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Green Intellectual Capital Driving Environmental Performance: The Mediating Role of Green Ambidexterity and Moderating Influence of Environmental Ethics

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Abstract

This empirical investigation explores the relationship between Green Intellectual Capital (GIC) and Environmental Performance (EP) within Pakistan's pharmaceutical industry. Employing quantitative methods and data form 286 respondents, findings reveal a positive correlation between GIC and EP. The significant and positive association between GIC and Green Ambidextrous Innovation (GAI) unveils a novel pathway for leveraging intellectual capital to foster innovation in environmentally sustainable practices within organizations. Moreover, the study underscores the pivotal role of GAI in enhancing EP, emphasizing its potential as a catalyst for environmental performance improvement. The observed moderating effect of GAI on the relationship between GIC and EP highlights the importance of cultivating ambidextrous capabilities to fully harness the benefits of intellectual capital for environmental sustainability. Additionally, the interaction between Environmental Ethics (EE) and GAI reveals s strong effect, underscoring the significance of ethical considerations in shaping organizational responses to environmental challenges. These findings offer valuable insights for scholars and industry practitioners, informing strategies for enhancing environmental performance and competitive advantage in the pharmaceutical sector, while contributing to the academic discourse on green innovation and corporate sustainability.

Keywords: Green Intellectual Capital, Green Ambidextrous Innovation, Environmental Ethics and Performance.

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1 INTRODUCTION

Environmental degradation is detrimental to the fitness and well-being of all living beings (Belaïd & Zrelli, 2019; Chen et al., 2021). Environmental preservation is a moral obligation of humans to mitigate the negative impacts of pollution and human activities on their surroundings. Recently, states, organizations, specialists, and businesses have shown interest in implementing plans and procedures for environmental security to mitigate the harmful activities stemming from human and industrial sectors alike (Aini, 2021; Borsatto & Bazani, 2021). Takalo and Tooranloo (2021) argued that firms can gain a competitive edge, achieve energy savings, reduce pollutants, enhance their ecological image, and improve environmental performance through compliance with green practices in their production processes. The importance of firms' environmental performance contributes to their corporate image and value, drawing the attention of policymakers and the public to environmental concerns (Wu et al., 2022).

IQVIA estimated that Pakistan's pharmaceutical industry is experiencing a 5-year compound annual growth rate (CAGR) of 15.3%, with a total worth of Rs. 748 billion. Local businesses dominate the industry and hold more than two-thirds of the local market share (Saad Usman 2024). Despite their crucial role in maintaining health, they have adverse effects on the environment (Klatte et al., 2017). The pharmaceutical manufacturing process contributes to water pollution because of the high usage of solvents, energy, and raw materials (Kumar et al., 2010). Consequently, pharmaceutical companies are increasingly adopting sustainable practices to provide greater care for the environment (Chaturvedi et al., 2017).

In the contemporary landscape where environmental sustainability takes precedence, there's a growing spotlight on the notion of 'Green Intellectual Capital' (GIC) and its implications (Wang & Juo, 2021; Yong et al., 2019). Yusliza et al. (2020) argue that GIC amplifies economic, social, and environmental performance, especially within the Malaysian context. Moreover, 'Ambidextrous Green Innovation' (AGI) emerges as a proposed intermediary mechanism bolstering environmental performance (Peters & Buijs, 2022; Úbeda-García et al., 2022; Wang et al., 2020b). Companies are seen embracing two ambidextrous strategies: exploitative green innovation, which leverages existing knowledge, processes, and competencies to advance green practices and products. (Chen et al., 2014); and exploratory green innovation, which focuses on seeking new skills and knowledge to address environmental issues efficiently (Wang et al., 2020b). Furthermore, Asiaei et al. (2022b) developed the 'natural resource orchestration' approach, which involves integrating GIC within a firm's operations. This synergistic approach enables knowledge sharing, resource transformation, and synchronization, thereby boosting innovation and exploring novel prospects (Asiaei et al., 2020).

As ecological concerns continue to escalate, novel approaches are being adopted to address them, including the implementation of preventive measures and utilization of effective remedies to rectify ecological imbalances (Xu et al., 2018). Corporate environmental ethics encompasses ethical principles, morals, and beliefs that guide firms in managing their environmental impacts (Palmer et al., 2014). Firms are expected to go beyond merely promoting environmental principles to achieve long-term economic success (Tate & Bals, 2018). This necessitates organizational executives to adhere to environmental ethics by designing and implementing policies in their day-to-day operations to reduce a firm's environmental footprint (El-Kassar & Singh, 2019). According to Wang and Xu (2019), corporate environmental ethics is regarded as a distinct corporate norm that contributes to resolving environmental issues and achieving sustainable objectives. The current study had the following objectives:

I. To assess the impact of green intellectual capital in enhancing environmental performance.

II. To assess the impact of green intellectual capital in enhancing ambidextrous green innovation.

III. To investigate the impact of ambidextrous green innovation on environmental performance.

IV. To analyze the mediating role of ambidextrous green innovation in the relationship between green intellectual capital and enhancing environmental performance.

V. To investigate the moderating impact of environmental ethics on ambidextrous green innovation and environmental performance.

Environmental performance advocates for a more sustainable and ecologically responsible approach, ensuring that businesses minimize their negative impacts on the environment while simultaneously making positive contributions to environmental well-being. An examination of the literature reveals that Green Intellectual Capital (Akhtar et al., 2024; Martínez-Falcó et al., 2024; Rehman et al., 2021), Ambidextrous Green Innovation (Asiaei et al., 2023; Shehzad et al., 2023; Úbeda-García et al., 2022), and Environmental Ethics (Aftab et al., 2022; Singh et al., 2019; Xie et al., 2024) are crucial drivers of environmental performance.

The remainder of this paper is organized as follows: Section 2 contains a theoretical and empirical review that serves as the foundation for hypothesis building; Section 3 describes the approach, which includes the statistical tools used for data analysis; Section 4 describes how the study results were interpreted; and Section 5 contains the conclusion, study implications, and limitations.

2 LITERATURE REVIEW AND THEORETICAL FARMWORK

The Intellectual Capital view (ICV) is not entirely a novel concept that is completely unrelated to the resource-based or knowledge-based view; rather, it is a specialization of RBV (Martín-de-Castro et al., 2011; Reed et al., 2006) and supplementary to KBV (Reed et al., 2006), highlighting intellectual capital as a key source beneficial for improved returns. Reed et al. (2006) assert that ICV is referred to as a mid-range view that narrows down the broader horizon of RBV into three unique assets–relational, human, and social capital–to earn a sustainable competitive edge. According to some practitioners, knowledge generation and storage can be directly associated with ICV, which considers three elements: employees, relationships, and data innovation structures and regulations (Edvinsson & Malone, 1997; Wright et al., 2001).

The strategic management concept of intangible assets influencing the productivity of firms and industries is reflected in the Intellectual Capital View (ICV). The author assimilated ICV into the study on the following grounds: First, the complex framework of GIC is especially well suited to the ICV method of classifying knowledge assets and how they influence environmental performance (Munawar et al., 2022). Second, the ICV provides guidelines for firms to adapt to the evolving nature of GIC according to varying environmental situations to gain a competitive edge, particularly for firms that focus on sustainability issues (Sheikh, 2022). Third, ICV helps fill the gap between the theoretical and practical implications of GIC by offering an organized method for examining the management and employment of knowledge resources for environmental sustainability, providing potential information to both organizations and practitioners (Sahoo et al., 2023).

2.1 GIC and EP

Environmental management practices and external information channels have recently come under business consideration (Martin-de Castro et al., 2023). Liu (2010) asserted that green intellectual capital (GIC) comprises a firm's intrinsic information and capacities to improve its competitive edge. GIC is directly related to a firm's success in the social, economic, and environmental domains (Yusliza et al., 2020). The varying expectations of stakeholders such as investors, policymakers, and clients highlight the significant role of GIC in examining a firm's attitude towards environmental management. The evolution of business operations impelled by GIC marks the transformation of conventional functioning methods into sustainable approaches, linking business goals with environmental protection initiatives (Munawar et al., 2022).

Literature on the execution and extent of environmental performance (Phan et al., 2018). Some studies present a limited perspective on environmental performance that focuses on environmental influences, such as water waste and carbon emissions (Mungai et al., 2020). On the other hand, some studies express a broader perspective based on firms' rankings regarding the environmental dimension and multidimensional assessments, including firms' subjective assessments performed by external organizations (Henri & Journeault, 2010; Lisi, 2015).

As stakeholders prioritize environmental sustainability, businesses with stronger green intellectual capital (GIC) are more focused on earning competitive advantage and building stakeholders' trust (Ullah et al., 2022). GIC enables firms to achieve their goals and strategic plans by aligning them with environmentally conscious stakeholders (Benevene et al., 2021). A firm's environmental performance improves because of greater investment in green intellectual capital (Mansoor et al., 2021; Shah et al., 2021). The literature supports the argument that GIC favorably enhance firms' environmental performance (Asiaei et al., 2022a; Rustiarini et al., 2023; Yusliza et al., 2020). Hence, this study hypothesizes that:

H1: Green Intellectual Capital has a positive relationship with Environmental Performance.

2.2 GIC and AGI

Li et al. (2018) defined green innovation as the development of novel goods, policies, services, technology, and management approaches that contribute to sustainable goals. In today’s sustainable era, where environmental concerns are of utmost importance, firms need to continuously create and follow green innovation tactics to preserve energy, reduce pollution, and enhance environmental quality in today’s sustainable era, where environmental concerns hold the utmost importance (Wang et al., 2021). To address environmental concerns, firms should simultaneously engage in exploratory and exploitative green innovation simultaneously (Cao et al., 2021). Successful businesses simultaneously consider exploratory and exploitative green innovation to attain ambidextrous innovation. Ambidextrous innovation arms firms to strive for their prospects while utilizing their old capabilities, which can assist them in achieving a competitive edge over rival firms (Asiaei et al., 2023).

Intellectual capital enables ambidextrous innovation to enhance a firm's capacity to explore novel knowledge and skills that go beyond its current capacities and knowledge (Cabrilo & Dahms, 2020). Previous studies have evidenced the importance of intellectual capital in achieving competitive advantage through innovation (Dost et al., 2016). Thus, innovative performance can be achieved not only through the mere integration of intellectual capital. Instead, innovation occurs through knowledge reintegration and communication – the modification of previously gathered information and skills into a whole new application context (Duodu & Rowlinson, 2016). Thus, this study develops the following hypothesis:

H2: Green Intellectual Capital has a positive relationship with Ambidextrous Green Innovation.

2.3 AGI and EP

The claim that ambidexterity innovation is positively related to environmental performance is based on the ambidexterity theory, which states that "firms that incorporate both exploitative and exploratory innovations tend to achieve greater sustainability than those who adopt only one while neglecting the other' (Raisch & Birkinshaw, 2008). Previous research has demonstrated the importance of ambidextrous green innovation through exploratory and exploitative innovation in achieving sustainable performance (Lin et al., 2013). Exploratory innovation stresses experimentation, which brings new knowledge and skills, while exploitative innovation is based on learning obtained by the selection, enhancement, and reconstruction of existing practices founded on aggregated databases (Mazzelli et al., 2020; Sheng & Hartmann, 2019).

H3: Green Ambidextrous Innovation has a positive relationship with Environmental Performance.

2.4 Mediating Role of GAI

Green human capital, which encompasses executives' considerations regarding environmental programs (Cao et al., 2021); green structural capital, which concerns environmental technologies and the latest environmental frameworks (Nadeem et al., 2021); and green relationships with clients, suppliers, and other stakeholders of the stakeholder network (Chen, 2008) are critical drivers of corporate environmentalism, such as eco-innovation. Creating a balance between both types of innovation, exploratory and exploitative ambidextrous innovation, at the firm level is essential despite being aware of their necessity for obtaining sustainable performance and competitive advantage (Sheng & Hartmann, 2019). Green ambidextrous innovation (GAI) adds to sustainable development by building consumer trust, enhancing the green image, enlarging the market (Wang et al., 2020a), and gaining first-mover benefits (Chen & Chang, 2013b). Doran and Ryan (2016) found that green intellectual capital (GIC) is a significant determinant of environmental performance through GAI interventions. Rehman et al. (2021) stressed the need to establish a potential mechanism through which GIC interacts with GAI to boost business performance. Thus, the current research hypothesizes the following:

H4: Green Ambidextrous Innovation mediates the relationship between Green Intellectual Capital and Environmental Performance.

2.5 Moderating Role of EE

Ethics are shared ideals that can change or evolve with the shifting circumstances of society (Akpan & Leonard, 2018). Environmental ethics involves understanding the connection between humans and the natural world, encompassing all the species that constitute the natural habitat. In the organizational context, environmental ethics are seen as a crucial internal resource that enables firms to adopt a value-creating strategy to enhance environmental performance. Firms that uphold strong environmental ethics and promote environmental awareness through training encourage progressive environmental initiatives, gain competitive advantages, and bolster the environment (Singh & El-Kassar, 2019). Shifting human-centered viewpoints towards environment-centered perspectives and influencing environmental norms and human perceptions related to ecological surroundings can be positively influenced by environmental ethics (Moorthy & Akwen, 2020).

Addressing the critical factors that drive the adoption of green ideas and technologies has recently gained attention. Stakeholder perception and market demand for sustainable goods, along with business environmental ethics, are driving factors that promote the adoption and successful compliance with green ambidextrous innovation (Chang, 2011; El-Kassar & Singh, 2019). Businesses can adopt positions on environmental protection where rivals are unable to replicate their effective environmental policies and reap long-term benefits as a result (Chang, 2011). Ployhart (2012) contends that businesses naturally lean towards developing value-creating tactics to maximize internal assets, such as environmental ethics, to enhance their environmental performance and outperform their competitors. Moreover, environmental training helps firms mitigate the detrimental effects of business operations on the physical environment (El-Kassar & Singh, 2019; Graves et al., 2013) and improve sustainable performance (El-Kassar & Singh, 2019; Paillé & Halilem, 2019). It also assists employees in becoming aware of the environmental ethics and targets of a firm (El-Kassar & Singh, 2019; Longoni et al., 2018).

H5: Environmental Ethics moderate the relationship between Green Ambidextrous Innovation and Environmental Performance.

Figure 1 presents the theoretical framework of this study.

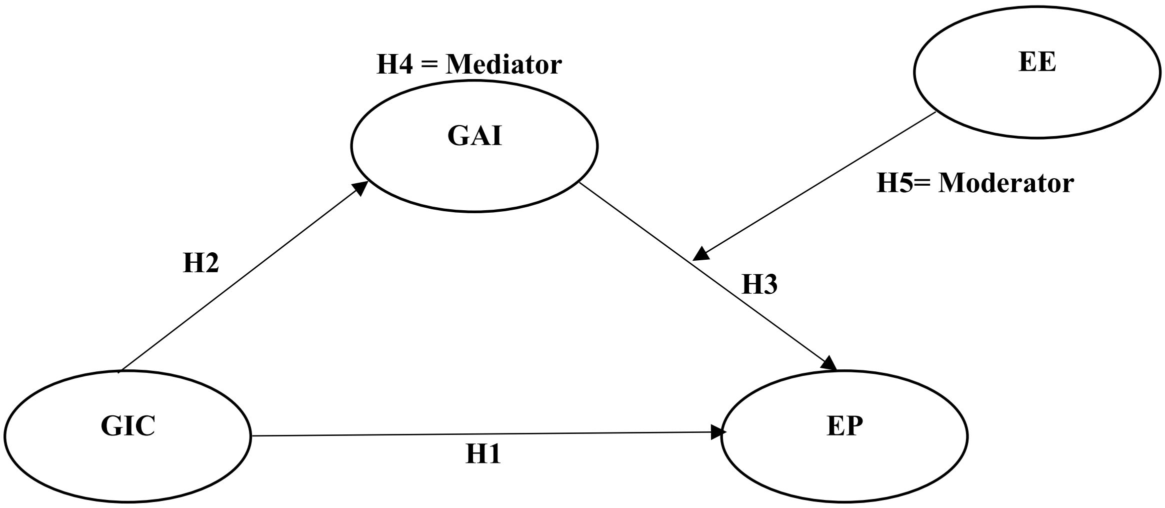

Figure 1. Research model of the study

3 METHODOLOGY

A nation's industrial sector provides significant financial support to its economy. However, carbon emissions and discharges from industries severely damage the environment (Mahmood et al., 2019). Pakistan's environmental legal framework is still lacking in effectively controlling these issues, despite having strong regulatory frameworks and policies. In recent years, insufficient actions have been taken to mitigate the detrimental effects of the industrial sector on the environment. Poor air quality can cause significant harm to public health (Shaukat & Ming, 2022). Established in 1961, the Pakistan Pharmaceutical Manufacturers Association (PPMA) serves as a representative body of the pharmaceutical sector in Pakistan (Malik & Kanwal, 2018). Policies and legislation aimed at ecological preservation, climate-change mitigation, and waste management underscore the importance of green management for firms. Therefore, achieving sustainability is a top priority in business operations in the pharmaceutical sector (Milanesi et al., 2020; Sheldon, 2017). The pharmaceutical sector significantly influences the economy at both national and international levels, and its growth positively impacts human health and well-being (EFPIA, 2023).

3.1 Population and Sample

This study focused on the pharmaceutical sector of Pakistan, which is regulated by the 'Drug Regulatory Authority of Pakistan' (DRAP). DRAP oversees the registration of new medications and production plants. The study covered approximately 650 firms in Pakistan’s pharmaceutical sector, including international firms (ICAP, 2024), for the period from November 2023 to February 2024. Given the absence of secondary data sources, such as Kinder, Lydenberg, and Domini in Pakistan, this study developed a questionnaire for data collection, constructed after a thorough examination of the literature. To ensure the reliability and accuracy of the data, the questionnaire was rigorously pre-tested with CEOs from the targeted sector. Through this adaptive strategy, the questionnaire items were refined to ensure the accuracy of each contract and the appropriateness of each construct to fulfill the study objectives. Targeting CEOs of the concerned sector was deemed appropriate as they possess comprehensive insights into the general strategic operations of companies.

3.2 Variable Measurements

This study employed four variables: GIC, EE, GAI and EP. To ensure accuracy, validity, and consistency, the previously adopted scales were used for each item of interest. Green Intellectual Capital was measured using seven items developed by (Martínez-Falcó et al., 2024; Zaragoza-Sáez et al., 2023), rated on a 5-point Likert scale. The Likert scale, a non-comparative scaling method, was employed in this study, pioneered by the Rensis Likert scale in 1932 (Li, 2013). Environmental Performance was assessed using seven items provided by (Cao et al., 2022; Martínez-Falcó et al., 2024), rated on a 5-point Likert scale. Green Ambidextrous Innovation was measured through two dimensions: exploratory green innovation, assessed with four items, and exploitative green innovation, measured with four items (Martínez-Falcó et al., 2024; Wang et al., 2020b). Additionally, Environmental Ethics were evaluated using four items developed by (Chang, 2011; Guo et al., 2020; Henriques & Sadorsky, 1999).

3.3 Analysis Techniques

The study employed partial least squares structural equation modeling (PLS-SEM) using SmartPLS v.4.0.0. PLS-SEM has become a widely used statistical tool across various fields in the social sciences, including organizational management (Sosik et al., 2009), operations management (Peng & Lai, 2012), strategic management (Hair et al., 2012a), marketing management (Hair et al., 2012b), international management (Richter et al., 2016), management accounting (Nitzl, 2016), and human resource management (Ringle et al., 2020). PLS-SEM further suggests methodological extensions in several textbooks (Garson, 2016), edited volumes (Ali et al., 2018) and additional issues of research journals (Rasoolimanesh & Ali, 2018; Shiau et al., 2019).

PLS-SEM is particularly favored by researchers for its ability to handle modest sample sizes and complex models with numerous constructs and indicator variables (Hair et al., 2012b; Willaby et al., 2015). This allows for the estimation of intricate models without requiring stringent distributional assumptions regarding the data. PLS-SEM is a causal-predictive technique within structural equation modeling that prioritizes prediction in a statistical model evaluation. While it emphasizes prediction, PLS-SEM also provides causal descriptions within the models, resolving the tension between prediction and explanation. This ability to generate management implications from empirical data is highly valued in scholarly research (Hair et al., 2019).

4 RESULTS AND DISCUSSION

The demographic profile, that is, gender, age, education, and experience of the chosen sample, is given in Table 1. The sample consisted of the majority of males (86.4%), which indicated the dominance of males in the study sector. Most of the respondents were aged under 25 to 35 years. Most of the study respondents had an educational profile up to the master's degree and with five to ten years of experience.

Table 1. Demographics

	Dimensions	N	%
Gender	Male	247	86.4
	Female	39	13.6
Age	Less Than 25 Year	87	30.4
	25 to 35 Years	122	42.7
	35 to 45 Years	65	22.7
	More Than 45 Years	12	4.2
Education	Graduation	79	27.6
	Master	114	39.9
	Professional Qualifications	73	25.5
	Other	20	7.0
Experience	Less than 5 Year	44	15.4
	5 to 10 Year	124	43.4
	10 to 15 Year	91	31.8
	More than 15 Year	27	9.4

Table 2 represents the reliability and validity of the measurement models. The study assessed the measurement model through convergent and discriminant validity (Hair et al., 2006). Average Variance Extracted AVE must be greater than 0.50 for data reliability. While convergent validity measure i.e., Composite Reliability CR must be greater than

0.70 to demonstrate reliability. Maximum Shared Variance MSV must be less than AVE for discriminant validity. The research observed CR that ranged from 0.75 to 0.905 which shows the reliability of the data.

Table 2. Construct Loadings & Convergent Validity

	EE	EP	GAI	GIC	Alpha	CR	AVE	MSV
EE1	0.671				0.743	0.75	0.566	0.311
EE2	0.81							
EE3	0.778							
EE4	0.742							
EP1		0.671			0.839	0.844	0.573	0.241
EP2		0.613						
EP3		0.708						
EP4		0.831						
EP5		0.761						
EP6		0.697						
EP7		0.703						
GAI1			0.82		0.895	0.905	0.630	0.255
GAI2			0.795					
GAI3			0.768					
GAI4			0.783					
GAI5			0.736					
GAI6			0.76					
GAI7			0.724					
GAI8			0.673					
GIC1				0.715	0.832	0.833	0.543	0.311
GIC2				0.759				
GIC3				0.728				
GIC4				0.771				
GIC5				0.692				
GIC6				0.640				
GIC7				0.632				

The AVE was found to be 0.543 to 0.630, whereas the MSV values in Table 2 are less than AVE, which represents discriminant validity. The coefficient reliability of the study construct was measured through Cronbach's alpha, which should be more than 0.70. The alpha values for EE were 0.743 and 0.839. GAI = 0.895 and GIC = 0.832, which were greater than 0.70, thus proving the validity of the research data. Table 2 presents the results of the factor loadings, convergent validity, and reliability. Each scale adopted in the data analysis fulfilled these requirements. As a whole, Table 2 reveals that Cronbach's alpha was more than 0.70, and the AVE was greater than 0.50, which proved that each measurement tool has both convergent and discriminant validity (Fornell & Larcker, 1981).

Discriminant validity refers to the degree to which a particular construct uniquely differs from other constructs, as evidenced by empirical observations. This was assessed by examining the correlation between each variable and the square root of the average variance extracted for each construct (see Table 3). When the square root of the average variance extracted exceeds the correlation between the study variables, it indicates robust discriminant validity.

Table 3. Discriminant Validity

Constructs	EE	EP	GAI	GIC
EE	0.752			
EP	0.453	0.715		
GAI	0.362	0.598	0.759	
GIC	0.475	0.371	0.411	0.707

Table 4 presents the estimates of the fitness of the model. The value of SRMR must be less than 0.06 for the model to be a good fit. The study estimated SRMR = 0.053, which is below 0.06, proving that the model is a good fit. Moreover, the NFI must be ≥ 0.8, and the study observed an NFI value of 0.83, which represents a good fit for the model.

Table 4. Model Fitness

Indicators	Saturated model	Estimated model
SRMR	0.050	0.053
d_ULS	4.517	4.521
d_G	1.607	1.621
Chi-square	2404.266	2402.6
NFI	0.81	0.83

Five statistical models were developed to test the proposed hypotheses, as presented in **Table 5.** The first model examined the relationship between the GIC and EP. GIC had a positive and insignificant relationship with EP, with values *β=0.115 and p=0.097.* Values *β=0.711 and p=0.000* represent a significantly positive association between GIC and GAI. The relationship between GAI and EP was positive and significant, with estimates *β=0.332 and p=0.000*. Moreover, GAI positively and significantly moderated the relationship between GIC and EP, with *β=0.236 and p=0.000.* Finally, the interaction term EE × GAI positively and significantly moderates the impact on EP, which can be estimated through the values *β=0.092 and p=0.019*.

Table 5. Regression Weights

Hypothetical Paths	Original sample	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
GIC -> EP	0.115	0.069	1.662	0.097
GIC -> GAI	0.711	0.032	22.436	0.000
GAI -> EP	0.332	0.063	5.308	0.000
GIC -> GAI -> EP	0.236	0.046	5.112	0.000
EE x GAI -> EP	0.092	0.039	2.338	0.019

The current study attempted to analyze the relationship between GIC and EP, with GAI as mediator between GAI and EP, while EE as moderator in the relationship of GAI and EP. Concerning H1, the study revealed that GIC has a quantitatively positive and insignificant impact on EP, which is in line with (Rehman et al., 2021; Yusliza et al., 2020). Intellectual resources committed to green operations result in better environmental outcomes. This finding signifies the importance of sustainable skills and procedures for fostering environmental results. The estimated results confirm H2, which proposes a positive relationship between GIC and GAI. These results are consistent with those of previous studies by (Martínez-Falcó et al., 2024; Shehzad et al., 2023). GIC emphasizes green intangible capital and competence enhancement through green knowledge development and partnership with external green partners, which cater to the process and compliance of green knowledge and the emergence of GAIs. The findings suggest that a combination of green intellectual assets aided by understanding production processes and developing the latest green goods, services, and technology also promotes green markets and green innovation.

As for H3, the study findings demonstrated the positive and significant influence of GAI on EP, which is consistent with previous studies (Martínez-Falcó et al., 2024; Úbeda-García et al., 2022). The findings indicate that a firm's capability to effectively comply with green exploitative and exploratory innovations offers creative answers that enhance process effectiveness and boost product and service standards in a manner that fosters environmental performance. The study results support hypothesis H4, which implies that GIC and EP work in harmony through the mediating effect of GAI. This result is in line with the findings of (Asiaei et al., 2023; Martínez-Falcó et al., 2024; Shehzad et al., 2023) who emphasized shaping the relationship rather than establishing a direct connection between environmental practices, GIC, and sustainable performance. The current study found that EE significantly moderated the relationship between GAI and EP, supporting H5. A number of practitioners insist that there is a need to incorporate environmental ethics into firms (Tate & Bals, 2018; Yawar & Seuring, 2017), to improve their social and environmental performance (Chang, 2011; Chen & Chang, 2013a). Businesses can benefit from environmental ethics as intangible assets that may be used to boost environmental performance by reducing firms' detrimental effects on the external environment and earning a competitive edge over rival firms (Paillé & Halilem, 2019; Singh et al., 2019).

5 CONCLUSION

This empirical study aims to examine the significance of green intellectual capital in environmental performance within the organizational context of Pakistan's pharmaceutical industry. Pharmaceutical companies are continually embracing sustainable practices to mitigate pollution resulting from the use of chemicals, high solvents, and energy in the production of medicinal drugs. This study further explored the mediating role of green ambidextrous innovation, along with the moderating impact of environmental ethics. Data collected from Pakistan's pharmaceutical sector from November 2023 to February 2024 were analyzed using partial least squares structural equation modeling (PLS-SEM) with SmartPLS v.4.0.0. The findings of this study offer valuable insights for scholars and industry professionals, enabling them to gain a deeper understanding of the pharmaceutical industry and strategies to achieve competitive advantage in the market.

This study has several theoretical and practical implications. First, the study presented a unique relationship by integrating EE as a moderator in the GAI-EP relationship, which has not been empirically explored in the literature, according to the author's knowledge. The addition of EE highlights that ethical issues have a significant impact on examining how well green innovations turn out in the sector. Second, the study implies that the company's management makes strategic decisions regarding green initiatives and sustainable development in the pharmaceutical sector. Third, this study contributes to the existing literature by identifying variables related to EP in the pharmaceutical sector. Fourth, the unique theoretical framework maintains the novelty of this study by distinguishing it from previous studies. Fifth, the results allow us to fulfill the following objectives: (1) GIC positively impacts EP; (2) GIC favorably impacts GAI; (3) GAI enhances EP; (4) GAI positively mediates the relationship between GIC and EP; and (5) EE positively moderates the relationship between GIC and EP.

With regard to practical implications, environment-oriented intellectual capital needs to be directed by pharmaceutical companies to integrate greener innovations in their operations. To foster environmental performance, firms need to actively coordinate with various stakeholders, such as vendors, clients, and partners, who share the same interests. Additionally, green ambidextrous innovation can be used to transform green assets to derive environmental performance. Thus, managers should efficiently orchestrate firms' green resources to earn a competitive edge and boost their environmental performance. Furthermore, organizations need to adopt environmental ethical practices in their routine operations proactively rather than reactively for the purpose of carrying on a cooperative relationship with the triads that are society, profits, and the environment.

This study had the following limitations. First, the study analyzed data collected from November 2023 to February 2024; hence, an extension is required to verify the results derived in the present study. Second, the study only targeted the pharmaceutical sector operating in Pakistan, which will hinder the operationalization of the results to other sectors and regions/countries that may have varied policies and plans related to sustainable development.

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