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Research Article

Charting Sustainable Paths: The Influence Of Sustainable Leadership And Green Innovation On Sustainable Performance In Higher Education Institutions

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ABSTRACT

This study aims to investigate the contribution of sustainable leadership and green innovation towards the enhancement of sustainability in Higher Education Institutions (HEIs) in Shaanxi, China, through the lens of the Resource-Based View (RBV) theory. The study employed a structural equation modelling (SEM) approach to examine the relationships among the variables simultaneously. Online questionnaires were collected from 505 faculty members across ten universities in Shaanxi, China. The SEM analysis revealed that sustainable leadership plays a significant role in boosting HEIs' sustainable performance, both directly and indirectly by fostering green innovation. The results also showed a synergistic effect of sustainable leadership and green innovation in promoting sustainability within HEIs. This study provides valuable theoretical contributions to the RBV theory and practical implications for HEI administrators and educators. The findings suggest that cultivating sustainable leadership skills and encouraging innovative green practices can lead to improved institutional sustainability outcomes.

Keywords: Sustainable leadership, green innovation, Resource-Based View, higher education institutions, sustainability

Abbreviations: SL: sustainable leadership, SP: sustainable performance, GI: green innovation, RBV: Resource-Based View, SEM: structural equation modelling.

Introduction

The global emphasis on sustainability, as highlighted by the United Nations' Agenda 2030, has pushed sustainable development to the forefront of international discussion. In particular, Sustainable Development Goal 4 of Quality Education plays a pivotal role in guiding global sustainable progress (Halisçelik & Soytas, 2019). The role of Higher Education Institutions (HEIs) in this context is increasingly acknowledged by researchers both in business and education fields. They are recognized not only for their potential in nurturing future leaders and integrating sustainable development principles, but also for their significant educational influence (Leal Filho, 2022; Nhamo & Mjimba, 2020). This Sustainable Development Goal 4 positions HEIs as one of the key contributors to the sustainability of education and the broader advancement towards sustainable society.

Within HEIs, sustainable leadership plays a crucial role not only in guiding educational strategies but also in embedding sustainable practices across all institutional activities (Gutiérrez-Mijares, Josa, Casanovas-Rubio, & Aguado, 2023). Sustainable leadership has emerged as a critical force driving the global agenda towards sustainable development objectives within HEIs (Leal Filho et al., 2020). Rooted in Hargreaves and Fink's

(2004) conceptualization, sustainable leadership is defined as a leadership approach that ensures the well-being of current generations without compromising the well-being of future generations. This definition has evolved by Avery and Bergsteiner (2011) that sustainable leadership emphasizes its long-term perspective and advocacy for systemic innovation. However, counter argument exists that Fleiszer et al. (2016) and Taylor (2010) had proposed some opposing ideas on the effectiveness of sustainable leadership on whether it can improve sustainable performance consistently.

The Resource-Based View (RBV) theory positions sustainable leadership as a unique resource that is instrumental in achieving sustainability goals when applied in educational contexts (Barney, 2001; Iqbal, Ahmad, & Halim, 2020; Pratolo, Utami, & Sofyani, 2022). This theory treats sustainable leadership and some other actions or management, such as green innovation, as intangible resources that can improve the overall performance in institutions.

Green innovation, which stems from the Schumpeterian Innovation Theory (Gürlek & Cemberci, 2020; Moreira, Klueter, & Tasselli, 2020), was recently categorized as two dimensions: green product innovation — targeting recyclability and eco-friendly materials — and green process innovation, aimed at reducing energy consumption and transforming waste into valuable resources (Khanra et al., 2022; Kivimaa & Kautto, 2010). This kind of innovation can be essential in fostering sustainable performance, and achieving the SDG4 (Triguero et al., 2013).

A noticeable knowledge gap exists in understanding the interplay between sustainable leadership and green innovation in driving sustainable performance, particularly within the context of HEIs. Prior studies have not comprehensively investigated this dynamic interaction nor have they fully utilized the RBV theory within educational context (Dangelico, Pujari, & Pontrandolfo, 2017; Solesvik, 2018). Filling this research gap is of great importance for gaining a more comprehensive understanding of sustainable development within the sphere of higher education.

This present study aims to address the research gap by applying the RBV theory to analyze the impact of sustainable leadership and green innovation and its potential mediation mechanism on sustainable performance in HEIs. The hypothesis is that these elements, seen as a unique combination of resources and capabilities from the lens of RBV, are crucial for enhancing sustainable performance in higher education. The RBV theory, which emphasizes strategic resource management for competitive advantage, provides a robust framework for examining how HEIs can utilize sustainable leadership and green innovation (Hart, 1995; Malik, Khan, & Mahmood, 2021). In addition, research by Singh et al. (2020) and Amores-Salvado et al. (2014) demostrarte the significant role of green human resource management and green transformational leadership in promoting green innovation and environmental performance, thereby performed a similar path from the RBV perspective. Furthermore, Mieg (2012) and Hart (1995) emphasize the importance of adopting a Resource-Based View for sustainability and innovation, particularly in urban development and organizational strategy contexts. This study aims to extend the RBV theory to the unique context of HEIs in Shaanxi Province, China, contributing to the broader discussion on sustainable development in higher education by exploring these relationships within a comprehensive sustainability framework. In doing so, it attempts to offer new insights into optimizing internal resources and capabilities for sustainable outcomes in diverse educational settings.

This study employs structural equation modelling (SEM) to analyze questionnaire data collected from 505 faculty and lecturers using convenience sampling across ten different universities and colleges in Shaanxi Province, China. SEM is an optimal choice due to its ability to examine complex relationships between observed and latent variables, enabling a nuanced analysis of the interplay between sustainable leadership, green innovation, and sustainable performance in HEIs (Kline, 2016). This method has been extensively validated in higher education research and is recognized for its robustness in handling complex data structures and its effectiveness in explanatory and predictive studies (Hitipeuw, Murwani, & Pali, 2023). The selection of Shaanxi Province in China for this study is based on its diverse mix of HEIs, significant student population, and unique regional setting, which includes proximity to the Qinling Mountains in China and a commitment to eco-friendly manufacturing practices (Dong et al., 2022; Shaanxi Provincial People's Government, 2020). The choice of SEM aligns with current trends in higher education research, where this method is increasingly employed for its capacity to rigorously test theoretical models and hypotheses (Becker, 2023; Ghasemy, Elwood, & Scott, 2023).

Literature Review and Hypotheses Development

Sustainable leadership and its impact on sustainable performance in HEIs

The landscape of HEIs has been deeply influenced by the concept of sustainable leadership, especially considering the key role these institutions played in guiding the global agenda towards sustainable development objectives (Piwowar-Sulej & Iqbal, 2023).

Sustainable leadership was originally conceived by Hargreaves and Fink (2004) as an approach that ensures the well-being of the current generation without risking the prospects of future generations. This definition has since been expanded by Avery and Bergsteiner (2011). They emphasized the part played by sustainable leadership for long-term perspective, advocacy for systemic innovation, and its function in fostering a culture that values sustainability. Within the area of HEIs, sustainable leadership not only provides direction for the

educational and administrative facets but also establishes an environment where sustainable principles are intricately interwoven into every aspect of educational practices (Gutiérrez-Mijares et al., 2023).

The role of leadership in driving sustainable performance has attracted considerable attention in the field of organizational studies. Previous researches transitioned from examining leadership's personal traits to their systemic influence. It shows a raising trend of complexity of achieving long-term organizational success. A significant study by Lynham (1998) introduces the 'Responsible Leadership for Performance' framework. This model integrates the leader's personal characteristics with a performance and systems approach, and stresses the vital role of engaged followership in leadership dynamics. Further exploring this domain, Wang et al. (2017) delineate various dimensions of ethical leadership, such as humane orientation and sustainability focus. These elements exhibit differential impacts of leader justice orientation on organizational outcomes. In traditional organizational contexts, Sapta et al. (2021) identifies a significant correlation between organizational culture, transformational leadership, and knowledge management towards sustainable performance.

However, there are some contrasting perspectives challenge these findings. Fleiszer et al. (2016) noted that in the absence of strategic coordination, sustainable leadership may not be adequate to achieve lasting improvements in nursing unit practices. Further challenging the generalizability of these findings, Taylor (2010) argues that while leadership development programs within the Australian water industry demonstrated positive results in fostering desired leadership behaviors, they do not ensure consistent sustainable performance. The effectiveness of these programs was largely dependent on customized interventions. This raises the doubt that generic sustainable leadership approaches may not yield similar effectiveness.

While the potential of sustainable leadership in influencing performance is evident, these diverse viewpoints highlight the need for a nuanced understanding and questions the universality of its effectiveness. This present exploration into the influence of leadership on sustainable performance thus attempts to uncover both its impact and the complexities that underlie its application in a different organizational context in HEIs in Shaanxi, China.

In analyzing the impact of sustainable leadership on sustainable performance, it's useful to invoke the Resource-Based View (RBV) theory (Tjahjadi et al., 2022). This theory posits that the competitive advantage of an organization is largely determined by how uniquely it manages its resources (Barney, 2001). In the context of HEIs, sustainable leadership can be viewed as a unique resource that shapes institutions' path towards achieving their sustainability goals (Pratolo et al., 2022). Iqbal et al. (2020) also supported this perspective by illustrating how sustainable leadership influences sustainable performance. Using structural equation modelling, they posited that such leadership promotes organizational learning and empowers employees psychologically, thus in turn enables them to skilfully navigate the multifaceted challenges of sustainable development.

Given the foundational and empirical insights into sustainable leadership and its influence, the following hypothesis is proposed:

H1: Sustainable Leadership positively influences Sustainable Performance in HEIs.

Green innovation and its relationship between sustainable leadership and sustainable performance in HEIs

Green innovation focuses on strategies that mitigate environmental impacts in management practices and also highlights the crucial role of sustainable leadership (Triguero, Moreno-Mondéjar, & Davia, 2013). The foundation of innovation in literature largely stems from the Schumpeterian Innovation Theory (Gürlek & Cemberci, 2020; Moreira et al., 2020). Schumpeter (1939) identified innovation as a key driver of economic growth, further defined in the context of green innovation as efforts minimizing environmental harm (Triguero et al., 2013). Green innovation encompasses green product innovation — targeting recyclability and eco-friendly materials — and green process innovation, aimed at reducing energy consumption and transforming waste into valuable resources (Khanra, Kaur, Joseph, Malik, & Dhir, 2022; Kivimaa & Kautto, 2010).

Leaders using transformational principles, encompassing sustainable leadership, can foster intellectual stimulation and innovative thinking, thereby nurturing a green innovation-friendly environment (Ferdig, 2007; Jones Christensen, Mackey, & Whetten, 2014; Zhang & Bartol, 2010). Incorporating green innovation in HEIs can transform institutional operations, research, and teaching methods, which shows sustainable leadership's effectiveness. Ramus and Steger's study (2000) illustrates that sustainable leaders catalyze innovative solutions through strong subordinate support.

The influence of sustainable leadership on green innovation are revealed by Mejia (2019) and Tuan (2020) and further corroborated by several studies. Iqbal and Piwowar-Sulej (2022) examine sustainable leadership's role in HEIs and identified social innovation as a key mediating mechanism for sustainable performance. Singh et al. (2020) explore the relationship between green transformational leadership, green innovation, and environmental performance. Their findings verifies that green human resource management mediates this relationship. Shahzad et al. (2020) highlight the significance of knowledge management in enhancing green innovation for corporate sustainability.

Despite current evidence on this influence, some counterpoints exist. For instance, Leal Filho et al.'s (2020) observed on the challenges in HEIs that there is a lack of interest from university administrations and among some academic community members, as well as a scarcity of expertise and resources. Also, Rodríguez-Abitia

et al. (2020) comments on the digital gap that challenges in integrating technology into the educational process, which can impede the effectiveness of sustainability education. Nevertheless, these challenges do not diminish the fundamental impact of sustainable leadership on green innovation.

Given the intricate relationship between sustainable leadership and green innovation in HEIs, the following hypothesis is posited:
H2: Sustainable Leadership positively influences Green Innovation in HEIs.

Green innovation encompasses various categories intrinsically linked to sustainable performance including environmental and social dimensions (Ramus, 2002). This perspective is supported by Asadi et al. (2020) in a business context where they developed a framework assessing the relationship between green innovation and sustainable performance.
Specific dimensions of sustainable performance have been individually investigated. Faucheux and Nicolaï (2011) describe green innovation as a novel solution to minimize environmental challenges while driving sustainability goals. Shahzad et al. (2020) stressed the significance of knowledge management in augmenting green innovation for corporate sustainability. Their research revealed that knowledge management processes foster green innovation, which in turn impacts corporate sustainable performance, including environmental, economic, and social dimensions. Burki et al. (2019) exemplified the correlation between top management's dedication to sustainability and the promotion of green managerial and process innovation and their impacts on sustainable performance in supply chains. In the hospitality sector, Gu (2022) demonstrates the significant positive impact of green innovation on economic performance. Moreever, Kemp and Pearson (2007), cited by Saunila et al. (2018), highlight green innovation's broader impact on effectively reduces environmental pollution and resource consumption. These literatures have been collectively advancing the sustainable development agenda.
Nevertheless, there exist dissenting perspectives regarding this influence. For instance, Li et al. (2017) discovered that corporate profitability exerts influence on green product innovation, yet it does not significantly impact green process innovation. This implies that the correlation between green innovation and sustainable performance may fluctuate based on the nature of the innovation and the financial standing of the corporation. Huong et al. (2021) proposed that the interplay between green innovation and firm performance is moderated by environmental management. This implies that in the absence of adept environmental management, the influence of green innovation on sustainable performance may not be as pronounced.
Despite various contrasting viewpoints, the influence of green innovation on the diverse dimensions of sustainable performance remains promising. These studies collectively substantiate the notion that green innovation is a pivotal factor in achieving sustainable performance across diverse dimensions.

Given the compelling evidence of the relationship between green innovation and sustainable performance, the subsequent hypothesis is proposed:
H3: Green Innovation positively influences Sustainable Performance in HEIs.

Mediating role of green innovation between sustainable leadership and sustainable performance
Sustainable leadership is characterized by an intrinsic environmental consciousness. This consciousness is coupled with a proactive stance that serves as a pivotal force to promote the adoption of green innovation practices within organizations. These practices are essential for achieving sustainability goals. Through this leadership approach, organizations can integrate environmental considerations into their core operations. Consequently, this integration facilitates a positive impact on ecological sustainability (Aftab, Abid, Sarwar, & Veneziani, 2022). Such leadership is characterized by a passionate commitment to ecological preservation and sustainable growth. It exerts significant influence over an organization's strategic direction and operational decisions (Su et al., 2020). These leaders are acting as crucial catalysts in nurturing a culture that actively integrates green methodologies with their dedication to environmental stewardship and expertise.
Delving deeper, Su et al. (2020) provided a comprehensive examination of green innovation, distinguishing between green process and product innovation. Their findings indicate that green innovation enhances resource efficiency and reduces environmental costs as well as offers a competitive edge to organizations concurrently. This advantage is amplified by the enhanced social credibility and legitimacy that green innovation grants upon organizations. Such legitimacy could attract governmental resources, guiding customer loyalty and purchase behavior, and fostering a heightened sense of job satisfaction among employees. The cumulative effect of these specific benefits directly leads to improved organizational performance (Aftab et al., 2022).
Aftab et al. (2022) dig deeper into this dynamic by framing the complex interplay between leadership, ethics, and innovation and their influence on environmental ethics, green innovation, and sustainable performance. Complementing this perspective, McCann and Sweet (2014) argue that the fusion of ethical and sustainable leadership practices lays the groundwork for organizational success. Given the great potential of this synergy, Burawat (2019) proposes the urgent need for academia and industry alike to delve deeper into the exploration of variables that might mediate the relationship between sustainable leadership and sustainable performance.

In resonance with the concepts presented by Kemp and Arundel (1998), green innovation emerges as a crucial component in the trajectory of sustainability. Their presentation focuses on key environmental strategies: reducing pollution, improving energy efficiency, and promoting recycling. These actions are crucial for sustainable development and tackling environmental issues. The role of green innovation as a vital mediator linking sustainable leadership and performance is bridging these concepts significantly and impactfully.

Incorporating the principles of the RBV into the framework of sustainable leadership and green innovation further enhances our comprehension of their interplay. RBV posits that internal resources, encompassing human, intellectual, and organizational capabilities as tangible and intangible, are pivotal for acquiring and sustaining competitive advantage. As delineated in recent research, these resources can serve as mediators in augmenting organizational performance. For instance, Patky and Pandey (2020) demonstrated that intellectual capital mediates the relationship between human resource practice flexibility and innovation performance. Additionally, Umrani et al. (2022) highlight the mediating role of absorptive capacity that can assimilate and apply new environmentally sustainable knowledge. This ability enables the effective use of sustainable leadership to enhance green innovation and performance. This aligns with Osobajo and Bjeirmi (2021) that value creation and improved performance serve as mediators linking tacit knowledge and competitive advantage within the RBV framework. This connection underscores the importance of internal resources and capabilities in achieving a competitive edge. Thus, integrating RBV into the analysis of sustainable leadership and green innovation underscores the critical role of internal resources and capabilities in propelling sustainable performance in organizations.

In light of these revelations, the following hypothesis is proposed:

H4: Green Innovation mediates the relationship between Sustainable Leadership and Sustainable Performance in HEIs.

While substantial research highlights the effect of sustainable leadership on sustainable performance in HEIs, the underlining mechanisms through which this influence operates remain opaque. Drawing from Resource-Based View theory, the current study incorporates green innovation as a mediator to elucidate the mechanism underlying the impact of sustainable leadership on sustainable performance in HEIs (as shown in Figure 1).

Research Methodology

Participants and data collection

Creswell et al. (2003) posits that a quantitative research approach is ideally suited for determining the influential relationships among variables, when the primary goal of the research is to illuminate such connections. This research employed Structural Equation Modelling (SEM) as its methodology. SEM is recognized for its ability to simultaneously evaluate complex interrelationships among variables (Hair Jr et al., 2021).

This study employs a convenience sampling method to survey faculty members and lecturers across ten different universities located in Shaanxi Province, China. After the selection of the target institutions, collaboration was sought from university administrators to facilitate the recruitment of faculty members. The data is collected through an online questionnaire platform, which respondents can participate using either computers or mobile devices. Participation in this study is entirely voluntary, with all participants duly informed of their right to withdraw at any time during this study. Informed consent is obtained from every participate, and the researcher of this study has received certificate from the Institutional Research Ethics Committee. The online survey successfully collected 580 valid responses with 505 usable questionnaires, showing a response rate of 87.7%. The demographic profile of the participants included 243 male and 262 female teachers and staff.

Data analysis was performed with two software tools: "SPSS" for descriptive statistics and "Mplus" for inferential statistics. Before analyzing the data, preparation tasks such as data entry, coding, and cleansing were carried out following the data collection phase.

Measurement for sustainable leadership

This study utilized the Sustainable Leadership (SL) scale, originally developed by McCann and Sweet (2014) and subsequently adapted by Al-Zawahreh et al. (2019) for broader applications. The scale's comprehensive scope and established validity render it particularly suitable for this research. It comprises 15 items, distributed across three critical dimensions: sustainable management, sustainable initiatives, and sustainable actions. To enhance relevance for participants, this study made minor adjustments to specific items based on expert suggestions. Examples of these items include: "My leader acts in a sustainable socially responsible manner" (sustainable management), "My leader puts goals before profits" (sustainable initiatives), and "My leader demonstrates sustainability in the recruitment, promotion, and replacement of employees and leaders in a planned manner" (sustainable actions).

Participants responded on a 5-point Likert scale, where 1 denotes "strongly disagree" and 5 represents "strongly agree." A higher score indicates a stronger perception of sustainable leadership practices within the organization. In this study, the Cronbach's α values for the three sub-dimensions were .924 for sustainable management, .875 for sustainable initiatives, and .897 for sustainable actions. The overall scale reflected a

Cronbach's α value of .932, with all these values surpassing the accepted threshold of 0.7, indicative of the scale's commendable reliability (Nunnally, 1978).
To reinforce the scale's construct validity, we conducted a Confirmatory Factor Analysis (CFA). The subsequent model fit indices were quite revealing: $\chi^2/df = 4.039$, SRMR = 0.019, RMSEA = 0.014, CFI = 0.998, NFI = 0.998, GFI = 0.998, and TLI = 0.998. These values collectively demonstrate an excellent fit between the proposed model and the observed data, resonating with standards for good model fit (McDonald & Ho, 2002).

Measurement for sustainable performance

For the assessment of Sustainable Performance (SP), this study utilized an extensive 15-item scale adapted from Khan and Quaddus (2015). The scale meticulously dissects the complex aspects of sustainable performance into three critical dimensions: economic, social, and environmental performance. Illustrative items from the scale, offering deeper insight, encompass: 'Our university performs well in acquiring the funds and other resources needed for sustainable development.' (economic performance), 'Our university enhances our social recognition, earning acknowledgment from the public and peers' (social performance), and 'Our university effectively implements waste, garbage sorting, and recycling' (environmental performance). Participants were prompted to respond via a 6-point Likert scale, ranging from 1, signifying 'strongly disagree,' to 6, representing 'strongly agree.'
In this study's framework, the reliability analysis revealed Cronbach's α values of .934, .912, and .929 for the economic, social, and environmental performance dimensions, respectively. The aggregate scale demonstrated a robust Cronbach's α value of .942, significantly exceeding the conventional threshold of 0.7, thus endorsing its high reliability (Nunnally, 1978).
Following this, a CFA was executed to validate the SP scale's construct. The resulting fit indices were revealing, with $\chi^2/df = 3.724$, SRMR = 0.017, RMSEA = 0.010, CFI = 0.999, NFI = 0.999, GFI = 0.999, and TLI = 0.999. Collectively, these indices indicate an exceptional alignment between the hypothesized model and the empirical data, resonating with standards for excellent model fit (McDonald & Ho, 2002).

Measurement for green innovation

The assessment of the Green Innovation construct utilized an 8-item scale, originally developed by Chen et al. (2006). This scale can be divided into two distinct dimensions: green product innovation and green process innovation. For a more detailed understanding, exemplary items from the scale include: 'My university uses materials that minimize pollution' (green product innovation) and 'My university prioritizes the procurement and utilization of non-toxic, eco-friendly products' (green process innovation). Participants expressed their perspectives via a seven-point Likert scale, ranging from 1, denoting 'strongly disagree,' to 7, representing 'strongly agree.'
Regarding reliability, the Cronbach's α value for the green process innovation dimension was .932, and for the green product innovation dimension, it was a robust .892. The comprehensive scale, encompassing both dimensions, displayed a Cronbach's α of .917, comfortably surpassing the generally accepted benchmark of 0.7, thus affirming its reliability (Nunnally, 1978).
Subsequently, a CFA was conducted to authenticate the Green Innovation scale's construct. The fit indices obtained from this analysis were noteworthy: $\chi^2/df = 2.670$, CFI = .986, TLI = .978, SRMR = .023, and RMSEA = .071. These indices collectively indicate a satisfactory correlation between the hypothesized model and the observed data, aligning with the established criteria for good model fit (McDonald & Ho, 2002).

Expert validity

Establishing the reliability of the research scales was crucial in this study. For this purpose, a comprehensive expert validity assessment was conducted, incorporating both quantitative and qualitative evaluations. In the quantitative analysis, the study utilized the Content Validity Index (CVI) and the Content Validity Ratio (CVR) (Rodrigues, Adachi, Beattie, & MacDermid, 2017). The CVI, particularly renowned for evaluating content validity, includes the Item-CVI (I-CVI) and the Scale-level-CVI (S-CVI). Items with an I-CVI value exceeding .790 are consistently considered relevant (Zamanzadeh et al., 2015). Meanwhile, the CVR, key in determining item essentiality, acts as a measure of expert consensus, with higher values indicating greater agreement (Zamanzadeh et al., 2015).
Following this rigorous evaluation, numerous revisions were made based on insightful feedback. A panel of six distinguished scholars from the fields of social and environmental sciences with at least ten years of experience provided both qualitative feedback and content validity ratings. Their valuable insights were crucial in driving strategic modifications to the questionnaires.
For example, within the Sustainable Leadership dimension, the item 'My leader's management officially recognizes when a mistake is made that affects sustainability' was refined to 'When my leader makes a mistake that affects sustainable development, he/she will admit the mistake,' adding more specificity (Al-Zawahreh et al., 2019). In the Green Process Innovation domain, the statement 'My school's production process reduces hazardous substances or waste' was altered to 'My university procures and uses non-toxic and environmentally friendly products,' shifting the focus towards the use of environmentally benign products (Chen et al., 2006). Regarding the Sustainable Performance aspect, the item 'We see our university is providing employment to us and others' was adeptly revised to 'Our university provides ample employment opportunities and career

development support for students and the community,' thus emphasizing the importance of broad opportunities and community engagement within the academic environment (Khan & Quaddus, 2015).

Common method bias

The use of self-reported questionnaires in this study raises the possibility of common method bias, a potential distortion in self-reported data. To mitigate this risk, Harman's single-factor test, as recommended by Podsakoff et al. (2003), was employed. This analytical technique revealed eight distinct factors with eigenvalues exceeding one. Notably, the predominant factor accounted for only 36.947% of the total variance, substantially below the often-cited 50% threshold (Podsakoff & Organ, 1986). These findings strongly indicate that common method bias does not significantly affect the integrity of this study's results, thereby enhancing the reliability of our conclusions.

Results

Reliability and validity analysis

The scales' reliability was confirmed through Cronbach's α evaluations, demonstrating robust internal consistency for sustainable leadership (.959), sustainable performance (.962), and green innovation (.900). Discriminant validity was established by comparing the square roots of the average variance extracted (AVE) for each sub-dimension against their respective inter-correlation coefficients. The results showed that the AVE square roots exceeded corresponding inter-correlations, satisfying Fornell and Larcker's (1981) criteria. This underlines the distinctiveness of each sub-dimension within our study as detailed in Table 1.

Table 1: Descriptive Statistics and Correlation Matrix

Dimensions	SL_M	SL_I	SL_A	SP_E	SP_S	SP_V	GI_S	GI_P
SL_Management	**0.738**							
SL_Initiatives	0.565**	**0.783**						
SL_Actions	0.547**	0.594**	**0.743**					
SP_Economic	0.328**	0.286**	0.266**	**0.740**				
SP_Social	0.389**	0.409**	0.359**	0.569**	**0.809**			
SP_V_environmental	0.335**	0.308**	0.242**	0.603**	0.677**	**0.814**		
GI_S_Process	0.197**	0.229**	0.163**	0.487**	0.432**	0.495**	**0.758**	
GI_P_Product	0.210**	0.238**	0.212**	0.520**	0.498**	0.497**	0.616**	**0.812**
Mean	3.422	3.337	3.408	3.760	3.679	3.709	4.280	4.359
SD	0.810	0.849	0.964	1.456	1.292	1.332	1.705	1.575

Note: SL_M is short for sustainable management, SL_I for sustainable initiative, SL_A for sustainable action, SP_E for economic performance, SP_S for social performance, SP_V for environmental performance, GI_S for green process innovation, GI_P for green product innovation. The data source is compiled by this research.

Correlation analysis

In this study, dimensions such as sustainable management (SL_M), sustainable initiatives (SL_I), and others demonstrated mean values ranging from 3.337 to 4.359, with standard deviations between 0.810 and 1.705 (Table 1). Notably, each dimension exhibited a positive and significant correlation at the $p < .001$ level, indicating a consistent positive interrelation. For instance, SL_M and economic performance (SP_E) showed a moderate correlation coefficient of 0.328, whereas SL_M and green process innovation (GI_S) presented a relatively weaker correlation of 0.197. Furthermore, the discriminant validity was affirmed as the square roots of the AVE for each dimension exceeded the off-diagonal correlations in their respective rows and columns. This finding meets Hair et al. (1998)'s criterion, confirming the distinctiveness of each construct. These preliminary analyses provide substantial credibility to the study, providing a solid foundation for subsequent model validation.

Model fit

The analysis using an SEM approach indicated a satisfactory fit for the model, as evidenced by the fit indices: RMSEA = 0.055 (90% CI: 0.035 to 0.076), CFI = 0.984, TLI = 0.974, and SRMR = 0.027. These metrics fall within the acceptable ranges suggested by Hu and Bentler (1999) and McDonald and Ho (2002) to show a good representation of the data.

Key findings from SEM reveal significant relationships among all variables in this study (Figure 2). Sustainable leadership (SL) was found to positively predict sustainable performance (SP) ($\beta = 0.310$, $p < .001$), and green innovation (GI) was also seen to significantly enhance SP ($\beta = 0.671$, $p < .001$). Additionally, SL positively influences GI ($\beta = 0.354$, $p < .001$). These findings validate Hypothesis 1, 2 and 3.

The study further explored the mediation effect of GI connecting SL and SP, using the bias-corrected percentile Bootstrap method. The results demonstrated partial mediation: the indirect effect of SL on SP via GI was significant with the Confidence Interval (CI) does not include zero (0.238, 95% CI [0.173, 0.310]), as was the direct effect of SL on SP (0.310, 95% CI [0.220, 0.414]). The total effect of SL on SP was 0.548, with a 95% CI

of [0.460, 0.643], confirming that GI plays a partial mediating role in the SL-SP relationship. Thus Hypothesis 4 is confirmed.

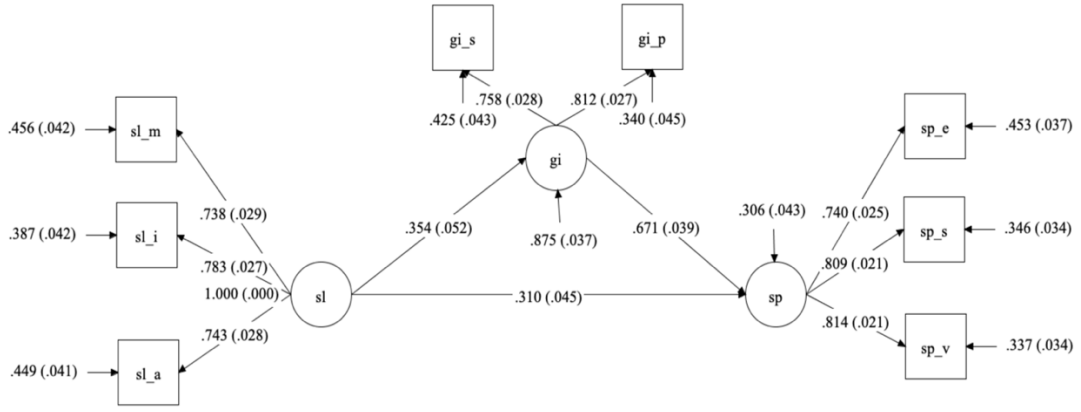

Figure 1: Structural Model Output

Discussion

The present research confirms that sustainable leadership positively influences sustainable performance in HEIs, thereby supporting Hypothesis 1. The findings reveal that sustainable leadership positively influences sustainable performance in the higher education context, which not only corroborates previous studies (Iqbal et al., 2020; Pratolo et al., 2022) but also expands its application to HEIs. There are two primary reasons for this phenomenon. Firstly, leaders with sustainable initiatives can encourage staff and lecturers in HEIs to promote sustainable performance, including environmental and economic aspects. The sustainable actions and management from the leaders in HEIs can directly impact the overall sustainable performance within these institutions. Furthermore, the perception of sustainable leadership as a valuable resource can optimize and contribute to the sustainable performance in HEIs.

This implies that the multifaceted concept of sustainable leadership, which encompasses sustainable management, initiatives, and actions, plays a pivotal role in advancing sustainable performance in universities and colleges. This leadership style contributes to various dimensions of sustainable performance. In other words, when leaders at every echelon within a university engage more actively in sustainability-focused management, actions, and initiatives, the institution's overall sustainable performance is directly and positively influenced.

Moreover, the findings also reveal a positive influence of sustainable leadership on green innovation, which corresponds with previous literature (Iqbal & Piwowar-Sulej, 2022; Singh et al., 2020) and thus supports the Hypothesis 2. It is less common to evaluate green innovation, including green process and product innovation, in the context of HEIs. So, this research employs expert validity check on CVI and CVR (Rodrigues et al., 2017) to test its feasibility of transferring these concepts from business management context to educational environment. The panel of six experts validated the scales to use in educational field. That is to say, sustainable leadership is a positive influencer of green innovation in HEIs. It can promote both the green process during daily management and academic activities in HEIs, but also efficiently manage product and promote green product innovation in universities and colleges.

Further, the research findings show that green innovation has a positive influence on sustainable performance in HEIs, which supports the Hypothesis 3. This coincides with the results of previous studies (Burki et al., 2019; Huong et al., 2021). The three-bottom line of sustainable performance have been influenced by green innovation. This shows that in an educational context, both the green process and product innovation behaviors and management by both lecturers and staff can promote the sustainable performance positively.

From the theoretical lens of RBV, both sustainable leadership and green innovation can be regarded as valuables resources as tangible or intangible resources (Barney, 2001; Pratolo et al., 2022; Iqbal et al., 2020). These resources further add the competitive advantage to improve its overall performance in a firm, or in this case a university. In present research, sustainable management, initiatives, and actions as well as green process and product innovation can be regarded as intangible resources in promoting sustainable performance. This combines the two variables together in a framework to analyze the mechanism of how different kinds of resources promote sustainable performance.

More than two direct paths, this research also validated the mediation mechanism of green innovation between sustainable leadership and sustainable performance, thus Hypothesis 4 is supported. Among the three paths, SL to SP ($\beta = 0.310$, $p < .001$), GI to SP ($\beta = 0.671$, $p < .001$) and the GI mediates SL-SP ($\beta = 0.238$, 95% CI [0.173, 0.310]). It can be inferred that green innovation has the largest influence over SP at $\beta = 0.671$. Also, when GI plays as a mediator, it also contributes to SP moderately. In general, this model with mediation effect shows the significance of green innovation. It unveils the intricate manner in which sustainable leadership,

through its wide-reaching and transformative effects, and green innovation, with its emphasis on eco-friendly practices, stand as central pillars for sustainability in the educational sector.

Conclusion

The collective evidence from numerous studies emphasizes the significant role of sustainable leadership in enhancing the sustainable performance in conjunction with green innovation of HEIs. Anchored in the RBV framework, our analysis highlights the crucial importance of intangible resources, notably sustainable leadership and green innovation, in establishing a competitive and sustainable position in the education sector. Our research, supported by the works of scholars such as Burawat (2019) and Iqbal & Piwowar-Sulej (2022), identifies sustainable leadership as green innovation as pivotal elements in achieving sustainable outcomes, its effectiveness significantly increased in settings that promote sustainable performance. This interplay illustrates the multifaceted role of leadership in not only achieving immediate sustainability goals but also in cultivating an innovative ethos critical for the long-term sustainability of institutions and the environment.
This investigation extends the discourse around the RBV theory, illustrating its utility in dissecting the dynamics of sustainable performance in HEIs. This theoretical exploration advances the broader sustainability dialogue, highlighting the indispensable roles of leadership and innovation in driving educational sustainability achievements. The application of SEM method in our study offers compelling evidence of this interrelation, underscoring the necessity for HEIs, especially in locales such as Shaanxi, China, to integrate sustainable leadership and green innovation into their strategic agendas.

Limitations

There are certain limitations of this research. Firstly, since the participants in this study came from ten universities in Shaanxi, China, the geographical distribution of the sample is limited compared to China's geographical space. Secondly, this is a cross-sectional study. Although it has been widely employed in previous research in the educational field, longitudinal research is more suitable for testing the causal relationship between variables, which may be conducive to revealing some novel findings. Thirdly, research data were obtained from a single source using the self-report format using convenience sampling, which may lead a common method bias. However, the CFA was achieved to determine any possible common method bias questions, and the results showed that there were none. Nevertheless, the CFA cannot eliminate common method variance in nature.

Future Directions

In response to these insights, we suggest practical strategies for embedding sustainable leadership and enhancing green innovation in HEIs. Proposed measures include proposing sustainable initiatives, encouraging sustainable management practices and actions. There measures include organizing sustainability-centric workshops, establishing dedicated sustainability units, and fostering interdisciplinary collaboration, as recommended by Singer-Brodowski (2017), Gaard et al. (2017), and Anderson et al. (2021). Additionally, engaging in external partnerships with local businesses and governmental entities, and incorporating external expertise through guest lectures, are vital for linking academic research with practical implementations and fostering innovative solutions to sustainability challenges.
Recognizing the limitations of this study in terms of methodology and theoretical scope, we encourage subsequent research to employ broader and more nuanced methodological approaches such as qualitative methods, delve deeper into the RBV theory, and investigate the sustainability practices across a wider range of HEIs in diverse regions. Future studies should strive to corroborate and expand upon our findings, so as to enrich the understanding of the complex interactions between leadership, innovation, and sustainable performance in the context of higher education.

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