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The Role of Transformational Leadership and Innovation Culture in Enhancing Innovation Performance in Polytechnic University of Beijing City, China

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Abstract: The increasing demand for innovation in higher education, particularly in rapidly developing economies like China, underscores the need to understand how organizational factors influence innovation performance. This study explores the impact of transformational leadership and innovation culture on innovation performance at the Polytechnic University of Beijing City, China. Using a quantitative research method, data were collected from 400 teachers across 14 polytechnic universities in Beijing through a structured questionnaire. Structural Equation Modeling (SEM) was employed to analyze the relationships among transformational leadership, innovation culture, and innovation performance. The results reveal that transformational leadership has a significant positive effect on innovation performance, both directly and indirectly through the mediation of innovation culture. The findings indicate that transformational leaders enhance innovation performance by fostering a supportive culture that encourages creativity, risk-taking, and continuous improvement. This study contributes to the literature by highlighting the critical role of leadership and culture in driving innovation within Chinese higher education institutions and offers insights for policymakers aiming to boost innovation outcomes through targeted leadership development and cultural initiatives.

Key words: Transformational leadership, innovation culture, innovation performance, polytechnic university, Beijing city

1. Introduction

In recent years, the rapid pace of technological advancement and globalization has intensified the need for innovation across various sectors, including higher education (Bie & Yi, 2024). Universities, as centers of knowledge creation and dissemination, play a pivotal role in fostering innovation to drive socio-economic progress (Aleru & Nkpolu Oroworukwo, 2024). China, as one of the world's fastest-growing economies, has increasingly recognized the importance of innovation in sustaining its competitive edge (Zhou, 2024). The Chinese government has launched numerous initiatives to support innovation and enhance the quality of education, emphasizing the strategic role of higher education institutions in producing research outputs and cultivating an innovation-oriented workforce (Yuan, 2024). In this context, the Polytechnic University of Beijing City serves as an ideal case study to explore how leadership and culture within educational institutions can enhance innovation performance.

Transformational leadership, a leadership style characterized by the ability to inspire and motivate followers towards achieving higher levels of performance, has been shown to positively influence innovation (Celestin & Sujatha, 2024). Transformational leaders create an environment that encourages creativity, autonomy, and a willingness to embrace change, which are all essential factors for innovation (Vo et al., 2024). On the other hand, organizational culture, specifically, an innovation-oriented culture, also plays a critical role in shaping an institution's approach to innovation (Ali et al., 2024). A culture that promotes openness to new ideas, values experimentation, and supports risk-taking can foster an environment conducive to innovation (Gupta, 2024).

In the modern global economy, the ability to innovate is not just a competitive advantage but a necessity. This imperative has prompted universities to not only focus on knowledge dissemination but also prioritize innovation as part of their core mission. For Chinese universities, this is especially significant, given the national focus on becoming a

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leader in technology and innovation (Yang et al., 2024). However, fostering an environment that supports sustained innovation is challenging, requiring effective leadership and a supportive organizational culture. The Polytechnic University of Beijing City, as a technical institution with a focus on practical skills and applied research, is well-positioned to contribute to this national innovation agenda. Yet, there remains a lack of clarity on how leadership styles and cultural factors within the university impact its innovation outcomes.

One of the primary challenges lies in identifying the mechanisms through which university leadership can effectively foster a culture of innovation that translates into tangible performance outcomes, such as high-quality research outputs, patents, and technology transfers. While transformational leadership has been widely recognized as a potent driver of innovation, its effectiveness is contingent upon the cultural context in which it is practiced (Babu & Kushwaha, 2024). In a Chinese university setting, where hierarchical structures and collective values may influence leadership dynamics, it is unclear how transformational leadership practices align with these cultural factors to support or hinder innovation performance.

Another issue is the role of an innovation culture within an academic institution. Innovation culture encompasses a set of shared values and norms that encourage creativity, experimentation, and open communication (Yun et al., 2020). In a university, where traditional values and bureaucratic structures often prevail, fostering an innovation culture can be particularly challenging. Therefore, understanding how a culture that promotes innovation is developed and maintained within a Chinese Polytechnic University is critical for enhancing its innovation performance.

Despite existing studies on transformational leadership and innovation culture in various sectors, there is a scarcity of research focusing specifically on these variables within the context of Chinese higher education institutions, especially at the Polytechnic level. This gap in knowledge limits the ability of educational administrators and policymakers to make informed decisions on how best to foster innovation in a university setting. Therefore, this study aims to fill this research gap by examining the influence of transformational leadership and innovation culture on the innovation performance of the Polytechnic University of Beijing City, China.

2. Literature review

2.1 Studies on Transformational Leadership and Innovation Performance

Research on the impact of transformational leadership on innovation performance has consistently shown a positive relationship. Transformational leadership, characterized by the ability to inspire, motivate, and intellectually stimulate followers, is widely recognized as a catalyst for enhancing innovation.

Novitasari et al. (2021) conducted an empirical study that highlighted the significant role of transformational leadership in fostering innovation. The study revealed that transformational leaders positively influenced innovation performance by encouraging a culture of open communication and creativity. By promoting a supportive environment where employees felt valued and empowered, transformational leaders were able to increase followers' willingness to take risks and experiment with new ideas, ultimately leading to higher levels of innovative output. The findings underscore the importance of transformational leadership in creating a work environment conducive to innovation, suggesting that leaders who inspire and intellectually engage their teams are more likely to achieve enhanced innovation performance.

Hadi et al. (2023) found a strong positive association between transformational leadership and innovation performance and observed that transformational leadership behaviors, such as articulating a compelling vision, providing intellectual stimulation, and offering individualized consideration, significantly boosted innovation. The study argued that these leadership behaviors encouraged employees to think creatively and embrace novel approaches to problem-solving. Furthermore, the researchers noted that transformational leaders fostered a sense of purpose and intrinsic motivation among employees, which was instrumental in maintaining a high level of innovative output over time. The findings from this study reinforce the idea that transformational leadership can serve as a driving force behind continuous innovation by sustaining employees' motivation and engagement in creative processes.

Iqbal et al. (2021) examined the link between transformational leadership and innovation performance and confirmed that transformational leadership had a robust, positive impact on innovation performance across various organizational contexts. The study concluded that transformational leaders' ability to challenge the status quo and encourage out-of-the-box thinking was a key factor in enhancing innovation. The study emphasized that transformational leadership promoted an organizational climate that valued experimentation and learning, which in turn facilitated innovative behavior among employees. The study suggested that transformational leaders provide the necessary psychological safety for employees to take creative risks without fear of negative consequences, thereby driving higher levels of innovation performance. The study strengthens the argument that transformational leadership is crucial for fostering an environment that supports continuous innovation.

In summary, these studies highlight the significant positive influence of transformational leadership on innovation performance. By fostering a supportive, motivating, and intellectually stimulating work environment, transformational leaders play a critical role in driving innovation within organizations. The consistent findings across these studies underscore the importance of transformational leadership in enhancing employees' creative capabilities and sustaining innovation over time.

2.2 Studies on Transformational Leadership and Innovation Culture

Transformational leadership has been widely acknowledged as a significant factor in fostering an innovation-friendly culture within organizations.

Gui et al. (2024) examined the positive influence of transformational leadership on innovation culture by focusing on how transformational leaders inspire, motivate, and challenge employees to think creatively and embrace change. The study emphasized that transformational leaders encourage their followers to question conventional practices and norms, enabling them to pursue novel ideas and solutions. By creating an environment where employees feel empowered to experiment and take calculated risks, transformational leaders directly contribute to the cultivation of an innovation culture. The findings revealed a strong correlation between transformational leadership behaviors, such as vision articulation, intellectual stimulation, and individualized support, and the development of an innovative work culture. The study concluded that transformational leadership serves as a catalyst for instilling a mindset of continuous improvement and exploration, which are essential for sustaining an innovation-oriented culture.

Gad David et al. (2023) conducted a study on the relationship between transformational leadership and innovation culture, demonstrating that transformational leaders play a critical role in shaping the cultural values and attitudes within organizations that support innovation. This study highlighted the importance of transformational leaders' ability to communicate a compelling vision that aligns with the values of creativity and adaptability. By fostering a sense of purpose and inspiring employees to embrace this vision, transformational leaders create a cultural foundation that prioritizes innovation as a core organizational value. The study also pointed out that transformational leaders' emphasis on intellectual stimulation encourages employees to engage in critical thinking and pursue unconventional approaches to problem-solving, both of which are integral to innovation culture. The findings of this study showed that transformational leadership not only enhances employees' openness to new ideas but also instills a collective commitment to innovation, reinforcing the link between leadership style and an organization-wide innovation culture.

Hooi & Chan (2023) explored the mechanisms through which transformational leadership fosters an innovation culture, focusing on the role of leader-employee interactions in promoting creative thinking and proactivity. This study found that transformational leaders create a supportive and inclusive environment that encourages employees to voice their ideas and take initiative. The study that transformational leaders' behaviors, such as providing individualized support and recognizing employees' unique contributions, help build a climate of trust and psychological safety, which are fundamental for an innovation culture to thrive. The research also highlighted that transformational leaders' commitment to continuous learning and improvement sets a powerful example for employees, motivating them to adopt similar attitudes. The study concluded that transformational leadership fosters a dynamic work environment where creativity is valued, and employees feel empowered to challenge the status quo, ultimately leading to a robust culture of innovation within the organization.

In summary, transformational leadership plays a pivotal role in nurturing an innovation culture within organizations by inspiring, motivating, and challenging employees to think creatively and embrace change. These leaders promote a sense of purpose, intellectual stimulation, and psychological safety, which are crucial for cultivating an innovation-oriented culture. This leadership style not only enhances openness to new ideas but also instills a proactive commitment to continuous improvement and innovation across the organization.

2.3 Studies on Innovation Culture and Innovation Performance

The relationship between innovation culture and innovation performance has been explored in the literature, with numerous studies underscoring the positive influence that an organization's culture of innovation has on its overall innovation outcomes.

Zhang et al. (2023) conducted a comprehensive study examining the ways in which innovation culture directly enhances innovation performance within organizations. By focusing on a sample of various companies, the study identified that organizations fostering a culture supportive of creativity, experimentation, and openness to new ideas showed significant improvements in their innovation output. The study found that innovation culture encouraged employees to take calculated risks and think outside conventional boundaries, which ultimately led to the development of more groundbreaking products and solutions. The study concluded that cultivating an innovation-oriented culture has a positive impact on organizational performance by motivating employees to engage more actively in the creative processes that drive innovation. This research underscores the importance of nurturing an internal environment that champions new ideas as a key driver of enhanced innovation performance.

Hanifah et al. (2020) conducted an empirical study that examined the direct effects of innovation culture on innovation performance, reinforcing the notion that a supportive cultural environment is crucial for boosting organizational innovation. In the study, a robust innovation culture was characterized by values such as tolerance for failure, collaboration, and continuous learning, all of which were found to significantly elevate the quality and quantity of innovative outputs. The findings indicated that when organizations prioritized building an innovation-focused culture, employees felt more empowered to propose novel solutions and experiment without the fear of failure, leading to more successful innovation initiatives. The study highlighted that the presence of a strong innovation culture not only improves innovation performance but also sustains it over time, as it creates an ongoing cycle of improvement and creative

engagement among team members. This study suggests that organizations aiming to enhance their innovation performance should invest in cultivating a culture that encourages experimentation and supports employee-driven initiatives.

Aboramadan et al. (2020) also emphasizes the positive impact of innovation culture on innovation performance, providing additional evidence that fostering an environment conducive to innovation is critical for achieving superior innovation outcomes. The research focused on how specific cultural attributes, such as openness to change, a proactive approach to problem-solving, and supportive leadership, contribute to an organization's ability to consistently generate innovative products and processes. The study found that organizations with a strong innovation culture were better equipped to adapt to shifting market demands and rapidly implement creative solutions, which directly translated to higher innovation performance metrics. The study argued that an innovation-oriented culture not only boosts immediate innovation outputs but also enhances an organization's long-term capacity for sustained innovation. By creating a workplace atmosphere that values curiosity and encourages taking the initiative, organizations can maintain a high level of innovation performance in a competitive and constantly evolving environment.

In summary, these studies highlight the critical role of innovation culture in driving and sustaining high levels of innovation performance. By cultivating a culture that promotes creativity, risk-taking, and continuous improvement, organizations are better positioned to achieve superior innovation outcomes. The consistent findings across these studies suggest that innovation culture is not merely a supportive element but a fundamental determinant of successful innovation within organizations.

3. Research Methodology

3.1 Research Design

The study employs a quantitative research method to assess the relationships between transformational leadership, innovation culture, and innovation performance. Quantitative research, which involves the collection and analysis of numerical data, is well-suited for examining the strength and direction of relationships between variables (Ioannidis & Maniadis, 2024). In this study, a structured questionnaire is used to gather data on teachers' perceptions of leadership style, organizational culture, and innovation outcomes in their respective institutions. Quantitative data provides an objective and statistical basis for understanding the impact of transformational leadership and innovation culture on innovation performance, allowing for the testing of specific hypotheses and generating insights that are generalizable across a larger population.

The choice of a quantitative research method is driven by the objective to measure and analyze how variations in leadership style and culture impact measurable innovation outcomes across multiple institutions. Using statistical analysis, this approach enables the researcher to identify trends, correlations, and potential causal relationships that may exist between transformational leadership, innovation culture, and innovation performance. Given the structured nature of quantitative research, it also allows for a high degree of reliability and replicability, which is important for contributing meaningful findings to the literature on organizational innovation in educational institutions.

The decision to adopt a quantitative approach is based on several key considerations. First, quantitative research allows for the efficient collection and analysis of data from a large sample, which is essential in this study as it aims to capture insights from teachers across 14 polytechnic universities in Beijing. Given the study's sample size and the complexity of the relationships being examined, quantitative methods offer a systematic way to explore patterns across a large population, ensuring the findings are statistically significant and representative of the broader academic environment. Second, a quantitative approach is appropriate for testing the hypotheses, which seek to establish the extent to which transformational leadership and innovation culture contribute to innovation performance in a university setting. Quantitative methods enable hypothesis testing through statistical techniques, such as Structural Equation Modeling (SEM), which can reveal both direct and indirect effects between variables. This analytical approach is critical for identifying the specific impact of transformational leadership and innovation culture on innovation performance, providing a clear, data-driven basis for evaluating the research questions. Third, the structured format of quantitative data collection, specifically using Likert-scale surveys, aligns with the study's aim to quantify subjective perceptions related to leadership and organizational culture. The Likert-5 scale, a widely accepted tool in social science research, allows respondents to express their level of agreement with statements related to transformational leadership and innovation culture in a standardized way, facilitating consistent data analysis and comparison across responses.

The study analyzes the role of transformational leadership and innovative culture in enhancing innovation performance in Polytechnic university of Beijing city, China based on the Fig. 1 research process.

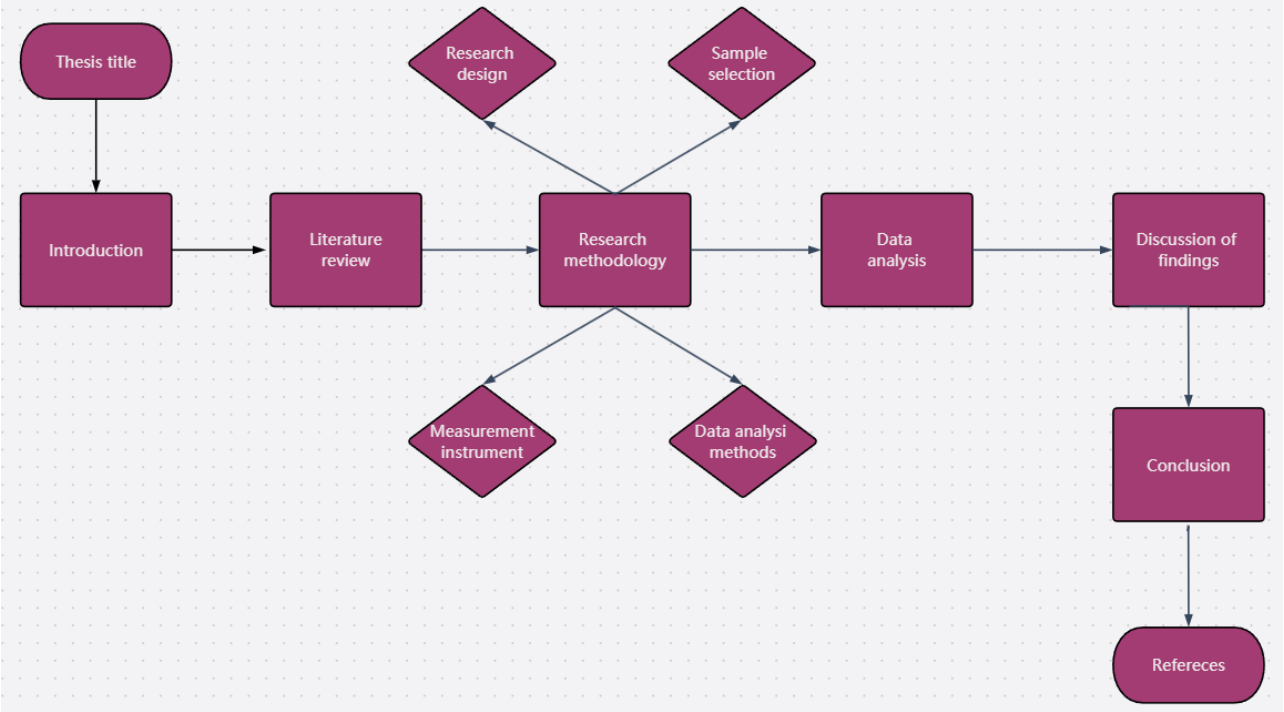

Figure 1. Research process

3.2 Sample Selection

The target population for this study includes all teachers working in polytechnic universities across Beijing, China. According to available data, there are a total of 36,666 teachers employed across 14 polytechnic universities in Beijing. To obtain a statistically significant sample size that accurately represents this population, the study utilized Raosoft's sample size calculator, which recommended a sample of 400 respondents for a 95% confidence level with a 5% margin of error. Based on these calculations, the study selected a sample of 400 teachers using a random sampling method. Random sampling ensures that everyone in the population has an equal chance of being selected, minimizing potential biases and enhancing the representativeness of the sample.

The selection of 400 teachers from the total pool of 36,666 ensures a robust sample that is large enough to allow for generalizations about the larger population of polytechnic university teachers in Beijing. This sample size provides sufficient data for conducting detailed statistical analyses, including Structural Equation Modeling. By choosing a random sampling method, the study minimizes selection bias, allowing for greater confidence in the validity and reliability of the findings.

Out of the distributed 400 questionnaires across 14 polytechnic universities in Beijing from November 11 to December 11, 2024, 393 were returned, indicating a high level of engagement among the participants. However, not all submissions were usable for analysis. After a careful screening process to ensure the quality and integrity of the data, 9 questionnaires were deemed invalid due to incomplete information or evident discrepancies in responses. This scrutiny was vital to maintaining the reliability of the findings. Consequently, a total of 384 valid questionnaires were retained and used for the subsequent data analysis.

3.3 Measurement Instrument

To collect data on transformational leadership, innovation culture, and innovation performance, the study adopts Likert-scale items that have been adapted and designed from previous research. A Likert-5 scale, ranging from 1 (strongly disagree) to 5 (strongly agree), is used to measure participants' responses.

The use of established Likert-5 scale items ensures that the measurement instrument is reliable and valid, as these items have been empirically tested in previous studies. This approach enhances the comparability of the findings with those from other research in the field, allowing for greater consistency and coherence in the interpretation of results. Furthermore, the Likert-scale provides a nuanced understanding of respondents' attitudes, as it captures varying degrees of agreement or disagreement, facilitating a more detailed analysis of the relationship between transformational leadership, innovation culture, and innovation performance.

3.4 Data Analysis Methods

The study employs two main data analysis techniques: descriptive statistics and Structural Equation Modeling (SEM)

path analysis. Descriptive statistics are used to provide an overview of the sample demographics and summarize the responses to each item on the survey. This includes calculating means, standard deviations, frequencies, and percentages to describe the general trends in the data. Descriptive statistics help to present an initial understanding of the level of transformational leadership, innovation culture, and innovation performance as perceived by the teachers in the sample.

To examine the relationships between transformational leadership, innovation culture, and innovation performance, the study utilizes Structural Equation Modeling (SEM) path analysis. SEM is a powerful statistical technique that allows for the simultaneous analysis of multiple relationships between variables, making it well-suited for studies examining complex models with mediating or moderating effects. In this study, SEM path analysis enables the testing of direct effects (e.g., transformational leadership on innovation performance) as well as indirect effects (e.g., transformational leadership's influence on innovation performance mediated by innovation culture). This analytical approach provides insights into the specific pathways through which leadership style and organizational culture impact innovation outcomes.

SEM path analysis is chosen for its ability to handle latent variables, which are constructs that cannot be directly observed but are inferred from multiple observed indicators. Transformational leadership, innovation culture, and innovation performance are all treated as latent variables in this study, with each construct measured by multiple Likert-scale items. By using SEM, the study can account for measurement error and obtain more accurate estimates of the relationships between variables, enhancing the validity of the findings.

In summary, the quantitative research method, sample selection of 400 teachers, use of Likert-scale items, and application of descriptive statistics and SEM path analysis collectively provide a robust methodological framework for investigating the influence of transformational leadership and innovation culture on innovation performance in Beijing's polytechnic universities. This methodology enables the study to generate statistically reliable findings that contribute to a deeper understanding of the organizational factors driving innovation in Chinese higher education institutions.

4. Data Analysis

The study utilized Structural Equation Modeling to examine the relationships and dynamic interactions among the three key research variables: transformational leadership, innovation culture and innovation performance. The analytical process, facilitated with AMOS software version 28.0, yielded insightful results that are visually represented in Fig. 1.

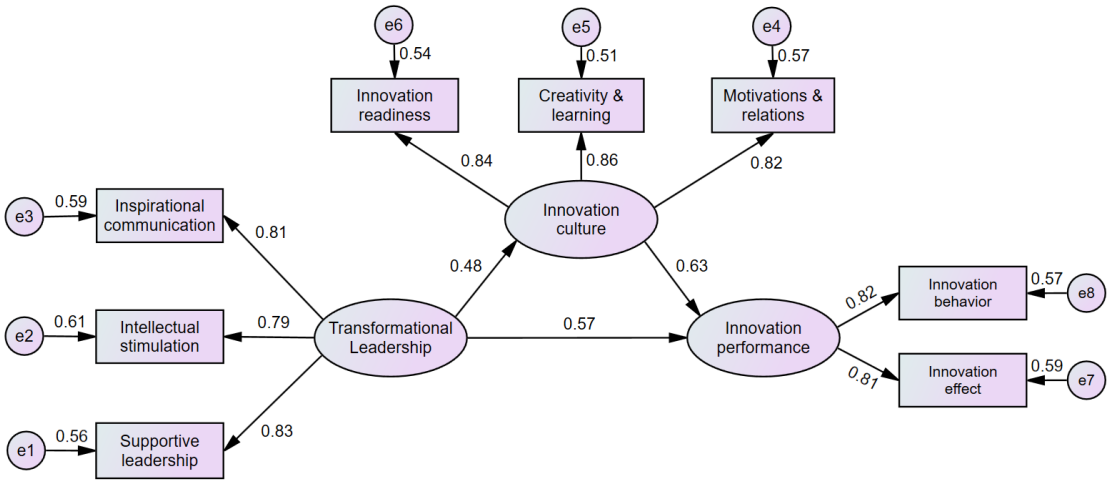

Figure 1. Structure equation model analysis results

According to the structural model presented in Fig. 2, the standardized path coefficient between transformational leadership and innovation performance is reported as 0.574, indicating a robust and positive influence of transformational leadership on innovation performance, with a statistical significance level of P<0.001. This strong relationship highlights the pivotal role that transformational leaders play in enhancing the innovative capabilities of organizations. This result confirms that transformational leadership positively impacts innovation performance.

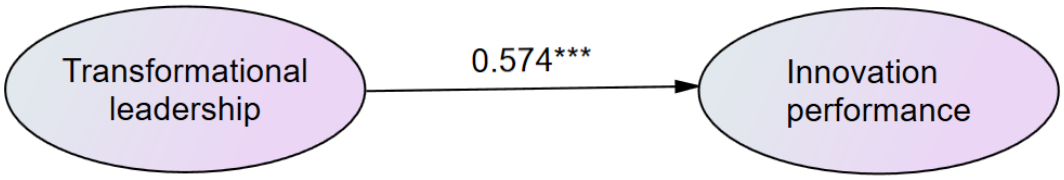

Figure 2. Path analysis between transformational leadership and innovation performance

Based on the statistical data presented in Fig. 3, it is evident that transformational leadership exerts a significant positive influence on innovation culture within educational institutions. The standardized path coefficient of 0.484, accompanied by a high significance level of P<0.001, confirming that transformational leadership positively affects the cultivation of an innovation-driven culture.

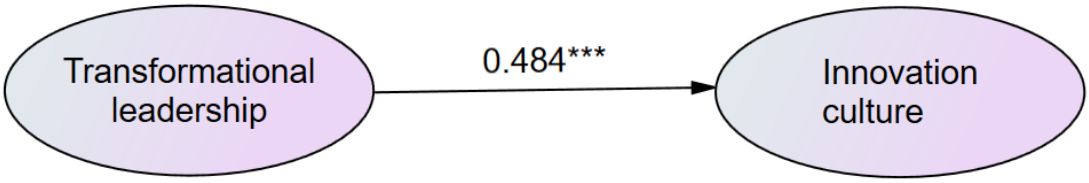

Figure 3. Path analysis between transformational leadership and innovation culture

In accordance with the data presented in Fig. 4, the standardized path coefficient linking innovation culture to innovation performance stands at 0.625, with a highly significant p-value of less than 0.001. This robust statistical result confirms a positive influence of innovation culture on innovation performance. The strength of this relationship underscores the critical role that an ingrained culture of innovation plays in enhancing organizational performance metrics related to innovation.

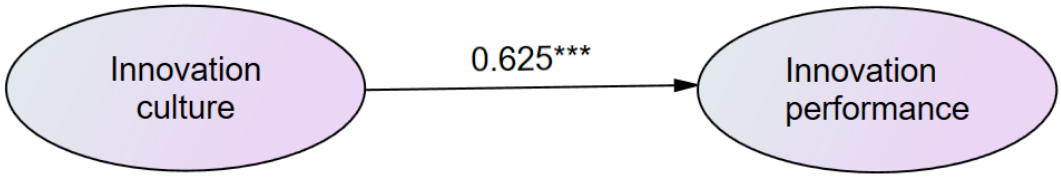

Figure 4. Path analysis between transformational leadership and innovation culture

Besides, the study utilized bootstrapping method to check the mediating effect of innovation culture in the influence of transformational leadership on innovation performance, with the mediating effect analysis results presented as follows in Table 1.

Table 1. Mediating effect results of innovation culture

Standard effect	Path	Effect coefficient	95% confidence interval		S.E.	P-value
			Lower	Upper		
Total effect	Transformational leadership ---->Innovation performance	0.877	0.828	0.926	0.025	0.000
Direct effect	Transformational leadership ---->Innovation performance	0.574	0.531	0.617	0.022	0.000
Indirect effect	Transformational leadership –Innovation culture->Innovation performance	0.303	0.265	0.341	0.020	0.000

Based on data in Table 1, the total effect of transformational leadership on innovation performance, which includes both direct and indirect effects, is 0.877 with a P-value of 0.000, indicating a strong and highly significant positive relationship. This total effect reflects the overall influence that transformational leadership has on innovation performance, both directly and through the mediation of innovation culture.

The direct effect of transformational leadership on innovation performance (i.e., the impact of transformational leadership on innovation performance without considering the mediation of innovation culture) is 0.574 with a P-value of 0.000. This significant direct effect suggests that transformational leadership alone has a substantial positive influence on innovation performance. Transformational leaders likely foster an environment that promotes creativity, autonomy, and motivation among employees, which directly enhances innovation outcomes.

The indirect effect of transformational leadership on innovation performance, mediated by innovation culture, is 0.303 with a P-value of 0.000. This means that transformational leadership indirectly enhances innovation performance by first fostering an innovation-oriented culture. Transformational leaders appear to create a supportive and psychologically safe environment where experimentation, risk-taking, and openness to new ideas are encouraged, which in turn boosts innovation performance. This indirect effect underscores the importance of innovation culture as a pathway through which transformational leadership can further amplify innovation outcomes.

The presence of both a significant direct and indirect effect suggests a mediation by innovation culture. This means

that while transformational leadership has a direct impact on innovation performance, a portion of its influence is channeled through the development of an innovation-oriented culture within the organization. The fact that the indirect effect (0.303) is substantial indicates that innovation culture plays a critical role in translating transformational leadership practices into tangible innovation outcomes. Transformational leaders not only impact innovation performance directly but also cultivate a culture that enhances employees' willingness to engage in innovative behavior, thereby amplifying the overall impact on innovation performance.

5. Discussions

The study aims to examine the influence of transformational leadership and innovation culture on innovation performance within the context of the Polytechnic University of Beijing City. The analysis utilized Structural Equation Modeling (SEM) to explore the relationships between these variables, with results indicating a significant and positive impact of both transformational leadership and innovation culture on innovation performance. Furthermore, the study identified innovation culture as a mediator in the relationship between transformational leadership and innovation performance, suggesting that transformational leaders not only directly influence innovation outcomes but also do so indirectly by cultivating a supportive innovation culture.

The findings reveal a strong and direct positive relationship between transformational leadership and innovation performance, with a standardized path coefficient of 0.574 ($p < 0.001$). This result corroborates the findings of studies by Tharnpas & Sakun (2015), which similarly observed that transformational leadership behaviors such as articulating a vision, intellectual stimulation, and individualized consideration significantly enhance innovation performance. These behaviors not only motivate employees to think creatively but also provide the psychological safety necessary for taking calculated risks, which is essential for fostering innovation. In the context of Chinese higher education, particularly in a polytechnic institution focused on applied research, the role of transformational leadership may be especially pronounced. China's educational institutions are traditionally hierarchical, and the presence of transformational leaders who challenge conventional norms and encourage out-of-the-box thinking can have a substantial impact on fostering innovation. This finding suggests that transformational leadership might be an effective approach in such settings, enabling universities to overcome rigid structures and encouraging a mindset that values adaptability and creativity. By promoting a culture of openness to change, transformational leaders can help bridge the gap between traditional educational practices and the need for continuous innovation to stay competitive on a global scale.

The study also found a significant positive relationship between transformational leadership and innovation culture, with a path coefficient of 0.484 ($p < 0.001$). This result reinforces the view that transformational leaders are instrumental in cultivating an organizational culture that supports innovation. According to Khalili (2016), transformational leaders contribute to innovation culture by empowering employees to experiment, question established norms, and embrace change. These leaders foster a sense of shared purpose and intellectual engagement that encourages team members to adopt a proactive approach to problem-solving and to embrace creativity. In the context of the Polytechnic University of Beijing City, this finding suggests that transformational leaders play a pivotal role in breaking down traditional bureaucratic structures that may hinder innovation. By creating a more inclusive and psychologically safe environment, these leaders enable faculty members to voice their ideas and take initiatives without fear of negative repercussions.

The analysis revealed a strong and significant positive relationship between innovation culture and innovation performance, with a path coefficient of 0.625 ($p < 0.001$). This finding supports previous research that emphasizes the importance of an innovation-oriented culture for achieving superior innovation outcomes (Ghasemzadeh et al., 2019). Innovation culture, characterized by openness to new ideas, tolerance for failure, and support for continuous learning, provides a conducive environment for creativity and experimentation. Organizations with a strong innovation culture are better able to develop groundbreaking products and solutions because employees feel empowered to take risks and think outside conventional boundaries. In the context of Beijing's Polytechnic University, fostering an innovation culture can be particularly challenging due to the traditionally rigid academic structures and bureaucratic practices that often prevail in Chinese universities. However, the findings suggest that promoting an innovation culture within the institution could significantly enhance its innovation performance. By encouraging values such as experimentation, open communication, and risk-taking, the Polytechnic University can create an environment that supports both applied research and technological advancements. This alignment with an innovation-driven culture not only benefits the institution's performance but also positions it as a key contributor to China's broader goals of technological leadership and economic development.

One of the most significant insights from this study is the mediating role of innovation culture in the relationship between transformational leadership and innovation performance. The total effect of transformational leadership on innovation performance was 0.877, with the direct effect being 0.574 and the indirect effect through innovation culture at 0.303 (all significant at $p < 0.001$). This suggests that while transformational leadership has a direct positive impact on innovation performance, a portion of its influence is channeled through the development of an innovation-oriented culture. The mediating effect observed in this study aligns with the findings of Zafar & Mehmood (2019), who highlighted that transformational leaders build a climate of trust and psychological safety, thereby promoting an innovation culture that encourages creative risk-taking. This mediated pathway underscores the critical role that an ingrained culture of innovation plays in maximizing the impact of transformational leadership. It implies that

transformational leaders are not only successful in directly enhancing innovation outcomes but also indirectly do so by instilling a culture that prioritizes continuous improvement and exploration. For the Polytechnic University of Beijing City, this mediated relationship suggests a twofold approach to enhancing innovation performance. First, investing in transformational leadership development programs can equip leaders with the skills to inspire and intellectually engage their teams. Second, fostering a supportive innovation culture will allow the positive effects of transformational leadership to be fully realized. By cultivating a work environment where experimentation and creative problem-solving are valued, the university can ensure that the gains achieved through transformational leadership are sustained and even magnified over time.

6. Conclusion

This study has demonstrated that transformational leadership and innovation culture significantly enhance innovation performance at the Polytechnic University of Beijing City. The findings confirm that transformational leadership has a direct and robust positive impact on innovation performance, as well as an indirect effect mediated by innovation culture. The positive relationship between transformational leadership and innovation culture suggests that leaders who inspire creativity and empower their followers help cultivate a supportive environment for innovation. Furthermore, innovation culture itself was shown to play a pivotal role in driving innovation performance, underscoring its critical role within academic institutions. The mediating effect of innovation culture highlights that transformational leaders not only influence innovation outcomes directly but also enhance them indirectly by fostering a culture that prioritizes continuous improvement and creativity. For the Polytechnic University of Beijing City, this indicates that combining transformational leadership development with initiatives to build an innovation-supportive culture could be a highly effective strategy to elevate its research output, technology transfer, and overall contribution to China's national innovation agenda. These findings underscore the importance of nurturing a conducive organizational environment, as both transformational leadership and innovation culture together provide a powerful foundation for sustained innovation performance in higher education institutions.

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Conflict of Interest

The authors declare no conflicts of interest.

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