

Research on the Influence of Undergraduates' Perceived Servant Leadership in China: The Effect of Innovative Atmosphere and Innovative Self-Efficacy

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Abstract

This study explores the influence mechanism of perceived servant leadership on innovative behavior among college students in Hebei Province, China, and the chain-mediating role of innovative atmosphere and innovative self-efficacy. This study adopts the questionnaire survey method and the convenience sampling method, and 478 college students are collected. The results show that the perception of servant leadership by college students in Hebei Province in China significantly positively affects innovative behavior; The innovative atmosphere and innovative self-efficacy mediate between college students' perceived servant leadership and innovative behavior.

Keywords: servant leadership; innovative behavior; innovative atmosphere; innovative self-efficacy

1. Introduction

University graduates are an essential component of the human capital of enterprises, underscoring the need to begin national innovation enhancement at the educational level. Therefore, focusing on fostering innovative thinking and behaviors in university students is a critical mission for higher education institutions (Lv et al., 2022). According to Kwon and Kim (2020), individual innovative behavior involves creating, introducing, and applying novel and beneficial actions within any organizational context. As such, this innovative behavior is a key element for individual success (Liang et al., 2020). Enhancing the innovative behaviors of university students is crucial for driving comprehensive educational reforms, strengthening their core competencies, and improving their employment prospects (Mahgoub, 2021). In a broader sense, university students' innovative actions are vital for driving business innovation and play a significant role in determining a country's economic development potential and competitive edge in the global market. As the nurturing ground for talented individuals, universities should aim to align their educational objectives with the needs of businesses and society for innovative talent. Therefore, stimulating and understanding the key factors that influence the innovative behaviors of university students is a vital area of current research (Kim et al., 2018).

Servant leadership represents a modern management style well suited for addressing the complexities of an evolving environment (Ruiz-Palomino et al., 2019; Slåtten & Mehmetoglu, 2011). Servant leadership in teaching aligns with the philosophy of 'people-centered, service-oriented education,' breaking away from the traditional, unilateral, authoritarian, and top-down educational approach. It redefines the role of teachers (Noland & Richards, 2015) and positively impacts students' academic achievements, personality development, and adaptability. Servant leadership prioritizes the needs of others, transforming these needs into personal goals, showing concern for others, and striving to fulfill their needs (Chiniara & Bentein, 2016; Eva et al., 2019; Liden et al., 2014; Van Dierendonck, 2011). Moreover, servant leadership can encourage and positively predict individual innovative behaviors (Cai et al., 2018; Hernández-Perlines & Araya-Castillo, 2020; Williams et al., 2017). Therefore, servant leadership may have a positive influence on the innovative behaviors of university students.

According to social learning theory, an innovative atmosphere is conducive to generating innovative behavior (Shanker et al., 2017). In the realm of research linking innovative atmospheres to innovative behaviors, Aryee et al. (2012) argue that fostering an innovative atmosphere necessitates attention to various aspects involved in the

genesis of innovative behavior, such as goal orientation, knowledge sharing, psychological empowerment, and environmental support, to bolster its influence (Le & Lei, 2019; Nardo et al., 2019; Pieterse et al., 2010; Runhaar et al., 2016). Examining the antecedent variables influencing innovative behavior, factors like cognitive styles, personality traits, organizational culture, and other antecedents have been found to impact individual innovative behaviors (Anderson et al., 2014; Bratianu et al., 2021; Mubarak et al., 2021). Currently, an increasing number of management researchers are focusing on external situational factors affecting individual innovative behaviors, emphasizing the significant role of the innovative atmosphere. Jönsson et al. (2021) consider the innovative atmosphere the most noteworthy factor in predicting individual innovative behaviors.

Furthermore, innovative self-efficacy positively influences individual innovative behavior and performance, effectively predicting innovation (Tierney & Farmer, 2004). Through a large-scale survey, Gu Yuandong and Peng Jisheng (2011) discovered that innovative self-efficacy not only directly impacts employee innovation behavior. Moreover, Harvey et al. (2019) and Zhou (2021) also found a significant favorable influence of the innovative atmosphere on innovative self-efficacy. Studies have further indicated that the innovative atmosphere affects employees' innovative behavior through innovative self-efficacy (Jankelová et al., 2021). However, the internal mechanism of innovative self-efficacy in the relationship between university students' perception of the innovative atmosphere and their innovative behavior remains unclear. Therefore, this study hypothesizes that the perceived innovative atmosphere among university students may enhance their innovative behavior by improving their innovative self-efficacy.

Presently, practical research on innovative behavior is primarily concentrated in the corporate sector, with few applications in the field of education (Bani-Melhem et al., 2018). Moreover, within the educational sector, research on innovative behavior primarily focuses on groups such as principals and teachers, with scant attention to the innovative behavior of university students (Sudibjo & Prameswari, 2021; Sun & Huang, 2019; Watted & Barak, 2020). Particularly scarce are studies on the factors influencing the innovative behavior of university students and the outcomes achieved through such behavior. Therefore, in summary, this study aims to investigate university students in Hebei Province, China, exploring the impact of perceived servant leadership on their innovative behavior and the mediating roles of the innovative atmosphere and innovative self-efficacy. The study anticipates enhancing understanding of the potential influencing mechanisms of this process and providing new directions for educators to improve university students' innovative behavior.

2. Research Hypothesis

Servant leadership positively influences the innovative atmosphere, stimulating individuals' interest and enthusiasm for innovation (Aboramadan, 2021). Aboramadan et al. (2021) have confirmed that servant leadership positively affects the innovative atmosphere, often focusing on individual development and support. Servant leadership nurtures followers' growth, encouraging them to become their best selves (Clarence et al., 2021; Lee et al., 2020). It encourages individuals to propose new ideas and engage in innovative activities, contributing to a positive atmosphere.

The innovative atmosphere cultivates innovative self-efficacy among university students, instilling belief in their capability to succeed in innovative activities (Luo et al., 2022). An organization's innovative atmosphere is crucial to members' innovative self-efficacy (Purnama et al., 2021). Specifically, organizations with a strong, innovative atmosphere usually have transparent management mechanisms and evaluation systems. Fair and just evaluations or rewards for innovative achievements stimulate members' innovative self-efficacy (Akbari et al., 2021). Teng et al. (2020) and Akbari et al. (2021) demonstrate the positive impact of an innovative atmosphere on innovative self-efficacy.

Javed et al. (2021) found that innovative self-efficacy positively predicts innovative behavior. Mittal and Dhar (2015) note that university students who have a strong sense of self and are willing to try new things harbor a strong sense of innovative self-efficacy, leading to outstanding innovative behavior. A survey of 546 secondary school teachers by Hsiao et al. (2011) found that innovative self-efficacy significantly influences innovative behavior. Nan (2018), studying university students, discovered that their innovative self-efficacy positively predicts their innovative behavior. If university students believe they can successfully engage in innovative activities, they are more likely to actively participate in innovative behavior, such as research projects and innovative attempts.

The research by Chong and Ma (2010) indicates that the innovative atmosphere significantly impacts innovative self-efficacy. Additionally, Choi (2004) found that innovative self-efficacy is an important mediating variable between an organization's innovative atmosphere and innovative behavior. Gonzalez-Gomez et al. (2022) also pointed out that a good innovative atmosphere enhances students' innovative self-efficacy, affecting their

learning observation skills and insights into professional development and thus increasing their performance in innovative behavior. Chang et al. (2012) found that the school’s innovative atmosphere can stimulate university students' self-efficacy and promote innovative behavior implementation. Based on social learning theory and self-determination theory, this study takes university students as the research subjects, considering servant leadership and innovative atmosphere as environmental factors and innovative self-efficacy as personal factors to explore the direct and indirect effects of environmental and personal factors on university students' innovative behavior. In summary, servant leadership may enhance the innovative atmosphere and innovative self-efficacy, and the innovative atmosphere may also enhance innovative self-efficacy, thereby improving university students' innovative behavior. Accordingly, this study proposes the following research hypotheses.

- H1: Perceived servant leadership among university students in Hebei Province significantly positively influences innovative behavior.
- H2: Perceived servant leadership among university students in Hebei Province significantly positively influences the innovative atmosphere.
- H3: Perceived servant leadership among university students in Hebei Province significantly positively influences innovative self-efficacy.
- H4: The innovative atmosphere among university students in Hebei Province significantly positively influences innovative self-efficacy.
- H5: The innovative atmosphere among university students in Hebei Province significantly positively influences innovative behavior.
- H6: Innovative self-efficacy among university students in Hebei Province significantly positively influences innovative behavior.
- H7: The innovative atmosphere has a mediating effect in the relationship between perceived servant leadership and innovative self-efficacy among university students in Hebei Province.
- H8: Innovative self-efficacy mediates the relationship between the innovative atmosphere and innovative behavior among university students in Hebei Province.
- H9: The innovative atmosphere and innovative self-efficacy have a chained mediating effect between perceived servant leadership and innovative behavior among university students in Hebei Province.

Accordingly, this study proposes a hypothetical model, as shown in Figure 1.

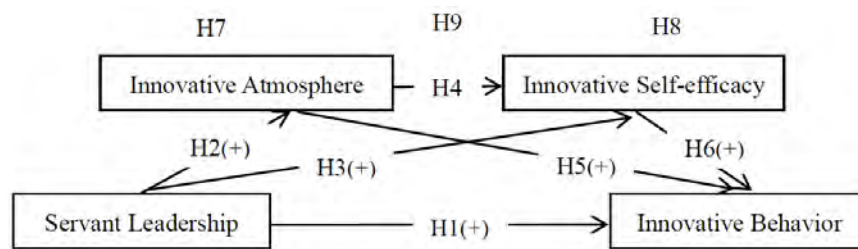


Figure 1. Hypothetical Model

3. Method

3.1 Participants and Procedure

This study conducted a questionnaire survey among students from four application-oriented undergraduate colleges in Hebei Province, China. These four institutions are situated in various regions across the province, further extrapolating the research findings. The study employed four scales comprising 46 items based on formal sampling criteria. Adhering to the principle of a maximum multiplier of ten, aiming to collect a minimum of 460 completed questionnaires (Ghiselli et al., 1981). To ensure an effective response rate, 550 questionnaires were distributed in total. Among these, 150 were allocated to School A, 150 to School B, 150 to School C, and 100 to School D. The study gathered 478 valid responses. Regarding gender distribution, there were 222 female participants, accounting for 46.4%, and 256 male participants, representing 53.6%. In terms of the academic year, there were 133 first-year students (27.8%), 110 second-year students (23%), 111 third-year students (23.2%), and 124 fourth-year students (25.9%).

3.2 Measures

3.2.1 Servant Leadership Scale

Sun and Wang (2009) revised the Servant Leadership Scale developed by Barbuto and Wheeler (2006). The revised questionnaire consists of 15 items across five dimensions: emotional healing, rational persuasion, altruistic orientation, wisdom enlightening, and societal responsibility, with each dimension having three items. This study supports the notion that servant leadership is a multidimensional concept with five factors rather than a unidimensional concept. The scale is selected for its good reliability and validity. An example item is, 'My teacher encourages me to be hopeful about my future development.' A 5-point Likert scale ranges from 1 (strongly disagree) to 5 (strongly agree).

3.2.2 Innovative Behavior Scale

The study adopted the Innovative Behavior Scale developed by Ng and Lucianetti (2016). This scale includes nine items across three dimensions: idea generation, dissemination, and implementation. The scale was chosen because it aligns with this study's definition of innovative behavior, which entails university students generating new ideas creatively based on learning and discovery, seeking support and recognition from teachers and peers, and applying them in practice (Çinar & Toker, 2019). An example item is, 'I look for new methods, skills, or tools through learning.' A 5-point Likert scale is used (1=strongly disagree, 5=strongly agree).

3.2.3 Innovative Atmosphere Scale

This study used the Innovative Atmosphere Scale developed by Kivimaki and Elovainio (1999). The scale comprises 14 items across four dimensions: shared vision, participation safety, task orientation, and innovation support. The scale demonstrates good reliability and validity in measuring the innovative atmosphere. This study supports its classification of innovative atmosphere into these four dimensions. An example item is, 'I believe classmates can share information during the learning process.' A 5-point Likert scale is used (1=strongly disagree, 5=strongly agree).

3.2.4 Innovative Self-Efficacy Scale

The Innovative Self-Efficacy Scale developed by Chen et al. (2001) was adopted for this study. This unidimensional scale includes eight items and is widely used in measuring the innovative atmosphere in organizations; known for its reliability. An example item is, 'I will be able to achieve most of the goals I have creatively set for myself.' A 5-point Likert scale is used (1=strongly disagree, 5=strongly agree).

3.3 Statistical Analysis Methods

The study employed SPSS 22.0 for correlation analysis and descriptive statistics. Finally, AMOS was used to build a structural equation model to verify the chained mediating effects, with Bootstrap applied for retesting the mediating effects.

4. Results

4.1 Reliability and Validity

The study analyzed the reliability of the four scales using Cronbach's Alpha values. Validity was assessed through standardized regression weight (SRW), average variance extracted (AVE), and composite reliability (CR), along with confirmatory factor analysis (CFA) to validate the model's fit with the actual data. The results are as follows.

For the Servant Leadership Scale, the overall Cronbach's Alpha was .975, with dimension-specific Alphas ranging from 0.874 to 0.896. The SRW coefficients of individual items ranged from 0.739 to 0.828; the CR values for each dimension ranged from 0.802 to 0.823, and the AVE values from 0.574 to 0.608. Model fit indices were RMR=0.034, CFI=0.977, GFI=0.957, NFI=0.955, TLI=0.970, IFI=0.977, PNFI=0.728.

For the Innovative Behavior Scale, the overall Cronbach's Alpha was 0.951, with dimension-specific Alphas ranging from 0.847 to 0.885. The SRW coefficients of individual items ranged from 0.752 to 0.818; the CR values for each dimension ranged from 0.820 to 0.836, and the AVE values from 0.603 to 0.630. Model fit indices were RMR=0.031, CFI=0.988, GFI=0.978, NFI=0.976, TLI=0.982, IFI=0.988, PNFI=0.651.

For the Innovative Atmosphere Scale, the overall Cronbach's Alpha was 0.970, with dimension-specific Alphas ranging from 0.858 to 0.903. The SRW coefficients of individual items ranged from 0.698 to 0.815; the CR values for each dimension ranged from 0.822 to 0.860, and the AVE values from 0.580 to 0.616. Model fit indices were RMR=0.040, CFI=0.989, GFI=0.968, NFI=0.969, TLI=0.986, IFI=0.989, PNFI=0.756.

For the Innovative Self-Efficacy Scale, the Cronbach's Alpha was 0.950. The SRW coefficients of individual

items ranged from 0.793 to 0.820; the CR value was 0.936, and the AVE was 0.648. Model fit indices were as follows: RMR=0.023, CFI=0.993, GFI=0.979, NFI=0.986, TLI=0.990, IFI=0.993, PNFI=0.704

4.2 Common Method Variance

The study used Harman’s single-factor test to assess common method bias. Factor analysis results showed a KMO value of 0.957 (>0.8), and Bartlett’s test of sphericity was significant ($p<0.001$). The unrotated factor analysis extracted ten factors with eigenvalues greater than 1, with the first factor explaining 38.922% (<50%) of the variance, indicating that there was no severe common method bias in the data (Podsakoff & Organ, 1986).

4.3 Descriptive Statistics and Correlations

Correlation analysis indicated that the innovative atmosphere was significantly positively correlated with innovative self-efficacy ($r=0.682, p<0.001$), innovative behavior ($r=0.652, p<0.001$), and servant leadership ($r=0.597, p<0.001$). Innovative self-efficacy was significantly positively correlated with innovative behavior ($r=0.710, p<0.001$) and servant leadership ($r=0.715, p<0.001$). Innovative behavior was significantly positively correlated with servant leadership ($r=0.696, p<0.001$).

Table 1. Descriptive Statistics and Correlation Analysis

| Variable | M | SD | Innovative Atmosphere | Innovative Self-Efficacy | Innovative Behavior | Servant Leadership |
|--------------------------|-------|-------|-----------------------|--------------------------|---------------------|--------------------|
| Innovative Atmosphere | 3.200 | 0.745 | 1 | | | |
| Innovative Self-Efficacy | 3.314 | 0.960 | 0.682*** | 1 | | |
| Innovative Behavior | 3.432 | 0.798 | 0.652*** | 0.710*** | 1 | |
| Servant Leadership | 3.490 | 0.743 | 0.597*** | 0.715*** | 0.696*** | 1 |

Note 1: *** $p<0.001$

4.4 Structural Equation Modeling

Taking into account the values of the following indicators, it can be concluded that the overall model fit is ideal and meets the requirements of the study

Table 2. Fit Indices for Confirmatory Factor Analysis

| Common Indicator | RMR | CFI | GFI | NFI | TLI | IFI |
|--------------------|--------|--------|--------|--------|--------|--------|
| Judgment Criterion | <0.050 | >0.900 | >0.900 | >0.900 | >0.900 | >0.900 |
| Values | 0.020 | 0.996 | 0.963 | 0.969 | 0.995 | 0.996 |

According to the results of the path analysis, servant leadership significantly and positively influences innovative behavior (standardized path coefficient=0.461, $p<0.001$), confirming Hypothesis 1: Servant leadership significantly and positively influences the innovative atmosphere (standardized path coefficient=0.706, $p<0.001$). Confirming Hypothesis 2: Servant leadership significantly and positively influences innovative self-efficacy (standardized path coefficient=0.520, $p<0.001$). Confirming Hypothesis 3: The innovative atmosphere significantly and positively influences innovative self-efficacy (standardized path coefficient=0.400, $p<0.001$). Confirming Hypothesis 4: The innovative atmosphere significantly and positively influences innovative behavior (standardized path coefficient=0.294, $p<0.001$). Confirming Hypothesis 5: innovative self-efficacy significantly and positively influences innovative behavior (standardized path coefficient=0.235, $p<0.010$), confirming Hypothesis 6.

Table 3. SEM Path Analysis Results

| Path | | B | S.E. | C.R. | p | β |
|--------------------------|-------------------------------|-------|-------|--------|-----------|---------|
| Innovative Behavior | <--- Servant Leadership | 0.479 | 0.080 | 5.970 | $p<0.001$ | 0.461 |
| Innovative Atmosphere | <--- Servant Leadership | 0.675 | 0.061 | 11.099 | $p<0.001$ | 0.706 |
| Innovative Self-Efficacy | <--- Servant Leadership | 0.692 | 0.079 | 8.726 | $p<0.001$ | 0.520 |
| Innovative Self-Efficacy | <--- Innovative Atmosphere | 0.556 | 0.080 | 6.980 | $p<0.001$ | 0.400 |
| Innovative Behavior | <--- Innovative Atmosphere | 0.319 | 0.074 | 4.322 | $p<0.001$ | 0.294 |
| Innovative Behavior | <--- Innovative Self-Efficacy | 0.183 | 0.061 | 3.002 | $p<0.010$ | 0.235 |

4.5 Bootstrap Test

Bootstrap sampling was used to test the mediating effects, with the number of samples set at 5000. The results showed that the mediating effect of servant leadership → innovative atmosphere → innovative behavior was significant ($\beta=0.207$, $p<0.001$ and the 95% confidence interval between 0.115-0.326 did not include 0). The mediating effect of servant leadership → innovative self-efficacy → innovative behavior was significant ($\beta=0.122$, $p<0.010$ and the 95% confidence interval between 0.031-0.275 did not include 0). The chained mediating effect of servant leadership → innovative atmosphere → innovative self-efficacy → innovative behavior was significant ($\beta=0.066$, $p<0.010$ and the 95% confidence interval between 0.015-0.149 did not include 0). Additionally, the model's direct effect was significant ($\beta=0.461$, $p<0.001$ and the 95% confidence interval between 0.246-0.667 did not include 0), and the total effect was significant ($\beta=0.857$, $p=0.001$ and the 95% confidence interval between 0.783-0.920 did not include 0), indicating that the mediation model is a partial mediation.

Table 4. Bootstrap Test Results for Mediation Effects

| Path | β | Lower | Upper | p |
|---|---------|-------|-------|-----------|
| Direct Effect | 0.461 | 0.246 | 0.667 | $p<0.001$ |
| Servant Leadership → Innovative Atmosphere → Innovative Behavior | 0.207 | 0.115 | 0.326 | $p<0.001$ |
| Servant Leadership → Innovative Self-Efficacy → Innovative Behavior | 0.122 | 0.031 | 0.275 | $p<0.010$ |
| Servant Leadership → Innovative Atmosphere → Innovative Self-Efficacy → Innovative Behavior | 0.066 | 0.015 | 0.149 | $p<0.010$ |
| Total Effect | 0.857 | 0.783 | 0.920 | $p<0.001$ |

5. Conclusion

The research results indicate that perceived servant leadership among university students in Hebei Province significantly and positively impacts innovative behavior. This finding is consistent with Bou Reslan et al. (2021) and Cengiz Ucar et al. (2021) studies. Servant leadership encourages individuals to think and challenge existing methods, thus stimulating innovative thinking. The study also found that perceived servant leadership among university students in Hebei Province significantly and positively affects the innovative atmosphere, aligning with the findings of Karatepe et al. (2020). When students perceive an emphasis on teamwork by leadership, they are more inclined to collaborate with colleagues and explore innovative ideas, creating a more innovative atmosphere.

Furthermore, perceived servant leadership significantly and positively impacts innovative self-efficacy among these students, corroborating the findings of Dayanti and Yulianti (2023), Zainal and Lata (2021), Iqbal et al. (2022), and Suhartanti and Prasetyanto (2022). Through positive emotional support and encouragement, servant leadership conveys to students that they are recognized, trusted, and capable of facing new challenges (Khan et al., 2022). The study also reveals that the innovative atmosphere significantly and positively influences innovative self-efficacy, aligning with Liu et al. (2021). An innovative atmosphere typically includes providing necessary resources, training, and support to help individuals implement innovative ideas, boosting students' confidence as they know they will receive support and assistance.

The research results align with Kim and Jang (2021) and Golmohammadi and Barghi Moghadam (2021), showing that the innovative atmosphere significantly and positively affects innovative behavior. An individual's innovative behavior is influenced by their perception and evaluation of their environment. Individuals tend to exhibit innovative behaviors when the environment offers sufficient support for innovation motivation, sources, and efforts (Hu, 2023). The study also confirms that innovative self-efficacy significantly and positively influences innovative behavior, which is consistent with Mittal and Dhar (2015) and Nan (2018). Innovative self-efficacy is associated with resilience (Khan et al., 2021). Individuals with higher innovative self-efficacy show greater psychological resilience, better withstand negative events, and can complete tasks creatively (Schunk & Pajares, 2002). Students with high innovative self-efficacy are more likely to persevere when encountering setbacks and difficulties and continue to pursue innovation.

The results demonstrate that the innovative atmosphere significantly mediates between perceived servant leadership and innovative self-efficacy among university students in Hebei Province. This may be because servant leadership often encourages individual participation in innovative activities and provides necessary support and resources. Furthermore, servant leadership encourages individuals to share innovative ideas, contributing to gradually forming an innovative atmosphere. This environment of encouragement and support helps students feel capable of participating in innovation, thereby enhancing their innovative self-efficacy.

The study also finds that innovative self-efficacy significantly mediates the relationship between the innovative atmosphere and innovative behavior, aligning with the findings of Gonzalez-Gomez et al. (2022) and Chang et al. (2012). An innovative atmosphere typically offers opportunities and resource support for engaging in innovative activities. When students perceive this atmosphere, they gain confidence in their innovative abilities because they are in an environment that encourages innovation, spurring them to engage in innovative behavior more actively.

The research reveals that the innovative atmosphere and innovative self-efficacy significantly mediate between perceived servant leadership and innovative behavior among university students in Hebei Province. Servant leadership encourages individual participation in innovation, providing necessary resources and training. This makes students feel noticed and trusted by their teachers, thus improving their innovative self-efficacy. Under the support and encouragement of perceived servant leadership, individuals develop an intrinsic motivation to engage in innovative activities (Bande et al., 2016). Servant leadership contributes to forming an innovative atmosphere, as other students are also inspired and actively participate in innovation (Yoshida et al., 2014). By participating in innovative activities within this atmosphere, students accumulate successful experiences sharing knowledge and experiences, enhancing their innovative self-efficacy (Liu et al., 2021). Increased innovative self-efficacy makes students more confident and motivated to implement innovative behavior (Nan, 2018). They are willing to try new ideas and methods, believing in their ability to succeed, further enhancing innovative behavior.

6. Practical Suggestions

6.1 Maintain the Universality and Balance of Servant Leadership

Promoting servant leadership in universities in Hebei Province is essential to ensure its universality and balance. Firstly, leadership training and education should emphasize every student's fair treatment. This requires regular training for university management to learn the latest leadership methods and strategies, ensuring their true implementation in student interactions. Secondly, universities should establish uniform standards and procedures to ensure that every student experiences the positive impact of servant leadership in both learning and living. For example, I would conduct regular student satisfaction surveys to gather feedback and then make improvements based on this feedback. Lastly, to maintain the consistency and stability of the leadership style, universities should conduct regular assessments and adjust based on feedback on leadership effectiveness. This may involve engaging third-party organizations to objectively assess the school's leadership style and strategies.

6.2 Value the Innovative Atmosphere and Meet Student Needs

Regarding the shared vision of the innovative atmosphere, universities should convey the importance of innovation and the school's vision for it at opening ceremonies, academic forums, or team activities. This vision should not only be at the school level but also encourage each college or major to set its innovative goals. Simultaneously, understand students' views and expectations on innovation through surveys or group discussions, ensuring the school's vision aligns with student expectations. Regarding participation safety in the innovative atmosphere, schools should create an open and inclusive environment, encouraging students to voice their ideas and opinions, even if they differ from mainstream views. For task orientation in an innovative atmosphere, schools should provide students with clear and specific innovation tasks, such as innovation projects, research papers, or technological challenges. These tasks should match the students' majors and interests to ensure they are motivated and interested in completing them. Additionally, provide resources and guidance, like books, research materials, and mentorship, to ensure smooth task completion. For innovation support in the innovative atmosphere, schools can establish an innovation support center or lab, offering various innovative tools, technologies, and resources, like 3D printers, programming software, design software, etc. Schools can also collaborate with businesses and research institutions to provide students with internships and practical opportunities, allowing them to apply and test their innovative ideas in real environments.

6.3 Enhance Innovative Self-Efficacy with Targeted Training

To cultivate and strengthen this confidence in students, universities should adopt the following targeted strategies and measures: First, organizing regular lectures and seminars, inviting experts, scholars, entrepreneurs, and practitioners who have achieved in the field of innovation. These events can provide students with knowledge and inspiration and enhance their self-efficacy. Seeing the success stories of others, especially those with similar genders and backgrounds, can strengthen students' confidence and determination. Second, regularly holding skill training and workshops, focusing on skills and knowledge in different innovation areas, such as programming, design thinking, project management, etc. These trainings can help students acquire basic skills necessary for innovation and enhance their self-efficacy. Third, establishing an innovation mentorship system assigning an

experienced mentor in the field of innovation to each student. Mentors can provide guidance, advice, and support to help students overcome obstacles in the innovation process and enhance their self-efficacy. Fourth, encouraging students to create or join innovation communities and networks, exchanging and collaborating with like-minded individuals. These communities can provide students with innovative resources and opportunities and enhance their sense of belonging and self-efficacy.

7. Limitation and Future Research

(1) Due to the convenience sampling method used for data collection and the sample size of only 478, there may be certain sampling errors, which could limit the study's results. This limitation is particularly relevant when considering different cultural backgrounds, organizational environments, and industry characteristics. To avoid sampling errors and ensure the generalizability of the research findings, future researchers should use a broader and more diverse sample, such as samples from multiple provinces or from middle and elementary schools. They should also explore how culture, organization, and industry influence the relationship between perceived servant leadership and innovative behavior.

(2) Although this study provides an in-depth exploration of the relationship between perceived servant leadership and innovative behavior, its cross-sectional nature makes it difficult to establish causality. Future researchers can use experimental designs or longitudinal study methods to confirm the causal relationship between perceived servant leadership and innovative behavior. This will help more accurately reveal the dynamic interaction and causal relationship.

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Competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Informed consent

Obtained.

Ethics approval

The Publication Ethics Committee of the Canadian Center of Science and Education.

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Data sharing statement

No additional data are available.

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