Innovation Sustainability: A Strategy for Achieving Business Success in the Digital Era

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Abstract

The present research explores how the growing demand for environmental sustainability compels businesses to implement knowledge management systems, embrace green digital learning orientations, and enhance technological capabilities. Consequently, this investigation assesses the impact of knowledge management systems and green digital learning orientations on the sustainability of businesses. Drawing upon the proposed model, data were collected from 395 cases of small and medium-sized enterprises (SMEs) in Erbil, northern Iraq. The results revealed the significance of both the knowledge management system and green digital learning orientation in fostering sustainable business practices. In essence, this study highlights critical catalysing factors, emphasizing the paramount importance of knowledge management systems, their functionality, and strategic operational decisions in adapting to the dynamic business landscape and sustaining competitiveness on the global stage.

Keywords: Environmental Sustainability, knowledge management systems, Green Digital, 4.0 Technologies

استدامة الابتكار: استراتيجية لتحقيق نجاح الأعمال في العصر الرقمي

الملخص:

يستكشف هذا البحث كيف يجبر الطلب المتزايد على الاستدامة البيئية الشركات على تنفيذ أنظمة إدارة المعرفة، وتبني توجهات التعلم الرقمي الأخضر، وتعزيز القدرات التكنولوجية. وبالتالي، يقيم هذا التحقيق تأثير أنظمة إدارة المعرفة وتوجهات التعلم الرقمي الأخضر على استدامة الأعمال. واستنادا إلى النموذج المقترح، تم جمع البيانات من ٥٩٣ حالة لمشاريع صغيرة ومتوسطة الحجم في أربيل، شمال العراق. وكشفت النتائج عن أهمية كل من نظام إدارة المعرفة وتوجه التعلم الرقمي الأخضر في تعزيز ممارسات الأعمال المستدامة. في جوهرها، تسلط هذه الدراسة الضوء على العوامل المحفزة الحاسمة، مع التأكيد على الأهمية القصوى لأنظمة إدارة المعرفة، ووظائفها، والقرارات التشغيلية الاستراتيجية في التكيف مع مشهد الأعمال الديناميكي والحفاظ على القدرة التنافسية على الساحة العالمية.

الكلمات المفتاحية: الاستدامة البيئية، أنظمة إدارة المعرفة، الرقمية الخضراء، ٤,٠ التقنيات

1. Introduction

In the ever-evolving business landscape, maintaining a competitive edge on the global stage necessitates adopt strategic, functional, and tactical decision-making (Haarhaus & Liening, 2020). The rising interest in extensive data for decision-making in intricate contexts has become a focal point for industry experts (Tseng et al., 2022). Nevertheless, the reliance on data-driven approaches by firms calls for significant investments in resources and labour capabilities for sustained viability, prompting the need for further research exploration (Papadopoulos & Balta, 2022). In the digital era, nations worldwide have strategically designed technology solutions tailored to navigate societal constraints and promote digital initiatives (Ardito et al., 2021; Chew et al., 2023). Institutional pressures play a guiding role, steering corporations to operate within these established boundaries. Technology investments are instrumental in delineating clear objectives and performance benchmarks, reinforcing business capabilities in the age of digitization (Bohnsack et al., 2022; Hassani et al., 2022). Moreover, the evolving landscape of customer demands exerts influence, compelling suppliers to leverage digital technology to enhance their resources and capabilities (Al Halbusi et al., 2022a). The examination of these dynamics reveals that institutional demands positively impact the availability, commitment, and infrastructure of tangible resources (Bag et al., 2021).

In Industry 4.0, data assumes a pivotal role as a significant asset (Ghobakhloo, 2020). The integration of Industry 4.0 technologies holds the potential to propel advancements in 'smart business' practices (Fromhold-Eisebith et al., 2021). Within the Industry 4.0 era, the capabilities of knowledge management systems and green digital learning orientation have emerged as invaluable tools, presenting opportunities for substantial innovation. These capabilities have been shown to enhance a business's cost and operational performance, exerting a positive influence on its current state (Abkenar et al., 2021; Benzidia et al., 2021).

The integration of knowledge management systems and green digital learning orientation has the potential to foster sustainable business practices through various avenues. For instance, algorithms focused on energy efficiency within these systems can optimize energy consumption in buildings, factories, and other facilities, thereby reducing costs and lessening environmental impact (Jarrahi et al., 2023; Chowdhury et al., 2023). Furthermore, these systems can aid businesses in streamlining supply chains to minimize waste, enhance delivery times, and decrease transportation costs, ultimately contributing to a reduction in carbon emissions (Leal Filho et al., 2022). In terms of waste reduction, the capabilities of these systems extend to identifying and minimizing

waste in production processes, leading to improved efficiency and reduced environmental impact. Thus, renewable energy optimization within these systems can enhance the performance of renewable energy systems like wind turbines and solar panels, resulting in increased efficiency and decreased costs. The application of these capabilities extends to sustainable product design by identifying materials and manufacturing processes with lower environmental impacts. Additionally, through environmental monitoring, these systems can analyze environmental data, boosting businesses in identifying areas for improvement in sustainability and reducing their overall environmental impact. In essence, the capabilities of knowledge management systems and green digital learning orientation empower companies to make informed decisions, reduce waste, enhance efficiency, and contribute significantly to sustainable business practices (Gupta et al., 2023).

Therefore, building on the preceding discussion, the primary objective of this research is to delve into the influence of knowledge management systems (KMS) and green digital learning orientation (GDLO) on sustainable business practices. The proposed model is inherently practice-oriented, equipped to identify challenges related to knowledge management systems and sustainable performance and to tackle issues in the development of green digital learning orientation (GDLO). Many firms currently face challenges arising from the shifting landscape of institutional forces and resources. Consequently, the model is designed to provide valuable insights into actual issues, offering assistance to management and decision-makers in crafting more effective action plans to attain their desired goals for environmental sustainability.

The research is important as it sheds light on the imperative role of knowledge management systems and green digital learning orientations in enabling small and medium-sized enterprises (SMEs) to meet the growing demand for environmental sustainability. By assessing the impact of these systems and orientations on business sustainability, the study provides actionable insights for SMEs in Iraqi context, and potentially beyond. Its findings emphasize the critical catalysing factors necessary for SMEs to adapt to dynamic business environments and sustain competitiveness globally, emphasizing the paramount importance of strategic operational decisions in this endeavour. Thus, this study attempted to addressed the research problem as there are massive need for small and medium-sized enterprises (SMEs) to effectively respond to the increasing demand for environmental sustainability. Specifically, this study investigates how SMEs can utilize knowledge management systems, green digital learning orientations, and enhanced technological capabilities to foster sustainable business practices. The study seeks to

understand the impact of these factors on the sustainability of SMEs, with a focus on their functionality and strategic operational decisions. Moreover, it aims to identify critical catalysing factors necessary for SMEs to adapt to the dynamic business landscape and sustain competitiveness on a global scale.

2. Research Objectives

Therefore, stemming from the main aim of this study, we transition to delineating the specific research objectives, outlined as follows.

1. To investigate the relationship between the implementation of knowledge management systems and the green digital learning orientations.
2. To examine the influence of green digital learning orientations on the sustainability efforts of businesses.

3. Research Importance

The significance of this research extends across both theoretical and practical realms. Theoretical perspectives benefit from an in-depth analysis of how the increasing emphasis on environmental sustainability shapes organizational strategies, such as the implementation of knowledge management systems and green digital learning orientations. By examining these dynamics, the research contributes to the theoretical understanding of how businesses adapt to emerging sustainability trends. On a practical level, the investigation offers valuable insights into the effectiveness of specific strategies, such as knowledge management systems and green digital learning, in enhancing the sustainability of businesses. This dual perspective bridges theoretical frameworks with actionable strategies, providing practical guidance for businesses striving to align with sustainable practices in a rapidly evolving landscape.

4. Literature Review and Hypothesis

4.1 Knowledge Management System (KMS) and Green digital learning orientation (GDLO)

A knowledge management system (KMS) serves as a software-based platform designed to facilitate organizations in capturing, storing, sharing, and managing knowledge and information. Its ultimate goal is to enhance organizational efficiency, effectiveness, and innovation by providing easy access to knowledge for employees, stakeholders, and

customers (Jarrahi et al., 2023). A typical KMS encompasses several components. For instance, a knowledge repository serves as a centralized database for storing and organizing information and knowledge. Knowledge creation involves the capturing and generation of new knowledge through collaborative efforts, experimentation, or research (Di Vaio et al., 2021). Knowledge sharing, another component, entails disseminating information across the organization through avenues such as forums, wikis, or social media platforms.

In the context of sustainable business practices, knowledge management systems (KMS) play a pivotal role by assisting organizations in capturing, storing, and sharing knowledge related to sustainability issues (Elia et al., 2022). For instance, KMS can support sustainable business practices by facilitating the sharing of best practices, including waste reduction, energy efficiency, and environmental management (Al Halbusi et al., 2022c). Furthermore, through the development of knowledge and skills, KMS can empower organizations to implement sustainable business practices such as sustainable product design, circular economy initiatives, and green supply chain management (Huesig & Endres, 2018). Additionally, KMS fosters collaboration among employees, suppliers, and other stakeholders, facilitating the sharing of information and resources necessary for the implementation of sustainable business practices (Friedrich et al., 2020).

Regarding tracking progress, KMS can monitor and report on sustainability performance, aiding organisations in identifying areas for improvement and measuring progress over time. Moreover, KMS contributes to fostering innovation by helping organizations identify new opportunities for sustainable innovation, such as developing new sustainable products or business models. Therefore, the role of KMS extends to enabling organizations to build the knowledge, skills, and infrastructure required for the successful implementation of sustainable business practices, ultimately enhancing environmental, social, and economic performance. Based on the above argument the following hypothesis was suggested:

Hypothesis 1: Knowledge management systems (KMS) positively correlated to Green digital learning orientation (GDLO).

4.2 Green Digital Learning Orientation (GDLO) and Sustainable Business

Green digital learning orientation, as highlighted by Benzidia et al. (2021), is acknowledged as an intangible resource influencing inter-functional management and collaboration with external partners within the manufacturing sector. The emphasis on learning within this context encourages environmentally friendly activities, facilitating the sharing of information externally, promoting the application of knowledge and skills

in digital innovations, and streamlining subsequent information exchange (Abu Afifa et al., 2022). Demonstrating enhancements in green digital learning orientation (GDLO) serves as a motivator for businesses to leverage AI capability, particularly to enhance operational efficiency and sustainable performance. Learning-focused organizations often deploy cross-functional teams to enhance operational procedures and promote knowledge acquisition among workers (Iyer et al., 2019; Sahoo et al., 2022).

Precisely, GDLO significantly influences learners' motivation, cognitive processes, methods, comprehension, and innovation (Borah et al., 2021). According to Sendlhofer and Lernborg, (2018) and Zhou et al. (2019), digital learning proves more effective as it encourages individual or collaborative learning through videos and quiz-style tasks. An advantage of digital learning lies in team members' ability to assess learners' understanding using advanced tools on computers or mobile devices. Such advancements align with new regulations aimed at environmental protection and overall sustainability (Zhang et al., 2020; Ardito et al., 2021). Thus, green digital learning initiatives are currently prevalent in areas such as manufacturing safety, risk management, system security, handling toxic compounds, waste disposal, and industrial hygiene (Nasiri et al., 2022; Rehman et al., 2022). Therefore, this research considers the moderating role of green digital learning orientation (GDLO) in the relationship between green innovation and sustainable performance. Grounded in the reasons mentioned above, the hypothesis posited is as follows.

Hypothesis 2: Green digital learning orientation (GDLO) is positively correlated to sustainable business.

5. Research Conceptual Framework

The conceptual framework of this research encompasses the interplay between environmental sustainability demands, knowledge management systems, green digital learning orientations, and technological capabilities within the context of small and medium-sized enterprises (SMEs). It suggests that the increasing pressure for environmental sustainability prompts businesses to adopt knowledge management systems, embrace green digital learning orientations, and enhance technological capabilities. These elements are hypothesized to directly influence of knowledge management systems and green digital learning orientations the sustainability practices of SMEs. Hence, this study underlines the critical role of knowledge management systems, emphasizing their functionality and strategic operational decisions, in enabling SMEs to adapt to the evolving business landscape and sustain competitiveness on a global scale.

6. Method

6.1 Sample Procedures

In practical terms, non-probability sampling is commonly preferred and is more suitable for fieldwork research (Hulland et al., 2018). It is deemed appropriate when the chosen sampling strategy aligns with the research objectives and the scope of the study. Since the research aims for theory generalization, considering the absence of a complete sampling frame in the given context, convenience sampling was selected as the most fitting strategy. Accordingly, data collection was conducted from 395 cases of small and medium-sized enterprises (SMEs) in Iraq. The participants were reached through self-administered surveys distributed via Google Drive. Additionally, to ensure the validity and acceptability of responses, participants were explicitly informed that all contributions are valuable and welcomed, emphasizing that the study is conducted solely for academic purposes.

6.2 Variables Measurement

All the measurement items employed in this study were adapted from previous research. To assess knowledge management systems (KMS), three dimensions were considered: IT infrastructures, collaborative technologies, and ICT adoption. Specifically, IT infrastructures were evaluated using 4 items, collaborative technologies with 5 items, and ICT adoption with 6 items—all adapted from (Meroño-Cerdan et al., 2007; Soto-Acosta & Meroño-Cerdan, 2008; Santoro et al., 2018). Concerning green digital learning orientation (GDLO) was measured using 3 items sourced from (Iyer et al., 2019; Benzidia et al., 2021). Sustainable business, on the other hand, was measured with 6 items drawn from (Benzidia et al., 2021). Additionally, firm size and age were included as control variables, acknowledging their potential influence on sustainable business, based on existing literature.

6.3 Common Method Variance (CMV)

Recognizing the potential impact of common method variance (CMV) in this study, considerable efforts were devoted to minimizing this risk. Following rigorous design methods outlined by Podsakoff et al. (2003) and Podsakoff et al. (2012), the survey underwent a series of phases. Preliminary versions were scrutinized and modified by a panel of experts from both academia and industry. These experts evaluated the validity of the questions and the appropriateness of their presentation.

In addition to these pre-emptive procedural measures, several post-hoc tests were

conducted to assess the risk of CMV biasing the results. While acknowledging that CMV cannot inflate the interaction terms, the primary focus of this research (Podsakoff et al., 2012). Initially, Harman's (1976) single-factor technique was employed to evaluate CMV bias, and the outcomes were not deemed critical. Subsequently, exploratory factor analysis was conducted to ascertain if a single factor could explain the majority of the covariance among the study items. The analysis identified five factors with eigenvalues exceeding one, collectively accounting for 68% of the total variance. Notably, the variance in the first factor explained only 29%, indicating that CMV is not a significant concern (Podsakoff et al., 2003). Furthermore, a comprehensive collinearity assessment was conducted based on variance inflation factors (VIFs) (Kock and Lynn, 2012; Kock 2015). Following recommended guidelines, this test assessed both vertical and lateral collinearity, indicating that a VIF greater than 3.3 signifies collinearity issues that could be influenced by CMV. The analysis, as presented in Table 1, revealed that the current study is devoid of CMV concerns.

Table 1
Common Method Variance Assessment Via Full Collinearity Estimate Criteria

Variable	Knowledge Management Systems	Green Digital Learning Orientation	Sustainable Business
VIF	1.221	2.137	1.325
Note: VIF = Variance Inflation Factor			

7. Data Analysis and Results

To validate the research model, partial least squares structural equation modeling (PLS-SEM) with Smart PLS 4.0, was utilized (Ringle et al., 2015).

7.1 Measurement Model

Table 2 presents measurements encompassing item reliability, internal consistency reliability, and convergent and discriminant validity. In terms of item reliability, the majority of items surpass the recommended 0.707 threshold (Hair et al., 2017). Both Cronbach's alphas and composite reliabilities (CR) exceed the 0.70 cut-offs (Hair et al., 2017). The average variance extracted (AVE) for all constructs surpasses the 0.5 threshold, signifying convergent validity ranging from 0.531 to 0.697 (Hair et al., 2017). Therefore, based on these outcomes, the measurement objectives have been achieved. Concerning discriminant validity, Heterotrait-Monotrait Ratio (HTMT) approach was employed.

Based on the Multitrait-Multimethod Matrix, if the Heterotrait-Monotrait Ratio (HTMT) values exceed 0.85, there is a concern with discriminant validity. Table 3 reveals that all HTMT values are below 0.85, indicating that each pair of variables demonstrates discriminant validity (Henseler et al., 2015).

Table 2

Measurement Model, Loading, Construct Reliability and Convergent Validity

First-Order Constructs	**Second - Order Constructs**	**Items**	**Loading (> 0.5)**	**CA (> 0.7)**	**CR (> 0.7)**	**AVE (> 0.5)**
IT infrastructures		ITI1	0.788	0.750	0.841	0.557
		ITI2	0.841			
		ITI3	0.755			
		ITI4	0.800			
Collaborative Technologies		CT1	0.785	0.754	0.818	0.631
		CT2	0.796			
		CT3	0.805			
		CT4	0.722			
		CT5	0.814			
ICT adoption/support		ICT1	0.853	0.747	0.840	0.589
		ICT2	0.770			
		ICT3	0.710			
		ICT4	0.845			
		ICT5	0.852			
		ICT6	0.771			
	Knowledge Management Systems	IT infrastructures	0.863	0.789	0.887	0.697
		Collaborative Technologies	0.794			

		ICT adoption/support	0.881			
Green Digital Learning Orientation		GDLO1	0.795	0.811	0.889	0.641
		GDLO2	0.766			
		GDLO3	0.785			
Sustainable Business		SB1	0.853	0.717	0.808	0.531
		SB2	0.770			
		SB3	0.810			
		SB4	0.811			
		SB5	0.788			
Note: CR= Cronbach's alphas, CR= Composite Reliability, AVE= Average Variance Extracted.						

Table 3

Discriminant Validity Via HTMT.

Constructs	**1**	**2**	**4**
1. Knowledge Management Systems			
2. Green Digital Learning Orientation	0.554		
4. Sustainable Business	0.527	0.404	

Note: HTMT should be lower than 0.85.

7.2 Hypotheses Testing

Table 4 provides the results of the direct hypotheses (H1, H2). As expected, both the knowledge management system (KMS) and green digital learning orientation (GDLO) exhibited a significant relationship with sustainable business. Specifically, the relationship for the knowledge management system (KMS) was found to be significant (β= 0.198, t= 3.019, p< 0.000), and similarly, the relationship for green digital learning orientation (GDLO) was also significant (β= 0.231, t= 3.751, p< 0.000). Therefore, both H1 and H2 were confirmed.

Table 4

Structural Path Analysis: Direct Effect.

						Bias and Corrected Bootstrap 95% CI	
Hypothesis	**Relationship**	**SB**	**SD**	**t-value**	**p-values**	**[Lower Level; Upper Level]**	**Decision**
H-1	Knowledge Management Systems (KMS) -> Green digital learning orientation (GDLO)	0.198	0.066	3.019	0.000	[0.075; 0.293]	Yes
H-2	Green Digital Learning Orientation (GDLO) -> Sustainable Business	0.231	0.059	3.751	0.000	[0.041; 0.243]	Yes

8. Conclusion

The primary objective of this research was to investigate the interplay between knowledge management systems (KMS), green digital learning orientation (GDLO), and AI capability and understand how this interrelationship influences sustainable business practices. In the current era of knowledge, technological advancements and collaborative efforts among economic entities have significantly reshaped management systems. Technology plays a pivotal role in enhancing knowledge management processes, and facilitating the seamless flow of information through cutting-edge information and communication technologies (Cillo et al., 2022). The Internet of Things (IoT) is particularly transformative, altering how businesses approach innovation and create value for stakeholders in their day-to-day operations. However, only a limited number of studies have delved into the impact of KMS utilizing advanced ICTs, internal and external knowledge, and management processes. These studies have demonstrated the potential of fostering business innovativeness and contributing to overall business sustainability (e.g., Santoro et al., 2018). This research sought to validate the critical role of KMS in fostering business sustainability. The

findings notably highlight that the level of green digital learning orientation (GDLO) has a positive impact on business sustainability.

The implications of the results underscore two critical assumptions. First, the attainment of high levels of green digital learning orientation serves as a motivating factor rooted in establishing a perception of elevated green and sustainable standards within firms. Second, for green innovation to exert its maximum impact, a critical level of green digital learning orientation is essential. The effectiveness of higher green digital learning orientation and the application of green innovation work in tandem to augment the sustainable performance levels of businesses. In essence, the study emphasizes the interconnectedness of knowledge management, green digital learning orientation, and AI capability in shaping sustainable business practices.

8.1 Knowledge and Practical Implications

This study made three theoretical contributions to the existing body of literature on sustainable green business. Firstly, it advanced and empirically validated a model for assessing long-term sustainable performance. Consequently, the acknowledgment of knowledge management systems was identified as a significant contributor to research on sustainable performance. While previous studies have identified various success factors, they often lacked a comprehensive perspective, as illustrated by Santoro et al. (2018). In contrast, this current research broadens the literature by examining the role of knowledge management systems in fostering green digital learning orientation and, consequently, achieving long-term sustainable performance. Unlike earlier investigations that primarily considered success factors, this study specifically delves into how green digital learning orientation enhances overall business performance. Only a limited number of studies have explored the impact of green learning orientation on long-term performance within the context of sustainable development. Therefore, this research expands our understanding of sustainable performance and elucidates the positive influence of green digital learning orientation. Furthermore, this research revealed the theory of green learning orientation and its correlation with sustainable performance. While previous studies have explored factors affecting sustainable development, such as stakeholder integration, green supply-chain management, and green intellectual capital, few have examined the role of green digital learning orientation in mediating the relationship between green innovation and sustainable performance (Imran et al., 2022). Consequently, this report underscores the significance of a robust green learning orientation in enabling businesses to achieve superior performance when integrating green innovation.

Regarding practical implications, this research underscores the critical role of businesses in harnessing technological advancements to foster green practices and achieve sustainable performance in the long term. In essence, executives must continually evaluate their environmental performance, establish new environmental goals, integrate technological support into business processes, and hire competent individuals to advance environmental compliance, reduce air emissions, and enhance both reputation and profitability. Active participation in green innovation is crucial for business owners and management to gain and sustain a competitive advantage over time. Additionally, recognizing the drivers of green innovation, such as trend identification and information management, is essential. Elements crucial for long-term performance, such as product or service innovation, should be identified as well (Al Halbusi et al., 2022b).

Practically, organizations should consistently redesign production and operation procedures to enhance energy sustainability, redevelop products or services to meet evolving environmental standards, utilize sustainable and non-polluting resources, and foster partnerships with green businesses and suppliers (Arfi et al., 2018). From another perspective, given the diverse nature of business activities and limited knowledge of environmental practices, decision-makers play a pivotal role in engaging with technological learning resources. To maximize the use of acquired information, decision-makers should explore how to complement technical capabilities with interoperability (Iyer et al., 2019). Businesses are also urged to enhance monitoring to safeguard the distribution of confidential data and protect the personal data of service users. Adopting a green digital learning orientation (GDLO) appears highly beneficial in fostering a collaborative environmental approach among business executives and their supplier network. With numerous business suppliers, GDLO facilitates clear communication on the business's configuration and efficient management of the environmental approach's execution in design, products, and building sustainability (Abu Afifa and Nguyen, 2022). This finding holds great potential and paves the way for a substantial debate on the application of a new model of environmental learning, particularly in business settings.

8.2 Limitations and Future Suggestions

This research is subject to several limitations that warrant consideration. Firstly, its focus on businesses in Iraq, a developing nation in the Gulf states, suggests a need for additional studies to validate the proposed concepts in other evolving or established countries within the region, such as Saudi Arabia, UAE, Oman, Kuwait, Bahrain, or other Middle Eastern nations. Expanding the geographical scope would contribute to a more comprehensive understanding

of the applicability of the research findings across diverse economic and cultural contexts. Moreover, the current study exclusively employed a quantitative approach to achieve its objectives. Future research endeavors could benefit from adopting a mixed-method approach, which integrates both qualitative and quantitative methodologies. This approach would allow for a more nuanced exploration of the factors influencing environmental sustainability and social responsibility among businesses. By incorporating qualitative insights, researchers can capture a deeper understanding of the contextual nuances that quantitative data alone may not fully illuminate. It's essential to acknowledge the unique circumstances in Iraq, where the government has initiated various programs to enhance capabilities in preparation for the digital revolution. These circumstances may differ in other states, and it is prudent for future research to recognize and account for these variations when interpreting results. Generalizing the findings beyond the specific context of Iraq would require further evaluation, particularly in countries facing distinct external pressures. Despite these limitations, the current research serves as a valuable foundation, paving the way for future investigations into the integration of 4.0 big data-powered and AI technological applications in sustainable business practices and consumption patterns. The insights gained from this study can inform and inspire subsequent research endeavours aimed at advancing our understanding of the broader implications of technological advancements on sustainability in various global contexts.

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