516	0.057	9.053	***	0.409

Based on data in the Table 1, the direct path from collaborative leadership to school improvement shows a significant and positive influence, with an estimate of 0.625, a critical ratio (C.R.) of 10.417, and a standardized path coefficient of 0.521. This indicates that when school leaders adopt collaborative practices, there is a substantial and statistically significant improvement in the school's overall performance. The high standardized path coefficient (0.521) suggests that collaborative leadership contributes strongly to school improvement, likely by creating an inclusive environment where teachers and staff are actively involved in decision-making. This involvement can lead to a shared commitment to the school's goals and a cohesive approach to addressing educational challenges, which ultimately enhances school outcomes.

The direct path from collaborative leadership to teacher autonomy is also positive and significant, with an estimate of 0.571, a C.R. of 9.845, and a standardized path coefficient of 0.468. This finding implies that collaborative leadership directly fosters teacher autonomy. When school leaders engage teachers in decision-making processes and promote a culture of mutual respect, teachers feel more empowered to exercise independence in their instructional practices. The substantial path coefficient (0.468) underscores the strong relationship between collaborative leadership and teacher autonomy, suggesting that a collaborative leadership style plays a key role in creating an environment where teachers feel trusted and are more likely to take ownership of their work. This empowerment can encourage teachers to innovate and tailor their teaching methods to better meet the needs of their students, especially in the vocational education context.

The path from teacher autonomy to school improvement is also significant, with an estimate of 0.516, a C.R. of 9.053, and a standardized path coefficient of 0.409. This indicates that teacher autonomy has a direct positive impact on school improvement. When teachers are given greater autonomy, they are more likely to feel motivated, professionally satisfied, and committed to student-centered learning approaches. The standardized path coefficient of 0.409 suggests that although teacher autonomy has a somewhat smaller impact on school improvement compared to collaborative leadership, it still plays an essential role in enhancing educational outcomes. This may be because autonomy enables teachers to adapt their teaching practices to the specific needs of their students, which is particularly important in vocational high schools where alignment with real-world applications is crucial.

In summary, the SEM path analysis shows that both collaborative leadership and teacher autonomy have significant direct effects on school improvement in vocational high schools in Zhengzhou. Collaborative leadership not only directly contributes to school improvement but also positively influences teacher autonomy, which in turn further enhances school improvement. This suggests that a leadership style that emphasizes collaboration and empowerment can create a supportive environment where teachers are motivated and able to contribute more effectively to the school's goals, leading to better outcomes for students and staff alike.

Besides, the study focuses on analyzing the influence of collaborative leadership on school improvement as well as check the mediating effect of teacher autonomy. To analyze this mediating effect, the Bootstrap method was employed, utilizing 5,000 resamples, adhering to the recommendations by Grzegorzewski & Romaniuk (2022). Detailed results of the mediating effect analysis, highlighting the influence of teacher autonomy, are presented in Table 2.

Table 2. Mediating effect of teacher autonomy

Standard effect	Path	Effect coefficient	95% confidence interval		S.E.	P-value
			Lower	Upper		
Total effect	Collaborative leadership--->School improvement	0.712	0.663	0.761	0.025	***
Direct effect	Collaborative leadership--->School improvement	0.521	0.476	0.566	0.023	***
Indirect effect	Collaborative leadership--->Teacher autonomy--->School improvement	0.191	0.148	0.234	0.022	***

Based on data in the Table 2, the total effect of collaborative leadership on school improvement is 0.712, indicating a strong and statistically significant positive relationship (p < 0.001) between these two variables. This suggests that collaborative leadership practices are highly effective in improving overall school performance, as collaborative approaches allow for greater inclusivity in decision-making and foster a supportive environment for teachers.

The direct effect of collaborative leadership on school improvement, without accounting for teacher autonomy, is 0.521 (p < 0.001). This effect shows that even in the absence of teacher autonomy as a mediator, collaborative leadership alone significantly contributes to school improvement. The relatively high effect coefficient of 0.521 highlights the substantial impact of leadership style in creating a positive school environment where shared goals and mutual accountability enhance educational outcomes.

The indirect effect of collaborative leadership on school improvement, mediated through teacher autonomy, is 0.191 (p < 0.001). This indirect effect indicates that part of the positive impact of collaborative leadership on school improvement occurs because collaborative leadership fosters teacher autonomy. When leaders engage teachers in decision-making processes and provide them with professional independence, teachers are more likely to innovate, adapt their teaching strategies, and address student needs effectively. This indirect effect suggests that teacher autonomy serves as a vital pathway through which collaborative leadership enhances school improvement, contributing an additional 0.191 to the overall impact.

In summary, the data demonstrates that teacher autonomy mediates the relationship between collaborative leadership and school improvement. While collaborative leadership directly influences school improvement, it also has an additional, indirect effect by empowering teachers. This mediating role of teacher autonomy underscores the importance of fostering a leadership style that not only includes teachers in decision-making but also grants them the freedom to exercise professional judgment. By enhancing both collaboration and autonomy, vocational high schools can create an environment that supports continuous improvement in teaching quality and student outcomes.

5. Discussion of findings

The findings from this study demonstrate a significant positive relationship between collaborative leadership, teacher autonomy, and school improvement in vocational high schools in Zhengzhou, China. The analysis, using Structural Equation Modeling path analysis, reveals that collaborative leadership not only directly impacts school improvement but also indirectly influences it through teacher autonomy.

5.1 Collaborative Leadership and School Improvement

The data indicates that collaborative leadership has a strong and direct positive impact on school improvement, with a path coefficient of 0.521 and a highly significant p-value (p < 0.001). This result aligns with previous research, such as Heck & Hallinger (2010), who found that collaborative leadership practices, which involve engaging teachers and other staff members in decision-making, are positively correlated with improved student outcomes and increased staff satisfaction. In vocational high schools, where educators face unique challenges associated with balancing theoretical instruction with practical skills training, the presence of collaborative leadership can create a supportive environment that encourages educators to work together towards shared objectives. Collaborative leadership, therefore, not only improves school climate but also enhances the adaptability of the curriculum to industry demands, which is particularly important in Zhengzhou's vocational education context, given the city's rapid industrial growth.

5.2 Collaborative Leadership and Teacher Autonomy

The data also reveal a strong, statistically significant relationship between collaborative leadership and teacher autonomy, with a path coefficient of 0.468 (p < 0.001). This finding supports the notion that when school leaders adopt a collaborative approach, teachers feel more empowered to exercise professional independence. Studies by Lu et al. (2015) have shown that collaborative leadership directly contributes to teacher autonomy by creating an atmosphere of trust and mutual respect. When teachers are included in discussions about curriculum design, classroom management, and instructional practices, they are more likely to feel valued and confident in their professional judgment. In the vocational education context, teacher autonomy is particularly important because it allows educators to tailor their teaching methods to align with practical skill requirements, making instruction more relevant to real-world applications. Collaborative leadership facilitates this by reducing the top-down pressures that often restrict teachers' creativity and flexibility. Collaborative leaders help establish a school culture that values teacher input and respects their autonomy, fostering an environment where educators can innovate in response to students' unique learning needs. This is particularly relevant in Zhengzhou, where the vocational high school curriculum must constantly adapt to the evolving demands of local industries.

5.3 Teacher Autonomy and School Improvement

The relationship between teacher autonomy and school improvement is also significant, with a path coefficient of 0.409 (p < 0.001). This suggests that greater teacher autonomy contributes positively to overall school improvement, albeit with a somewhat smaller effect compared to collaborative leadership. This finding is consistent with research by Honig & Rainey (2012), who found that schools where teachers were granted greater decision-making power in instructional practices demonstrated improvements in student achievement, teacher retention, and school climate. Autonomy enables teachers to innovate and personalize their approaches, which can lead to higher levels of student engagement and better learning outcomes.

In the context of vocational education, teacher autonomy is crucial as it allows educators to modify their teaching techniques to match industry requirements, ensuring that students acquire practical skills that are directly applicable in the workforce. Autonomy fosters a dynamic and adaptive learning environment where teachers can respond effectively to feedback and student performance. This flexibility is particularly valuable in vocational schools, where standardized teaching methods may not adequately address the diverse skill sets needed in technical fields. By granting teachers the

freedom to adapt their instruction, vocational high schools in Zhengzhou can enhance the relevance and quality of their educational offerings, thereby better preparing students for local labor market demands.

5.4 The Mediating Role of Teacher Autonomy

One of the most significant findings of this study is the mediating effect of teacher autonomy on the relationship between collaborative leadership and school improvement. The indirect effect of collaborative leadership on school improvement, mediated by teacher autonomy, was found to be 0.191 ($p < 0.001$). This indicates that part of the positive impact of collaborative leadership on school improvement occurs because collaborative leadership fosters teacher autonomy, which then enhances school performance. This mediating role of teacher autonomy highlights the importance of empowering teachers as part of a broader collaborative leadership strategy.

This finding demonstrated that collaborative leadership creates an environment conducive to teacher empowerment, which ultimately leads to better educational outcomes. By promoting a culture where teachers are encouraged to exercise professional judgment, collaborative leaders enable teachers to develop innovative solutions to instructional challenges. The indirect effect found in this study suggests that collaborative leadership amplifies school improvement efforts not only by directly enhancing the school climate but also by fostering teacher autonomy, which in turn boosts teachers' motivation, satisfaction, and commitment to student-centered learning.

6. Conclusion

This study highlights the crucial roles of collaborative leadership and teacher autonomy in driving school improvement within vocational high schools in Zhengzhou, China. The findings underscore that collaborative leadership has a strong direct impact on school improvement. This leadership style not only enhances teachers' job satisfaction and motivation but also creates a cohesive school culture that is responsive to the unique challenges of vocational education. Furthermore, the study reveals that collaborative leadership significantly promotes teacher autonomy, empowering educators to make independent, professional decisions that improve instructional effectiveness and student engagement. Teacher autonomy, in turn, contributes directly to school improvement by allowing teachers to tailor their approaches to better meet students' needs, particularly in vocational contexts where practical, skills-based learning is essential. The study also finds that teacher autonomy mediates the relationship between collaborative leadership and school improvement, indicating that the empowering effect of collaborative leadership is partly channeled through enhanced teacher independence. This mediating role of autonomy suggests that for vocational high schools aiming to improve their educational outcomes, fostering both collaborative leadership and a culture of teacher autonomy is essential. These insights offer valuable implications for educational policy and school administration in Zhengzhou and similar urban areas, suggesting that shifting towards more collaborative and empowering leadership practices could significantly boost the effectiveness of vocational education and better prepare students for the workforce.

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Conflict of Interest

The authors declare no conflicts of interest.

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