Impact of Knowledge Application on Green Employee Behaviour:
A Healthcare Developing Countries Perspective

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Article information

Abstract

The healthcare sector faces increasing pressure to balance service delivery with environmental sustainability, particularly in developing countries where institutional constraints challenge traditional pathways to green transformation. This study investigates the role of knowledge application (Ka) in shaping green employee behaviours across four dimensions: green learning (GL), green voice (GV), individual practice (IP), and influence on others (IO). Drawing on the knowledge-based view of the firm and organisational learning theory, the research conceptualises Ka as a behavioural catalyst that transforms cognitive resources into sustainability-oriented actions. A longitudinal, two-wave survey design was employed involving 1,663 employees from private hospitals in Baghdad, Iraq. Data were analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM). The findings reveal that Ka exerts a significant and positive effect on all four dimensions of green behaviour, with the strongest impact observed on IP. These results underscore the strategic value of applied knowledge not only in promoting efficiency or innovation but also in cultivating an environmentally conscious workforce. The study advances theoretical discourse by positioning Ka as a central mechanism in organisational sustainability. It also contributes to the growing body of empirical evidence from under-researched contexts, offering practical insights for healthcare leaders, sustainability managers, and policy-makers. Integrating Ka into training, leadership, and performance systems may serve as a low-cost yet high-impact strategy for embedding green behaviour across healthcare institutions.
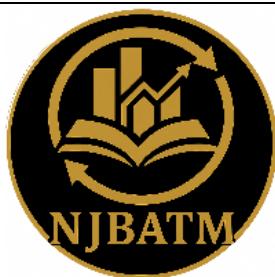
1. Introduction

Environmental degradation, climate change, and unsustainable resource consumption have emerged as defining challenges of the 21st century, prompting a critical shift in how organisations, particularly in high-impact sectors such as healthcare, approach their operational, ethical, and strategic responsibilities (Alsharari et al., 2024). Healthcare institutions—by virtue of their intensive energy use, material consumption, and waste generation—bear a significant environmental footprint (Downey, 2023). At the same time, they hold a moral obligation to protect public health not only through clinical services but also through environmental stewardship (Richie, 2024). This paradoxical role underscores the urgent need for more sustainable organisational practices at both institutional and individual levels (Collins & Demorest, 2022).

In response, scholars and practitioners, such as Ones et al. (2012), Davis and Challenger (2015), and Norton et al. (2015) have begun advocating for the integration of sustainability into employee behaviour—commonly conceptualised as green employee behaviour—which includes proactive learning, advocacy, personal action, and influence geared toward environmental responsibility within the workplace (Katz et al., 2022; Zacher et al., 2023). These behaviours are vital to organisational sustainability, yet they are often voluntary, informal, and situated within complex socio-cognitive and institutional dynamics (Robertson & Barling, 2012). Among the organisational antecedents of such behaviours, knowledge management (KM)—specifically knowledge application (Ka)—has been proposed as a potentially powerful enabler (Amir A. Abdulmuhsin, Abeer F. Alkhwaldi, et al., 2025), yet remains underexplored in empirical research.

Although prior studies have established the importance of knowledge sharing and knowledge creation in fostering environmental innovation and green HR practices (Abdul Rahim et al., 2023; Harakan et al., 2021; Jabbour & de Sousa Jabbour, 2016), few have investigated how the *application* of knowledge—where tacit and explicit knowledge are translated into action—shapes the day-to-day green behaviours of employees. Most extant work on Ka has focused on performance and innovation outcomes (e.g., ; Cong (2023); López-Torres et al. (2019); and Krara et al. (2025)), with minimal attention paid to its role in cultivating sustainable mindsets and behaviours among individuals in operational contexts. Moreover, the intersection of Ka and green behaviour remains particularly neglected in high-stakes service environments such as healthcare, where sustainability is not merely an ethical ideal but a clinical necessity (Gilcrease et al., 2024; Huss et al., 2020; Pinzone et al., 2012; Topcu & Kiraz, 2025).

Additionally, much of the current literature has been developed in Western or high-income contexts (Kim et al., 2014; Zhang & Chabay, 2020), leaving a significant gap in understanding how these dynamics unfold in developing countries where institutional pressures, resource constraints, and

sustainability awareness differ considerably. In countries such as Iraq—where the healthcare system faces chronic challenges linked to infrastructure, policy, and education—there is a pressing need to investigate how internal capabilities, such as knowledge utilisation, can drive low-cost, high-impact sustainability improvements at the employee level (Al Issa et al., 2022; Ibrahim et al., 2023).

This study therefore targets scholars of organisational behaviour, sustainability, and knowledge management, as well as healthcare leaders and policy-makers striving to operationalise sustainability in constrained environments. For this audience, understanding the mechanisms that drive green employee behaviour is not only academically valuable but strategically critical for meeting sustainable development goals (SDGs), improving institutional legitimacy, and enhancing public trust.

The purpose of this study is to examine the direct influence of Ka on green employee behaviours in the healthcare sector, with a focus on four key dimensions: green learning (GL), green voice (GV), individual practice (IP), and influence on others (IO). Drawing on theoretical perspectives from the knowledge-based view (KBV) of the firm and organisational learning theory, this research investigates how applied knowledge can activate and sustain pro-environmental conduct among healthcare professionals. By employing a two-wave survey of healthcare staff in Iraq, this study aims to provide empirical insights into an under-theorised mechanism with both local relevance and global implications. This paper is organised in seven main sections, introduction, theoretical background and hypothesis development, methodology, results, discussion, implications and future works.

2. Theoretical Background and Hypothesis Development

2.1 Green Employee Behaviour: Concept, Importance, and Application in Healthcare

In recent decades, the world has witnessed escalating environmental degradation driven by human activity, contributing to climate change, resource depletion, and the loss of biodiversity (Zacher et al., 2023). In response to these challenges, governments and organisations have adopted various initiatives aimed at achieving sustainable development (Yuan et al., 2023). Among these, the concept of *green employee behaviour* has emerged as a key strategy for fostering environmental alignment within workplace settings (Chaudhary, 2019).

Green employee behaviour refers to actions undertaken by individuals in the workplace—either as part of formal job responsibilities or stemming from personal initiative—that aim to reduce environmental impact and promote sustainability (Ones et al., 2012; Ones et al., 2018). These behaviours can range from simple acts such as switching off unused equipment and conserving paper to active participation in recycling programmes (Ashraf et al., 2023; Safari et al., 2018). While definitions of green employee behaviour vary across the literature, there is a shared emphasis on its role in supporting both organisational performance and broader environmental outcomes. Some

3

scholars conceptualise it as a form of voluntary (B. Zhang et al., 2021), environmentally responsible conduct (Wu et al., 2024); others highlight its measurable dimensions within the workplace (Bodhi et al., 2024; Zhang, 2024), or frame it as a core element of an organisation's sustainability culture (Cheng et al., 2022; Ozkan et al., 2024). Consequently, green employee behaviour is commonly categorised into two forms: (Ones et al., 2018)

- *Mandatory green behaviour*: Environmentally responsible actions required by the organisation as part of an employee's formal duties—such as prudent energy usage or adherence to waste reduction protocols (Chaudhary, 2019; Telli Danışmaz, 2023).
- *Voluntary green behaviour*: Environmentally conscious practices initiated by employees independently, such as proposing green innovations or promoting sustainable practices, absent any formal organisational obligation (Khalid et al., 2022; Zhang, 2024).

The healthcare sector is among the most environmentally impactful industries, due to its high energy consumption and substantial waste generation (Mandal & Pal, 2024). At the same time, healthcare professionals bear a profound responsibility, as their roles are intimately linked to both human and environmental health (Aslan & Yıldız, 2019; Ozkan et al., 2024). Thus, the integration of green employee behaviour in healthcare settings is of particular significance. Sustainable practices in this sector may include reducing medical waste, adopting electronic health records, optimising energy consumption, and utilising telemedicine to minimise the carbon footprint (El-Sayed et al., 2024; Pacis et al., 2018). Healthcare workers—including physicians, nurses, and technicians—often serve as role models within society (Ozkan et al., 2024). Their commitment to green practices can exert a positive influence on patients and the wider public, thereby fostering a culture of environmental responsibility (Lee & Lee, 2022). The importance of green employee behaviour can be delineated across four levels:

- *Environmental*: It mitigates pollution and emissions, and promotes the responsible use of natural resources (Kerse, 2024; Wang et al., 2024).
- *Organisational*: It enhances institutional performance, reduces operational costs, drives innovation, and strengthens competitive advantage (Mirahsani et al., 2023; B. Zhang et al., 2021).
- *Personal*: It improves employee satisfaction, supports psychological and professional wellbeing, and boosts intrinsic motivation and self-worth (Mi et al., 2020; Mirahsani et al., 2023).
- *Social*: It raises environmental awareness across communities and cultivates a broader culture of sustainability (Al Doghan & Zakariya, 2022).

In healthcare, the salience of green behaviour is amplified by the sector's environmental sensitivity and its impact on public health (Pan et al., 2022). Here, the adoption of such behaviours is not merely a strategic choice but an ethical imperative. Existing studies such as Francoeur et al. (2019), Fadel et al. (2021), Moustafa Saleh et al. (2024), B. Zhang et al. (2021), and Zhang et al. (2024) often rely on four key dimensions to assess green employee behaviour in healthcare institutions:

- *GL*: Refers to employees' acquisition of environmental knowledge and skills that enable them to make informed decisions contributing to sustainability (Alhemimah et al., 2024). This includes two subtypes: *explorative learning*, which involves generating innovative solutions, and *exploitative learning*, which optimises existing practices (Cui et al., 2022).
- *GV*: Encompasses employees' expression of environmentally oriented suggestions and opinions aimed at enhancing the organisation's environmental performance (Nourafkan et al., 2023; Tabrizi et al., 2023). This dimension plays a vital role in catalysing change and promoting more effective sustainable practices (Hosseini & Sabokro, 2022).
- *IP*: Involves self-initiated environmentally responsible actions, such as minimising electricity use or conserving materials (Mi et al., 2020; Taris & Wielenga-Meijer, 2010). While these behaviours may not be formally mandated, they nonetheless contribute meaningfully to environmental improvement (Zhang et al., 2024).
- *IO*: Reflects an employee's ability to positively affect colleagues through role-modelling or advice (Bourgeois et al., 2009; Pandey, 2022), thereby cultivating a workplace culture that supports green behaviour (Zhang et al., 2024).

Green employee behaviour constitutes a foundational pillar in organisational responses to environmental challenges and the pursuit of sustainable development goals. Its relevance is particularly pronounced in healthcare, where institutions must strike a delicate balance between delivering high-quality care and protecting the environment. Emphasising the four dimensions—learning, voice, individual practice, and influence—offers a holistic framework for fostering a green organisational culture that advances performance, safeguards the environment, and serves the broader community.

2.2 Knowledge Application: Concept and Importance

Ka constitutes a critical phase within the knowledge management cycle, as knowledge only becomes truly valuable when it is practically employed (Igbinovia & Ikenwe, 2018). Whether acquired or shared, knowledge fails to yield tangible impact unless it is utilised to address real-world challenges or enhance organisational performance (Al-Emran et al., 2018; Alharbi & Aloud, 2024). In this context, Ka refers to the process of transforming knowledge from its *explicit* form—documented and

codified—into *tacit* knowledge, embedded in individual behaviour or collective practice, through learning, experience, and action (Shujahat et al., 2019).

Ka is commonly defined as the effective utilisation of information and expertise within an organisation to support operations and inform decision-making, ultimately leading to improved products and services (Mahdi et al., 2019). This phase is indispensable for achieving competitive advantage and producing measurable outcomes, such as heightened efficiency, error reduction, and innovation in both products and organisational policies (Georgakellos et al., 2024). The strategic value of Ka lies in its capacity to:

- Improve the quality of decision-making by aligning knowledge with practical, real-time workplace contexts (Zhang et al., 2022).
- Stimulate innovation by leveraging prior knowledge to generate new ideas and creative solutions (Kiflie & Lo, 2024).
- Enhance competitiveness through greater agility in responding to change and reducing inefficiencies (Georgakellos et al., 2024).
- Drive the development of products and services, thereby enriching the customer or beneficiary experience (Nakash & Bolisani, 2024).
- Strengthen overall organisational performance by supporting the execution of daily operational processes (Abbas, 2020).

However, the process of applying knowledge is not without obstacles. It is often hindered by weak knowledge-sharing cultures, low levels of trust, inadequate technological infrastructure, or insufficient managerial support (Almansoori et al., 2021). These barriers underscore the importance of cultivating a supportive institutional environment to facilitate successful Ka. In healthcare organisations, Ka is particularly vital due to the complexity and sensitivity of the medical environment. Its importance can be observed across several dimensions:

- *Improved Quality of Care*: The application of clinical knowledge allows for more effective and safer treatment, ensuring better outcomes for patients (Ayatollahi & Zeraatkar, 2020).
- *Operational Efficiency*: Leveraging knowledge can reduce operational costs and minimise redundancies or procedural errors (Gesser da Costa et al., 2023).
- *Innovation in Service Delivery*: Knowledge sharing and application among healthcare professionals foster the development of advanced health services (Ayatulloh et al., 2021).
- *Health Promotion and Disease Prevention*: Applied knowledge underpins public health initiatives, such as screening programmes and health education campaigns aimed at reducing the incidence and impact of chronic diseases (Ayatollahi & Zeraatkar, 2020).

- *Empowerment of Healthcare Workers*: Ka enhances staff competence, equipping them with the skills to interpret data and apply evidence-based practices effectively (Kurniawan et al., 2019).

Healthcare institutions that systematically apply knowledge are better positioned to improve patient outcomes, boost satisfaction levels, and achieve superior organisational performance. Moreover, such institutions play a pivotal role in shaping broader public health policy and promoting sustainable development at the societal level.

2.3 Knowledge Application and Green Learning

Ka serves as a primary driver of GL, as it translates theoretical understanding into practical experience. Through engagement in hands-on activities, employees deepen their comprehension, acquire new competencies, and contribute meaningfully to their organisation's sustainability objectives. In the healthcare sector, fostering Ka not only facilitates the assimilation of green initiatives but also ensures their effective implementation. Furthermore, the repeated use of acquired knowledge in decision-making processes can yield measurable environmental improvements (B. Zhang et al., 2021). A shift towards GL reflects an institutional commitment to leveraging environmental knowledge for organisational development (Wang et al., 2020). Ka involves the internalisation and integration of acquired knowledge into the design and delivery of final outputs, thereby enhancing processes and overall performance (Shahzad et al., 2021). Within healthcare institutions, the application of sustainability-related knowledge is recognised as a critical tool enabling professionals to absorb and operationalise environmental insights, which, in turn, positively influences learning outcomes and advances sustainability goals (Nguyen et al., 2024).

This process encompasses several core elements, including organisational commitment, experiential learning, the use of applied expertise, information-driven approaches, and environmentally responsible dedication (Widyanti et al., 2023). Collectively, these elements empower healthcare organisations to refine their operations by introducing environmentally friendly practices and technologies that also support operational efficiency. By aligning with stakeholder interests, dynamic organisations integrate both existing and emergent knowledge into research and development activities, enabling them to deliver high-quality services while conserving vital resources (Sushruta Mishra, 2022). GL, as a construct, is centred on the acquisition and application of environmental knowledge and is widely regarded as a foundational capability that supports the development of environmental decision-support systems and the cultivation of sustainable innovation behaviour. Organisational GL ultimately aims to improve the quality of environmental knowledge transfer and

experience-sharing across the organisation (Wang et al., 2022). Based on the foregoing discussion, we propose the following hypothesis:

H1: Knowledge application has a direct positive effect on green learning.

2.4 Knowledge Application and Green Employee Voice

The application of environmental knowledge within healthcare—particularly regarding green practices and sustainability initiatives—plays a pivotal role in fostering green employee behaviour, and more specifically, in empowering *green employee voice*. This concept refers to the active use of accumulated environmental knowledge by individuals to support sustainable decision-making and operational practices within healthcare institutions. By applying such knowledge, healthcare professionals can overcome psychological barriers—such as misinformation, fear, or lack of awareness—that often impede meaningful environmental engagement. While knowledge alone may not guarantee environmentally responsible behaviour, its absence or distortion frequently leads to unsustainable decisions (Fawehinmi et al., 2020; Harakan et al., 2021). Effective Ka activates employees' positive environmental cognition, encouraging them to embrace innovative, well-informed solutions to ecological challenges. This empowerment strengthens employees' confidence in articulating their environmental ideas and initiatives, thereby motivating them to actively contribute to the improvement of institutional environmental performance. As a result, Ka fosters an organisational culture grounded in openness and constructive dialogue, in which green employee voice becomes a genuine force for advancing institutional sustainability goals (B. Zhang et al., 2021). Moreover, the application of environmental knowledge within healthcare settings can initiate a self-reinforcing cycle. When employees participate in sustainability efforts, their sense of responsibility and organisational belonging tends to deepen. This heightened sense of affiliation, in turn, enhances their motivation to express their views and propose green initiatives, thereby amplifying the effectiveness of their contributions to the institution's environmental objectives (Widiantari et al., 2024). Based on the above discussion, we propose the following hypothesis:

H2: Knowledge application has a direct positive effect on green employee voice.

2.5 Knowledge Application and Individual Practices

Ka significantly influences individual green practices within healthcare settings by converting theoretical insights into sustainable practical actions. This transformation facilitates the development of environmentally responsible behaviour at the individual level. When employees apply environmental knowledge effectively, it acts as a powerful green catalyst that encourages proactive engagement with green initiatives. It enables employees to reinforce their positive beliefs and attitudes

towards sustainable practices while diminishing negative perceptions (B. Zhang et al., 2021). To enhance individual green practices, healthcare institutions must apply already acquired knowledge—recognising that knowledge, skills, and practices form the foundation of organisational innovation (Shahzad, Qu, Zafar, Ding, et al., 2020). When such knowledge is translated into action, it becomes embedded in organisational behaviour, institutional memory, and the operational routines used to resolve complex problems. The long-term benefit of applying knowledge lies in its capacity to expand individual expertise and enable employees to evolve into domain experts over time (Kejzar et al., 2022). Ka, in essence, refers to the practical use of acquired knowledge in real-world contexts. In the healthcare domain, this involves the implementation of environmentally friendly practices to effectively navigate and address complex ecological challenges (Widyanti et al., 2023). For organisations striving to achieve sustainable development goals, applying absorbed knowledge in day-to-day operations is essential. The degree to which knowledge is internalised has a strong influence on the adoption and integration of sustainable organisational practices (Shahzad et al., 2021). Based on the above rationale, we propose the following hypothesis:

H3: Knowledge application has a direct positive effect on individual green practice.

2.6 Knowledge Application and Influence on Others

Ka plays a pivotal role in enhancing an individual's IO by offering tangible evidence of the benefits of green practices and reinforcing credibility through the practical enactment of sustainability knowledge. Healthcare professionals who effectively apply sustainable knowledge inspire their colleagues and contribute to fostering a culture of environmental responsibility. In healthcare, where teamwork and collaboration are vital, Ka ensures that individual efforts contribute to broader organisational transformation (Heeren et al., 2016). In collaborative work environments—characteristic of healthcare settings—the application of knowledge enables the translation of individual green actions into systemic institutional change. It empowers professionals to effectively demonstrate the outcomes of sustainable practices, thereby motivating others to emulate their behaviour and adopt similar environmentally conscious approaches (Shahzad, Qu, Zafar, Ding, et al., 2020). Furthermore, the green influence derived from Ka facilitates the transformation of negative behavioural patterns while promoting positive practices. It encourages the adoption of new, more sustainable behaviours and strengthens interpersonal relationships. This form of influence enhances organisational performance, boosts productivity, and fosters individual professional growth (Pandey, 2022). Ka also functions as a strategic process within organisations, whereby shared knowledge is mobilised to support various operations and functional areas. This, in turn, leads to improved decision-making and

yields concrete outcomes, such as enhanced quality in products and services (Alharbi & Aloud, 2024). Based on this conceptual foundation, we propose the following hypothesis:

H4: Knowledge application has a direct positive effect on influence on others.

3. Methodology

3.1 Data Collection

We employed a longitudinal research design with two waves of data collection (T1 and T2), spaced two months apart. Although no definitive theoretical guidelines currently exist regarding the optimal time intervals for studies in knowledge management and organisational behaviour (Griep et al., 2021), a time lag exceeding one month is generally considered sufficient to mitigate recall and anchoring biases (Taylor et al., 2009), while still short enough to preserve the relative stability of respondents' perceptions over a one- to two-month period (Bakker & Bal, 2010) (Bakker & Ba(Dormann & Griffin, 2015; Ng et al., 2013).

A key advantage of this repeated-measures design is its capacity to reduce potential threats arising from common method bias (Podsakoff et al., 2024). This design enables the estimation of effects across time; for instance, Ka in healthcare organisations was measured at T1, while green employee behaviours—namely GL, GV, IP, and IO—were measured at T2. This temporal separation allows for a more robust examination of causal relationships, rather than relying solely on cross-sectional data gathered at a single point in time. Additionally, it facilitates the inclusion of autoregressive effects to model change over time. Participants received a personalised email invitation containing a link to an online survey. They were asked to complete the survey within ten working days. Responses were treated as missing if participants failed to submit their answers within the allotted timeframe.

At the beginning of the survey, we included a screening question to identify whether respondents had engaged in any sustainability-related activities within their organisations over the past six months. Respondents who answered "No" to this filter question were excluded from the remainder of the study. To ensure conceptual clarity, we provided participants with definitions of both Ka and green employee behaviour, based on Alhemimah et al. (2024) Nourafkan et al. (2023), Pandey (2022), Taris and Wielenga-Meijer (2010), and Shujahat et al. (2019). Confidentiality was fully assured for all participants.

3.2 Study Sample

We contacted senior administrators from a diverse range of private hospitals in Baghdad, the capital of Iraq, following formal approval from the Iraqi Ministry of Health. Upon receiving their

consent to participate, we asked these administrators to forward a personalised email to their staff—including medical, nursing, service, administrative, and support personnel—inviting them to take part in the study. The email contained a link to the survey as well as explanatory information about the research. Participation was entirely voluntary, and no compensation was offered.

In total, 2,973 employees were contacted, of whom 2,335 completed the survey, resulting in a response rate of 78.54%. Among these, 1,663 respondents reported having applied their knowledge to perform sustainability-related activities within their respective domains over the previous six months (screening rate = 71.22%). The remaining 672 individuals who indicated no such engagement were excluded from further analysis.

Of the 1,663 respondents who reported engaging in sustainable and green practices at work, 48.9% were male and 51.2% were female. These proportions are comparable to national figures reported for Iraq's healthcare workforce, where 53.7% are male and 46.3% female according to the Iraqi central statistical organisation (in 2023)[1]. The average age of respondents was 39.92 years (SD = 10.49), aligning with the predominant age range (29–49 years) within the national healthcare labour force. Regarding educational attainment, 25.7% of respondents held a secondary or vocational qualification, 13.0% held a postgraduate degree, and 61.3% held an undergraduate degree. This reflects the education profile typically required by private hospitals in Iraq, where primary service delivery is generally entrusted to bachelor's degree holders, supported by specialised and vocational qualifications. On average, respondents had been employed by their current organisation for 5.6 years (SD = 6.2), suggesting familiarity with the evolution of Iraq's sustainable development initiatives, which were launched nearly a decade ago.

To assess the statistical power of our regression analysis, we conducted a Monte Carlo simulation based on a set of methodological assumptions (Griep et al., 2025). We assumed a standard error of 0.10 for each standardised beta coefficient, a unique variance of 1.0 for each independent variable, and a significance threshold of $\alpha = 0.05$. The simulation aimed to estimate the statistical power required to detect direct effects (Standardised Betas) across five effect sizes (0.1, 0.2, 0.3, 0.4, 0.5) and five different sample sizes (n = 50, 100, 200, 300, 500). For each ($\beta \times n$) combination, 5,000 replications were run, generating estimates of the coefficients and testing their statistical significance. The results revealed low statistical power for small effect sizes, even at larger sample sizes. However, for medium effects ($\beta = 0.3$), power exceeded 85% across all sample sizes and approached 100% for large effects ($\beta = 0.5$). These findings confirm that the actual sample size used in this study (n = 1,663) is more than adequate for detecting statistically significant medium to large effects.

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[1] https://mop.gov.iq/en/central-statistical-organization

3.3 Measures

Data for this study were collected using a structured questionnaire developed based on validated scales drawn from prior literature. The items were translated from English into Arabic in a manner that ensured alignment with the local cultural context (Amir A. Abdulmuhsin, Haitham O. Owain, Abdulkareem H. Dbesan, Mohd Abass Bhat, et al., 2025). All constructs were measured using a five-point Likert scale, ranging from (1) "Strongly disagree" to (5) "Strongly agree". To ensure content validity, the questionnaire was reviewed by a panel of nine academic experts specialising in knowledge management and organisational behaviour (Amir A. Abdulmuhsin, Marco Valeri, et al., 2025). The questionnaire was organised into two main sections. The first section included demographic information and the independent variable, measured at Time 1 (T1), as follows:

- *Knowledge Application (Ka)*, the independent variable, was measured using a four-item scale adapted from previous studies, such as Alharbi and Aloud (2024), Maraqa (2019), and Yu et al. (2022). Participants were asked to assess the extent to which their organisation applies knowledge management practices, such as encouraging innovation and the exchange of new ideas, using a five-point Likert scale ($\alpha = 0.956$).

The second section covered the dependent variables, which were assessed at Time 2 (T2) and represented the four dimensions of green employee behaviour:

- *Green Learning (GL)* was measured using four items adapted from the studies of B. Zhang et al. (2021) and Zhang et al. (2024). Sample items included statements such as, "I actively seek knowledge about environmental practices at work," rated on a five-point Likert scale ($\alpha = 0.944$).
- *Green Voice (GV)* was assessed using a four-item scale adopted from Ari et al. (2020) and B. Zhang et al. (2021), capturing participants' willingness to speak up and propose environmental ideas within their organisation ($\alpha = 0.941$).
- *Individual Practice (IP)* was measured through four items adapted from Xu et al. (2022), such as, "I personally reduce environmental resource use in my daily work," also rated using a five-point Likert scale ($\alpha = 0.958$).
- *Influence on Others (IO)* was evaluated using a four-item scale developed by Zhang et al. (2024). Participants rated the extent to which they encourage colleagues to act in environmentally responsible ways ($\alpha = 0.936$).

All items related to green employee behaviour were rated on the same five-point Likert scale, from (1) "Strongly disagree" to (5) "Strongly agree". The internal consistency of each scale was

confirmed through Cronbach's alpha coefficients, all of which exceeded the generally accepted threshold of α > 0.70 for social science research (A. A. Abdulmuhsin et al., 2025).

3.4 Statistical Analysis

To test the proposed theoretical model and research hypotheses, Partial Least Squares Structural Equation Modelling (PLS-SEM) was employed using SmartPLS version 3.9. PLS-SEM is a widely adopted technique in studies aiming to predict relationships among variables and estimate both simple and complex models involving latent constructs (Rehman et al., 2025). It is particularly well-suited to exploratory research, models with a moderate number of indicators, those involving mediation or moderation effects, and situations where the assumption of multivariate normality is not met (Hair et al., 2021).

The PLS-SEM analysis was conducted in two primary stages:

- *Measurement Model Evaluation*: The reliability and validity of the constructs were assessed through convergent validity—using Average Variance Extracted (AVE)—and internal consistency reliability, using both Composite Reliability (CR) and Cronbach's Alpha (Alkhwaldi et al., 2025). Discriminant validity was examined using the Fornell–Larcker Criterion and the Heterotrait–Monotrait Ratio (HTMT) (Amir A. Abdulmuhsin, Haitham O. Owain, Abdulkareem H. Dbesan, Abeer F. Alkhwaldi, et al., 2025). The thresholds applied followed established methodological standards: AVE ≥ 0.50, CR ≥ 0.70, and HTMT < 0.90.

- *Structural Model Evaluation*: Once the quality of the measurement model was confirmed, causal relationships among the constructs were assessed using a bootstrapping procedure with 5,000 resamples (Bhat et al., 2025). This allowed for the estimation of path coefficients and the evaluation of their statistical significance. Model explanatory power was examined using the coefficient of determination (R^2), while predictive relevance was assessed using the cross-validated redundancy index (Q^2), providing an indication of the model's predictive validity for the dependent variables (Alshaher et al., 2022).

A significance level of α = 0.05 was used as the criterion for hypothesis acceptance or rejection (Abdulmuhsin & Ali, 2022). The application of SmartPLS was deemed appropriate for this study given the multivariate and complex nature of the research model, as well as the study's predictive orientation.

4. Results

This section presents the findings derived from the PLS-SEM analysis, addressing the psychometric properties of the measurement model and evaluating the structural model to test the proposed hypotheses. The reliability and validity of the constructs were first assessed to ensure robustness in the measurement model. As shown in *Table 1*, all constructs demonstrated strong internal consistency, with Cronbach's alpha (α) values ranging from 0.936 to 0.958, and Composite Reliability (CR) values between 0.954 and 0.970—both exceeding the recommended threshold of 0.70 (Hair et al., 2019). Convergent validity was confirmed, with all constructs exhibiting Average Variance Extracted (AVE) values well above the 0.50 cut-off, ranging from 0.839 to 0.889.

Table 1. Correlation analysis.

Constructs	M (SD)	Kurtosis (Skewness)	1	2	3	4	5
1. Ka	3.560 -1.390	-0.450 (-1.000)	1				
2. GL	2.908 -0.570	0.107 (-0.013)	0.399	1			
3. GV	2.915 -0.582	0.013 -0.080	0.398	0.698	1		
4. IP	2.992 -0.589	0.278 -0.002	0.439	0.753	0.699	1	
5. IO	2.975 -0.596	0.087 -0.047	0.390	0.703	0.704	0.723	1
Cronbach's alpha (α)			0.956	0.944	0.941	0.958	0.936
Composite Reliability (CR)			0.968	0.960	0.958	0.970	0.954
Average Variance Extracted (AVE)			0.882	0.857	0.850	0.889	0.839

*Notes: N=1663, **P<0.001, M=Mean, SD=Standard Deviation.*
Source: Authors' own work

To assess discriminant validity, both the Fornell–Larcker criterion and the Heterotrait–Monotrait ratio (HTMT) were applied. As presented in *Table 2*, the square root of the AVE (bold diagonal values) for each construct exceeded its inter-construct correlations, confirming the Fornell–Larcker condition. In addition, all HTMT values remained below the conservative threshold of 0.90, further establishing discriminant validity.

Once the adequacy of the measurement model was established, the structural model was evaluated to test the hypothesised relationships between Ka and the four dimensions of green employee behaviour. Bootstrapping with 5,000 subsamples was employed to estimate the path coefficients, t-

statistics, and effect sizes. As shown in *Table 3* and visualised in *Figure 1*, all four hypotheses were supported:

- *H1: Ka had a significant positive effect on GL (β = 0.399, t = 18.962, p < 0.001), with a moderate effect size (f^2 = 0.189), and acceptable predictive power (Q^2 = 0.158; R^2 = 0.159).*
- *H2: Ka significantly influenced GV (β = 0.398, t = 18.609, p < 0.001), with a comparable effect size (f^2 = 0.188), and explanatory power (Q^2 = 0.157; R^2 = 0.158).*
- *H3: A stronger effect was observed on individual green practice (β = 0.439, t = 21.288, p < 0.001), yielding the largest effect size (f^2 = 0.239), and explaining the highest variance among the four behaviours (Q^2 = 0.192; R^2 = 0.193).*
- *H4: Ka also significantly predicted IO (β = 0.390, t = 18.808, p < 0.001), with an effect size of f^2 = 0.179 and predictive indicators (Q^2 = 0.151; R^2 = 0.152).*

Table 2. Constructs' Discriminant validity.

Constructs	GL	GV	IO	IP	Ka
GL	**0.926**	*0.740*	*0.748*	*0.791*	*0.419*
GV	0.698	**0.922**	*0.750*	*0.736*	*0.419*
IO	0.703	0.704	**0.916**	*0.763*	*0.412*
IP	0.753	0.699	0.723	**0.943**	*0.459*
Ka	0.399	0.398	0.390	0.439	**0.939**

*Notes: **Bold number**= √AVE, Italic number=HTMT*
***Source:** Authors' own work*

Table 3. The path analysis of the study model

Relationships	β	SD	T Statistics	P Values	F²	Q²; R²	Results?
H1: Ka → GL	0.399	0.021	18.962	0.000	0.189	0.158; 0.159	*Accept*
H2: Ka → GV	0.398	0.021	18.609	0.000	0.188	0.157; 0.158	*Accept*
H3: Ka → IP	0.439	0.021	21.288	0.000	0.239	0.192; 0.193	*Accept*
H4: Ka → IO	0.390	0.021	18.808	0.000	0.179	0.151; 0.152	*Accept*

Note: *β = Standard regression, SD = Standard Deviation.*
   **NFI = 0.947, SRMR = 0.022**

***Source:** Authors' own work*

Model fit indices further supported the adequacy of the structural model, with a Standardised Root Mean Square Residual (SRMR) of 0.022 and Normed Fit Index (NFI) of 0.947, both indicating excellent model fit (Hair et al., 2020). The results provide strong empirical support for all proposed

hypotheses. Ka emerged as a significant and consistent predictor across all four dimensions of green employee behaviour—GL, GV, IP, and IO—thus affirming its pivotal role in shaping environmentally responsible workplace conduct within healthcare institutions.

Figure 1. The structural model of the study
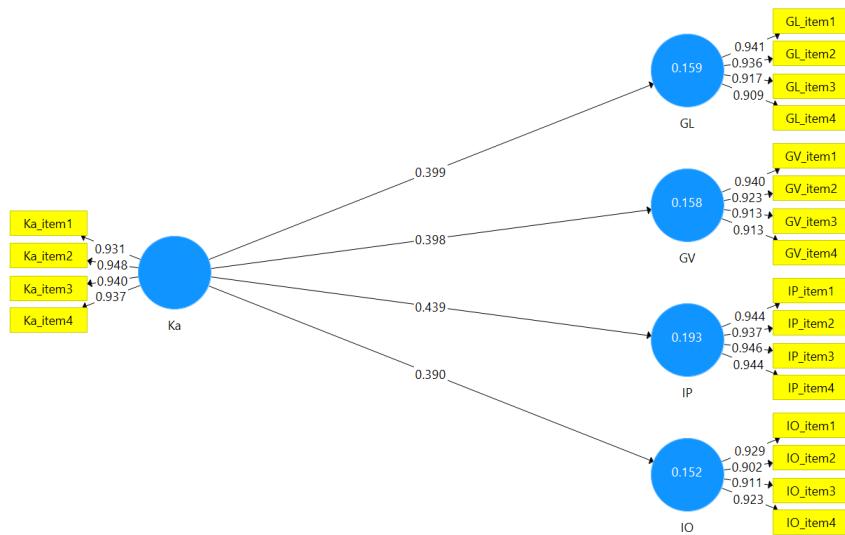
5. Discussion

The present study set out to examine the impact of Ka on four distinct dimensions of green employee behaviour—namely, green learning (GL), green voice (GV), individual green practice (IP), and influence on others (IO)—within the healthcare sector in Iraq. Grounded in contemporary perspectives from knowledge management and organisational sustainability literature, the findings offer robust empirical validation for the proposed hypotheses and provide several important theoretical and practical implications.

The results reinforce the theoretical argument that Ka is not merely a concluding step in the knowledge management cycle, but a strategic enabler of behavioural change (Alharbi & Aloud, 2024; Shahzad et al., 2021). Consistent with our expectations, Ka was found to have a significant and positive effect on all four green behavioural dimensions, confirming Hypotheses H1 to H4.

The positive relationship between Ka and GL supports the conceptualisation of Ka as a mechanism for experiential and transformative learning. Theoretically, this aligns with the view that GL involves not only the acquisition of environmental knowledge but also its integration into practice through reflection, experimentation, and feedback (Nguyen et al., 2024; Wang et al., 2020). Our results suggest that healthcare professionals who actively apply their knowledge are more likely to develop

16

deeper environmental insights and adaptive green capabilities—whether through explorative efforts that generate innovative ideas or exploitative learning that enhances existing procedures.

The positive effect of Ka on GV corroborates the idea that applied knowledge increases employee confidence and perceived efficacy in suggesting sustainable improvements. This supports Fawehinmi et al. (2020) and W. Zhang et al. (2021), who assert that the internalisation of environmental knowledge strengthens employees' willingness to speak up, thereby fostering a psychologically safe climate for constructive dialogue around green initiatives. The findings imply that when healthcare workers are equipped with usable, practice-based environmental knowledge, they are more inclined to contribute ideas and advocate for systemic change within their institutions.

Among all hypothesised paths, the strongest effect was observed between Ka and individual green practice. This validates the assertion that applied knowledge transforms into habitual, self-directed action (Kejzar et al., 2022; Xu et al., 2022). In the healthcare context, where environmental sustainability is increasingly critical, staff who routinely apply knowledge are more capable of embedding green behaviours into their daily routines—such as minimising waste, conserving energy, or optimising the use of medical resources. These micro-level behaviours, although often informal, have been shown to contribute meaningfully to organisational sustainability goals.

The significant relationship between Ka and IO underscores the social and normative aspects of environmental behaviour. Employees who demonstrate competence and commitment in applying sustainable knowledge often serve as role models, encouraging others to follow suit (Pandey, 2022; Shahzad, Qu, Zafar, Rehman, et al., 2020). This peer influence fosters the diffusion of green practices throughout the organisation, shaping a collective environmental identity and reinforcing sustainability as a shared organisational value. In line with (Heeren et al., 2016), our results suggest that healthcare professionals can exert substantial informal influence through knowledge-based demonstration and encouragement.

These results collectively affirm the central theoretical proposition that Ka functions as a behavioural bridge between cognitive resources and sustainable action. As posited in our conceptual model, Ka serves as a proximal driver that activates individual intentions and capabilities into tangible environmental outcomes. The four dimensions of green employee behaviour examined in this study—learning, voice, practice, and influence—reflect both internal (cognitive-motivational) and external (social-institutional) manifestations of sustainability engagement, all of which are rooted in the strategic application of knowledge.

This study also resonates with organisational learning theory, particularly the notion that learning is an embedded, continuous process shaped by the application and contextualisation of knowledge. Furthermore, from the lens of knowledge-based theory, the findings highlight the strategic

17

value of knowledge as a renewable and actionable asset capable of influencing both individual behaviour and organisational culture.

6. Conclusion

This study makes several important contributions to both the theoretical development and practical implementation of knowledge management and sustainability practices in healthcare institutions. By empirically examining the influence of Ka on green employee behaviours—GL, GV, IP, and IO—this research addresses significant gaps in the intersection of knowledge management, organisational behaviour, and environmental sustainability.

6.1 Theoretical Implications

First, the study advances the theoretical understanding of Ka as a critical antecedent of pro-environmental behaviour in organisational settings. While much of the extant literature has focused on knowledge creation and sharing, relatively little attention has been paid to the transformative role of Ka in shaping behavioural outcomes. By validating its effect across four dimensions of green employee behaviour, the study provides a more nuanced view of how applied knowledge functions not only as a cognitive asset but also as a behavioural driver. Second, the study contributes to the broader organisational sustainability literature by proposing and empirically testing a multidimensional framework of green employee behaviour. This framework reflects both individual and relational dimensions—ranging from internalised practices (learning and individual action) to externalised influence (voice and social impact). The integration of these dimensions with Ka provides a holistic model that bridges cognitive processes with sustainability engagement, responding to calls for more comprehensive behavioural models in sustainability research.

Third, from a knowledge-based view (KBV) of the firm, the findings offer evidence that knowledge, when effectively applied, can yield not only economic but also environmental value. This aligns with the view that intellectual capital—particularly in knowledge-intensive sectors such as healthcare—can be leveraged to advance strategic sustainability goals. Moreover, the results support principles from organisational learning theory, in that learning is most impactful when derived from experiential, applied engagement with environmental knowledge, rather than passive absorption alone. Finally, the study enriches the understanding of green organisational behaviour in developing country contexts, particularly within healthcare systems. By focusing on Iraq, a setting often underrepresented in sustainability and KM research, the findings contribute to the growing recognition of how contextual and cultural factors shape knowledge enactment and behavioural transformation.

18

6.2 Practical Implications

From a managerial standpoint, the findings offer actionable insights for healthcare administrators, policy-makers, and sustainability practitioners:

- *Embedding Ka in Sustainability Training*: Institutions should prioritise applied learning opportunities that encourage healthcare professionals to operationalise environmental knowledge. This may include green simulations, case-based learning, and problem-solving workshops that go beyond theoretical instruction.

- *Fostering a Culture of GV*: Encouraging open dialogue and idea-sharing around sustainability practices can empower staff to voice suggestions and co-create green innovations. Managers can implement idea submission platforms, green suggestion schemes, or cross-functional sustainability committees to institutionalise GV.

- *Supporting Individual Green Practices through Enablers*: Access to relevant technologies, environmental guidelines, and personal accountability mechanisms (e.g., self-monitoring tools, eco-feedback systems) can help translate knowledge into consistent, voluntary green behaviours.

- *Amplifying Positive Peer Influence*: Recognising and showcasing employees who model green behaviours can foster a ripple effect, encouraging others to adopt similar practices. Green leadership programmes, peer mentorship, and storytelling of sustainability successes can be particularly effective in this regard.

- *Linking Ka to Organisational KPIs*: Institutions should incorporate sustainability-related Ka into performance evaluation and reward systems. This alignment reinforces the strategic importance of green behaviour and its role in service quality and institutional reputation.

Thus, healthcare organisations that strategically invest in mechanisms to apply and operationalise knowledge will be better equipped to cultivate an environmentally conscious workforce, enhance institutional resilience, and contribute to national and global sustainability targets.

7. Limitations and Future Research Directions

Despite the theoretical and empirical contributions of this study, several limitations must be acknowledged, each of which offers promising avenues for future research. First, the study's data were collected from private healthcare institutions in a single geographic context—Baghdad, Iraq. While this context is both timely and underexplored, the findings may not be fully generalisable to other regions, cultures, or institutional settings. Organisational dynamics, leadership practices, and environmental norms may differ significantly across national and sectoral boundaries. Second,

although a two-wave longitudinal design was employed to strengthen causal inference and reduce common method bias, causality cannot be definitively established due to the observational nature of the study. Additional experimental or time-lagged designs involving three or more measurement points would further clarify the temporal relationships among constructs. Third, the study relied on self-reported data, which may be subject to social desirability or cognitive bias. While confidentiality was assured and a screening filter was used to enhance response validity, objective behavioural measures or supervisor ratings could add rigour to future investigations. Fourth, the study focused exclusively on Ka as the antecedent of green behaviour. While this choice aligns with our theoretical model, other knowledge processes—such as knowledge retention, knowledge integration, or absorptive capacity—may also play crucial roles in influencing sustainable workplace behaviours and deserve further exploration.

To build upon these findings, future research could consider several extensions:

- *Cross-Cultural Comparative Studies*: Investigating how the relationship between Ka and green behaviours unfolds in different national or institutional contexts (e.g., public vs. private hospitals, emerging vs. developed economies) would deepen the understanding of cultural and structural contingencies.

- *Moderators and Mediators*: Exploring potential moderators (e.g., organisational climate, leadership style, psychological empowerment) or mediators (e.g., environmental commitment, green identity, eco-centric motivation) could reveal the underlying mechanisms that amplify or buffer the effects of Ka.

- *Mixed Methods Designs*: Future studies may benefit from combining quantitative approaches with qualitative techniques—such as interviews or ethnographic observations—to gain deeper insight into how knowledge is enacted in real-time workplace practices.

- *Broader Sectoral Applications*: Extending the current model to other environmentally impactful sectors—such as manufacturing, logistics, or education—could help generalise the findings and generate sector-specific interventions.

- *Long-Term Impact and Organisational Outcomes*: Future research could examine how knowledge-driven green behaviours accumulate over time to influence broader organisational outcomes such as innovation performance, resource efficiency, institutional reputation, or patient satisfaction.

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Data availability

The datasets analysed during the current study are available from the corresponding author on reasonable request.

Appendix A. Study Questionnaire Items

T1 – Independent Variable

Knowledge Application (Ka): Alharbi and Aloud (2024), Maraqa (2019), and Yu et al. (2022).

"KA1. Our organisation encourages employees to use acquired knowledge to improve work performance. KA2. Employees in our hospital apply their knowledge to solve sustainability-related problems. KA3. We regularly implement new ideas and insights generated from past experiences. KA4. Our teams are encouraged to convert shared knowledge into green initiatives."

T2 – Dependent Variables (Green Employee Behaviours)

Green Learning (GL): B. Zhang et al. (2021) and Zhang et al. (2024).

"GL1. I seek knowledge about environmental practices related to my work. GL2. I learn how to reduce environmental impact in my workplace. GL3. I improve my work habits by acquiring green knowledge. GL4. I try to enhance my environmental understanding through workplace learning."

Green Voice (GV): Ari et al. (2020) and B. Zhang et al. (2021).

"GV1. I express my environmental concerns in the workplace. GV2. I suggest environmentally friendly solutions to improve operations. GV3. I openly share ideas for reducing the environmental footprint of our organisation. GV4. I speak up when I notice unsustainable practices."

Individual Practice (IP): Xu et al. (2022).

"IP1. I personally take steps to minimise the use of resources at work. IP2. I avoid unnecessary waste in my daily tasks. IP3. I proactively reduce energy consumption in my department. IP4. I adopt eco-friendly behaviours even when not formally required."

Influence on Others (IO): (Zhang et al., 2024).

"IO1. I encourage my colleagues to adopt environmentally friendly practices. IO2. I serve as a role model for green behaviour in my organisation. IO3. I share my environmental knowledge to support others' actions. IO4. I positively influence team members to act in sustainable ways."

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