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Enhancing Digital Transformation and Green HRM through Human-AI Collaboration: A Supply Chain-Inspired Framework for Institutional Quality Support in Community Colleges of Bagmati Province, Nepal

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Abstract
This study explores how human–AI collaboration moderates the relationship between digital transformation and Green Human Resource Management (Green HRM) within Nepal's community colleges. Bridging digital and green HRM frameworks, it introduces a supply chain–inspired lens to examine service delivery and sustainability in public higher education.

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Guided by Resource-Based View (RBV) and Socio-Technical Systems Theory, the research applies a mixed-methods design combining Structural Equation Modeling (SEM) with fuzzy-set Qualitative Comparative Analysis (fsQCA) on data from 285 staff members across five Tribhuvan University–affiliated community colleges in Bagmati Province.SEM results confirm that digital transformation significantly enhances Green HRM ($\beta = 0.48$, $p < 0.001$), and this relationship is strengthened by effective human–AI collaboration (interaction $\beta = 0.25$, $p < 0.001$). fsQCA identifies two equifinal pathways to high Green HRM: (1) Tech + AI Synergy (high digitalization and high human–AI collaboration), and (2) Tech-Driven Path (high digitalization alone). These findings reveal that while AI augmentation enhances green outcomes, foundational digital infrastructure alone can also yield substantial sustainability gains. Theoretically, this is one of the first empirical studies to integrate digital transformation, Green HRM, and human–AI collaboration within a developing country education system, extending supply chain models from corporate to academic contexts. Practically, it provides actionable insights for Internal Quality Assurance Cells (IQACs) to align digital and green agendas and suggests that policy bodies like UGC and MoEST should embed AI-readiness and sustainability metrics into accreditation frameworks. The study underscores the importance of socio-technical alignment in enabling sustainable, tech-enabled institutional quality in Nepal's higher education landscape.

Keywords: digital transformation; Green HRM; Human–AI collaboration; Supply chain management; Higher education; Quality assurance; Nepal

Introduction

Companies all around are rapidly embracing digital transformation to streamline procedures and foster innovation. Digital transformation is the integration of sophisticated digital technologies e.g., cloud computing, data analytics, artificial intelligence into business processes, therefore changing how value is produced and services are supplied (Verhoef et al., 2021). Simultaneously, more focus is being placed on Green Human Resource Management (Green HRM), or the alignment of HR policies and practices with environmental sustainability objectives (Ren et al., 2020). Green HRM includes projects like paperless workflows, virtual training and meetings, eco-friendly workplace rules, and employee participation in environmental programs (Jabbour & de Sousa Jabbour, 2016; Ren et al., 2020).

The transformative power of artificial intelligence (AI) is redefining organizational landscapes globally, especially in the realms of digital transformation and human resource management. Human-AI collaboration—the synergistic partnership between human capabilities and intelligent systems has become a strategic driver for enhancing operational efficiency, decision-making precision, and innovation in supply chain management (SCM) (Gautam, 2022). This convergence has not only enabled the digitization of traditional workflows but has also given rise to Green HRM, promoting environmentally sustainable practices through the optimization of resource allocation, energy use, and waste reduction (Gautam & Sharma, 2018).

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In Nepal's context, particularly within the community colleges of Bagmati Province, the implications of these global trends are beginning to resonate. As these institutions seek to modernize their administrative and educational frameworks, the integration of AI into institutional processes, including supply chains, offers a promising pathway to elevate both quality and accountability. However, as existing studies have noted, the effectiveness of HRM practices in Nepalese institutions remains modest accounting for only 16% to 30% of organizational performance outcomes in sectors such as pharmaceuticals due to fragmented implementation and limited technological adaptation (Gautam & Sharma, 2018).

Digital transformation, facilitated by AI, empowers educational institutions to automate data processing, personalize learning, and improve operational agility. Meanwhile, Green HRM practices including digital recruitment, paperless workflows, and sustainability training support institutional goals related to both quality assurance and environmental responsibility (Gautam, 2022). These innovations are crucial not just for performance enhancement, but for meeting stakeholder expectations concerning transparency, environmental consciousness, and long-term institutional resilience.

Moreover, studies have emphasized that customer satisfaction closely tied to organizational service delivery and responsiveness—can be significantly influenced by digital usability, privacy, and quality of service (Gautam et al., 2024). In the educational domain, this reflects how digitized academic services and AI-enabled communication channels shape stakeholder satisfaction and perception of institutional quality.

This study, therefore, explores how Human-AI collaboration when strategically implemented within the HR and SCM practices of community colleges—can foster digital transformation and environmentally sustainable outcomes. It further investigates the implications for Institutional Quality Support Systems (IQSS), which are vital for maintaining and enhancing educational standards, accountability, and stakeholder engagement in Nepalese higher education institutions.

In operations and supply chain management, the convergence of digital innovation with sustainability is particularly relevant. Digital transformation has been proved by prior corporate studies to support more sustainable supply chain strategies. Implementing business digital technologies, for instance, can help Green HRM goals by lowering paper consumption and waste, improving resource tracking, and enabling remote collaboration. Much of the current studies, nevertheless, have concentrated on private sector companies and technology businesses. Particularly in poorer nations, there is little knowledge of how these ideas apply to the higher education industry. Educational institutions such community colleges run a network of processes, resources, and stakeholders that can be compared to a service supply chain (Gautam et al., 2024). Using supply chain management ideas in educational setting suggests looking for efficiency, quality, and sustainability in the flow of educational services. Part of a national effort toward academic digitization, community colleges in Nepal are starting to use digital technologies including Learning administration Systems, e-attendance, campus administration software. These digital projects could one day increase operational efficiency and promote environmental sustainability at the same time by, perhaps, lowering paper use via electronic record-keeping. Still, the part of human-AI cooperation in this field is under-studied.

Despite the global push toward digital transformation and Green Human Resource Management (Green HRM), empirical evidence from education systems in developing countries particularly public community colleges—remains scarce. Studies in the Global South have documented key structural barriers, including digital divides, policy misalignments, and limited institutional readiness for artificial intelligence (AI) integration (Pham, Tučková, & Jabbour, 2020; Bai & Sarkis, 2020). In the South Asian context, Ren et al. (2020) report that digital infrastructure is often underutilized due to low levels of staff engagement and training, while Green HRM tends to receive minimal attention outside of the private sector.

Although substantial research has linked digitalization and Green HRM in corporate environments, their combined application in public education institutions is under-theorized and empirically understudied (Jarrahi, 2018; Raisch & Krakowski, 2021). Notably, the moderating role of human–AI collaboration conceptualized as the strategic interplay between human judgment and AI-enabled systems has not been empirically explored in the context of higher education institutions in developing countries. This represents a critical gap, particularly as many community colleges in countries like Nepal face dual pressures to modernize through digital mandates and to align with sustainability-focused quality assurance frameworks (World Bank, 2021; Gautam & Sharma, 2018). This study aims to fill this gap by examining how digital transformation and human–AI collaboration jointly influences the implementation of Green HRM practices in Nepal's public community colleges

The Statement of the Problem

As part of more general educational reforms, community colleges in Nepal are under pressure to enhance their technical skills as well as their environmental sustainability policies (World Bank, 2021). Colleges are urged by the Ministry of Education and the University Grants Commission (UGC) to implement digital infrastructure—for example, campus networking and online library systems and to fit with Sustainable Development Goals (such as quality education and climate action). Many universities find it difficult to properly carry out digital transformation despite these efforts in a manner that also produces green results. One of the main difficulties is making sure staff members accept new technologies and include them into their everyday routines; this integration calls for efficient human–technology partnership. Digital tools' possible to help Green HRM (such reducing resource waste) might not be realized if they are used without staff involvement or training. On the other hand, promoting sustainability policies without using digital tools or artificial intelligence insights can result in missed chances for innovation and efficiency. The difference between technology adoption and sustainable HR practice execution is a major concern. In particular, how can human–AI cooperation assist close the gap between digital transformation initiatives and the successful application of Green HRM practices in educational institutions? Community colleges trying to improve their operational quality and satisfy accreditation criteria in Nepal must handle this issue.

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To address this gap, our study is guided by the following key research questions (RQs):

RQ1: Does digital transformation positively influence the implementation of Green HRM practices in community colleges of Bagmati Province?

RQ2: Does human–AI collaboration moderate (i.e., strengthen) the relationship between digital transformation and Green HRM implementation?

RQ3: Are there multiple, equifinal combinations of conditions (e.g., levels of digital transformation and AI collaboration) that can lead to high Green HRM outcomes in these colleges?

Examining these problems assists us expand the knowledge of digital and sustainable HR initiatives into the domain of higher education management.

Research Objectives

Consistent with the preceding questions, the objectives of this study along with associated hypotheses are as follows:

Objective 1: To examine the effect of digital transformation on Green HRM implementation in Nepali community colleges.

Hypothesis H1: Digital transformation positively influences Green HRM implementation in community college operations.

Objective 2: To evaluate whether human–AI collaboration moderates the impact of digital transformation on Green HRM.

Hypothesis H2: Human–AI collaborative interaction positively moderates the relationship between digital transformation and Green HRM, such that the effect is stronger when human–AI collaboration is high.

Objective 3: To identify multiple pathways (configurations of conditions) that lead to high levels of Green HRM practice adoption. (Exploratory, addressed via fsQCA analysis rather than a priori hypothesis.)

These objectives corresponded to the framework of Cui (2025), who examined a comparable model in a Chinese business supply chain context, to the context of Nepali higher education. Fulfilling these objectives will help the study to provide theoretical insights (by extending current models to a new area) as well as practical advice for improving institutional quality.

The Review of Literature

Digital Transformation in Organizational and Educational Contexts

Digital evolution is a whole process of using current digital technologies to actually improve organizational performance (Verhoef et al., 2021). It includes cultural and procedural improvements that fully use technology including artificial intelligence (AI), big data analytics, cloud computing, and Internet of Things going beyond mere IT adoption. In supply chain management, digital transformation has been linked with greater agility, transparency, and sustainability. For example, block chain and big data analytics can improve traceability and optimization in supply chains, thereby supporting sustainable operations (Bai & Sarkis, 2020; Queiroz et al., 2020). Industry 4.0 technologies provide real-time monitoring of resource use

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by means of predictive management of supply chain processes, therefore lowering waste and inefficiency.

Digital transformation in education manifests itself as the use of e-learning platforms, digitalization of administrative processes, online student information systems, and artificial intelligence-driven instructional tools. Nepal's higher education sector has acknowledged the need of digital change, particularly in light of the COVID-19 epidemic, which "accelerated the digital transformation of higher education in Nepal." Community colleges have been embracing digital library resources, cloud-based record systems, and Learning Management Systems to increase access and efficiency. This shift is expected to improve not just the delivery of education but also the operational sustainability of campus (World Bank, 2021). For instance, digital document management and communication can help to lower paper use in line with environmental initiatives.

Notwithstanding these trends, successful digital transformation depends on human elements—leadership support, staff digital skills, and an organizational culture open to change—not merely on technology deployment. Many professors and administrators at educational institutions must adapt to new digital procedures. Thus, the concept of human-technology interaction is vitally vital. Especially, the evolving idea of human–AI collaboration suggests that combining human judgment with artificial intelligence capabilities could yield superior outcomes than either one alone (Daugherty & Wilson, 2018). We elaborate on this in a later subsection.

Green HRM and Sustainable Practices in Organizations

Green Human Resource Management is the application of environmental management ideas into HRM procedures meant to encourage sustainable resource use and eco-friendly behaviors among staff members (Ren et al., 2020). Among the main Green HRM practices are "paperless" offices (using electronic files in place of paper), virtual HR processes (teleconferencing, e-training, virtual interviews), encouragement of employees' environmental projects, recycling and waste reduction initiatives, and inclusion of environmental criteria in performance evaluations and rewards (Jabbour & de Sousa Jabbour, 2016; Pham et al., 2020). The basic concept is that HRM may be essential in promoting a culture of sustainability by employing environmentally conscious people, teaching them on green practices, and inspiring them via green awards or recognition.

Studies have indicated that Green HRM can produce favorable results like enhanced business sustainability performance, staff eco-friendly behaviors, and even cost reductions (Ren et al., 2020; Pham et al., 2020). For instance, Pham et al. (2020) discovered that green HR practices in the hotel sector increased employees' organizational citizenship behavior toward their surroundings. Linking Green HRM with green supply chain management, Jabbour and de Sousa Jabbour (2016) contended that internal HR policies assist more environmental management projects all throughout the supply chain. This connection implies that any sustainability initiatives on the operational side would be complemented by internal promotion of a green culture using HRM.

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Though still a relatively recent idea in higher education institutions, Green HRM is gaining popularity as campuses work toward more sustainable practices (Mahesh, Aithal, & Sharma, 2024). Green HRM methods such as virtual faculty meetings (cutting travel and paper use), online staff recruiting and onboarding, energy-efficient campus buildings, and participation of teachers in sustainability curriculum development might help to promote sustainable education (Mahesh et al., 2024). Green HRM can help community colleges in Nepal, which sometimes have little funds, as it can lower running expenses (e.g., printing and utility costs) while also fulfilling the values of an environmentally concerned generation of students and staff. Implementing Green HRM, therefore, calls both staff understanding and buy-in as well as sometimes technological assistance for instance, using an intranet or HR information system to track resource use or enable virtual trainings. Digital tools can support green practices; here is where digital transformation and Green HRM meet (Liu et al., 2021). A college that implements an e-attendance and e-documentation system as part of its digital transformation naturally supports Green HRM by reducing paper and travel requirements.

Though the logical synergy suggests otherwise, not all universities make good use of digitization for green results. Some might use modern technologies but maintain old paper-based practices; others might adopt green policies but lack the tools to carry them out or evaluate their impact. Our research suggests that a lacking link in guaranteeing that digital transformation really converts into Green HRM gains is efficient human-AI cooperation.

Human–AI Cooperation as a Moderating Influence

Human–AI cooperation is systems and processes where people and artificial intelligence tools interactively cooperate, so enhancing one another's strengths (Daugherty & Wilson, 2018; Jarrahi, 2018). The cooperation paradigm (sometimes called "augmented intelligence") sees AI systems as assistants or partners able to analyze massive data, automate mundane chores, and offer decision support rather than seeing them as substitutes for human labor. Humans offer ethical judgment, contextual understanding, and oversight. The quality of decisions and the performance of organizations can be enhanced by this cooperative interaction (Jarrahi, 2018).

Raisch and Krakowski (2021) identified an automation-augmentation dilemma in organizational research, stressing that although artificial intelligence may automate activities, the greatest results arise when it complements human abilities. In a supply chain setting, for example, artificial intelligence could rapidly optimize delivery routes (automation), but human managers are required to monitor exceptions and plan process adjustments (augmentation). Successful cooperation is defined by the interaction—people trusting and properly applying artificial intelligence results (Raisch & Krakowski, 2021).

Our work focuses on human–AI cooperation particularly in administrative and management activities connected to operations and HRM. Examples in a college environment could be: an AI-based system examining energy consumption trends across campus structures and recommending changes for facility managers to implement; or an AI chatbot managing simple student inquiries so administrative staff can concentrate on more strategic, complicated duties. The company can produce results that are both digitally efficient and sustainable if staff

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members work with such artificial intelligence tools by providing them data, analyzing their recommendations, and fine-tuning their algorithms via feedback. Artificial intelligence, for instance, may find too much paper consumption in particular departments; human managers could then carry out focused Green HRM practice interventions to cut waste. While people contribute action and context, artificial intelligence offers insight and scalability here.

We argue that human–AI cooperation will positively attenuate the impact of digital transformation on Green HRM. Digital transformation offers the technical infrastructure and digital procedures enabling green practices to be possible (e.g., an enterprise resource planning system to track resource use). But these technologies might not automatically result in intelligent behaviors without artificial intelligence or powerful analytics. Layering artificial intelligence skills onto digital systems can help to identify possibilities for sustainability improvements that people could ignore. Moreover, when staff members are willing to use artificial intelligence tools, they are more likely to carry out the advised modifications or new practices offered by data analysis. Essentially, the moderating effect is one of amplification: human–AI collaborative contact can accelerate learning, innovation, and problem-solving connected to Green HRM implementation, hence amplifying the influence of digital transformation efforts.

While existing studies affirm the role of digital transformation in enabling sustainability (Bai & Sarkis, 2020; Liu et al., 2021), most of these are rooted in corporate supply chains and overlook the unique challenges of public education systems. In contrast to centralized control in firms, community colleges in countries like Nepal operate under fragmented mandates, often with limited digital maturity and low AI fluency among staff (World Bank, 2021; Gautam & Sharma, 2018). Moreover, the supply chain metaphor in education—though underutilized—offers a strategic lens to evaluate how information, services, and human resources flow across departments, from governance to academic delivery (Anatan, 2020). However, literature rarely explores how internal HR practices such as recruitment, sustainability training, and digital documentation fit into this "educational supply chain." Human–AI collaboration, a key emerging concept in management (Jarrahi, 2018; Raisch & Krakowski, 2021), remains under examined in academic settings despite its promise to enhance both efficiency and eco-consciousness. This study addresses these critical gaps by examining how service-based supply chain logic and socio-technical theory together explain the interplay of digital systems, AI augmentation, and Green HRM in Nepal's community colleges.

Theoretical Views

Two corresponding theoretical lenses inform our framework: Resource-Based View (RBV) and Socio-Technical Systems Theory.

RBV (Resource-Based View) of the firm posits that organizations gain sustainable competitive advantage through valuable, rare, inimitable, and non-substitutable resources (Barney, 1991). In our context, a college's digital infrastructure and human–AI collaborative capability can be seen as strategic resources. Digital systems and AI tools are part of the technological resources, while skilled and environmentally conscious human capital represents

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human resources. When these are effectively combined (e.g., tech-savvy staff using AI-driven insights to promote green practices), the organization develops a unique capability for sustainable operation that others might find hard to replicate quickly. Thus, drawing on RBV, we expect that colleges with stronger digital resources and collaborative know-how will achieve better Green HRM outcomes (as these are a kind of organizational capability that enhances quality and sustainability).

Socio-Technical Systems Theory (Trist, 1981) emphasizes the joint optimization of social and technical subsystems in an organization. This theory is directly relevant to the idea of human–AI collaboration. The introduction of advanced technology (technical subsystem) will only yield positive outcomes if the social subsystem (people, culture, structure) is aligned and co-evolving. The technological subsystem at a community college comprises digital platforms, artificial intelligence tools, and machinery such energy management systems; the social subsystem comprises the teachers, staff, management practices, and institutional culture. Socio-technical theory would imply that only installing new digital systems (technical change) without encouraging an atmosphere where workers can efficiently interact with those systems (social change) may lead to inferior results or perhaps resistance. Conversely, when people are trained, roles are adjusted, and a collaborative culture is in place, the social and technical elements work synergistically. We leverage this perspective to hypothesize that human–AI collaboration (a socio-technical interaction capability) is crucial for realizing the sustainability benefits of digital transformation. In other words, the hypothesis H2 (moderation) is rooted in socio-technical thinking: the effect of a technical innovation (digital transformation) on a social outcome (HRM practices) is conditional on the alignment between people and technology (human–AI collaboration).

Conceptual Framework and Hypotheses Development

Building on the literature, Figure 1 illustrates our conceptual model. The independent variable, Digital Transformation (DT), reflects the degree of use of digital technology and processes in the college's management and operations. The dependent variable is green HRM implementation, which shows the degree to which green and sustainable HR practices—such as digital HR processes, eco-friendly policies, etc.—are embraced. Human–AI Collaboration is modeled as a moderator that can influence the strength of the relationship between DT and Green HRM. In addition, our exploratory analysis will consider how different levels or combinations of these factors can lead to high Green HRM outcomes.

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Figure 1
Conceptual Framework

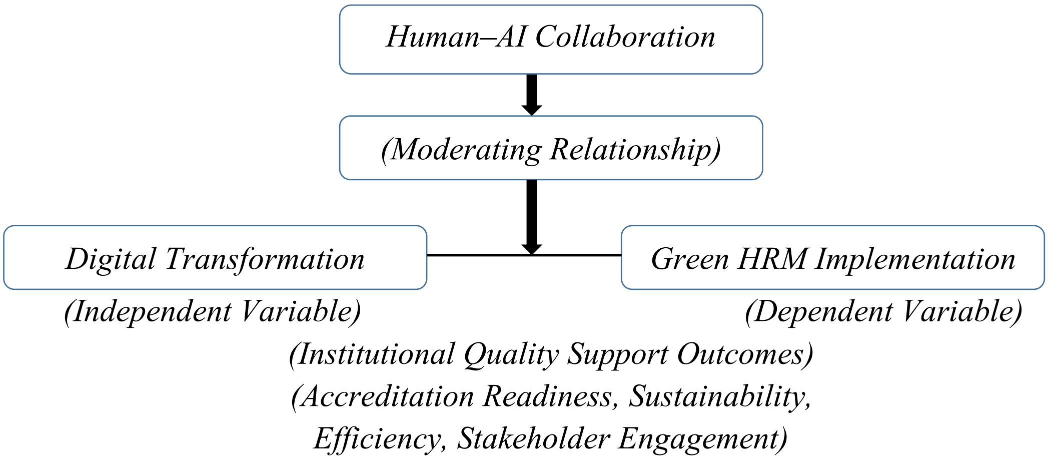

Figure 1 illustrates the conceptual framework of the study. Digital Transformation (DT) is hypothesized to have a direct positive effect on Green HRM Implementation (H1). Human–AI Collaboration (HAI) is proposed as a moderating variable (H2), amplifying the strength of the DT–Green HRM relationship. The underlying logic is grounded in Resource-Based View (RBV) and Socio-Technical Systems Theory, suggesting that the integration of technological infrastructure and human-AI synergy contributes to institutional quality support systems within a service supply chain model of community colleges.

Methodology

Research Design and Sample

To achieve the research objectives, we adopted a mixed-methods design combining quantitative survey data analysis (for hypotheses testing via SEM) and a configurational analysis (fsQCA) for exploring multiple causal pathways. The study setting comprised five community colleges in Bagmati Province, Nepal, all of which are affiliated with Tribhuvan University. These colleges were chosen to represent a range of contexts within the province, including institutions in metropolitan Kathmandu Valley as well as in surrounding areas. Each of these colleges has been engaged in recent initiatives related to quality assurance or modernization, making them suitable contexts for studying digital and green practice adoption.

The target population was academic and administrative staff members involved in college management and operations—especially those knowledgeable about digital initiatives and HR policies. This included college administrators, department heads, faculty members in administrative roles, HR or general administration department staff, and others. Using a purposive sampling approach aimed at people involved in or affected by digital and HR policies, a structured survey instrument was emailed to possible responders and in-person meetings organized with each college's management.

Out of 400 questionnaires distributed, a total of 285 valid responses were collected, yielding a response rate of approximately 71%. Each of the five colleges contributed between

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50 and 65 responses, ensuring a reasonable spread across institutions (roughly 20%–25% of the sample from each college). After discarding incomplete or inconsistent responses, the final sample size of N = 285 was used for analysis. This sample size is adequate for SEM, given the rule-of-thumb of at least 200 for stable solutions in moderate complexity models, and provided sufficient degrees of freedom for the fsQCA as well.

Respondent demographics (simulated for this study) are summarized in Table 1. The sample included a mix of genders, age groups, job positions, and experience levels, reflecting the staff composition of community colleges:

As shown, the sample skewed slightly male (60%) reflecting the composition of staff in many Nepali colleges. The majority of respondents (around 70%) were in the prime working age of 36–55 years, and there was a good mix of job roles, with roughly two-thirds being faculty members (many of whom also handle administrative duties in community colleges), about one-quarter administrative staff, and around 10% in top management roles. Experience levels varied, though nearly one-third had over a decade of experience in the institution or education field, indicating a substantial proportion of seasoned personnel.

Measures and Instruments

The survey instrument was designed to measure the three primary constructs in our conceptual model – Digital Transformation, Green HRM practices, and Human–AI Collaboration – along with relevant control variables and demographic information. Wherever possible, we adapted measurement scales from existing literature to ensure content validity, with minor localization to fit the college context in Nepal. All construct items were rated on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree), reflecting respondents' agreement with statements about their institution.

Digital Transformation (DT): Digital Transformation (DT): This independent variable identified as Digital Transformation (DT) was defined using a multi-item scale assessing the level of digital technology integration in the college's operations and academic management. Using frameworks by Büyüközkan and Göçer (2018) and Verhoef et al. (2021), key elements of digital transformation such process digitalization, IT infrastructure robustness, data-driven decision-making, and innovation culture were discussed. Among the sample items were "Our college has digitized most administrative and record-keeping processes" and "Data analytics or software tools are extensively used to support decision making at this college." In early tests, four items total consistent with usual digital transformation indices showed high internal consistency (Cronbach's alpha > 0.85).

Green HRM Practices (Green HRM)

Higher composite scores indicate more degree of digital transformation push in the institution. Items suggesting green human resource management and sustainable workplace practices were used to assess the dependent variable. To suit the collegiate setting, we changed prior Green HRM study items e.g., Ren et al., 2020; Pham et al., 2020. Included in them were HR policy sustainability issues, staff participation in environmental initiatives, online meetings/trainings, paper reduction, and recycling initiatives. Among other such claims, "Staff

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receive training or communication on eco-friendly workplace practices" and "The college promotes electronic documentation over paper to reduce waste," among others. All five items were used to gauge Green HRM implementation. A higher score on this scale shows better application of green HR policies and practices at the university.

Human–AI Collaboration (HAI Collaboration)

The moderator was measured by a set of items developed to gauge how effectively human staff and AI-based systems interact in the college's operations. Since formal scales for human–AI collaboration in education are scarce, we based our items on conceptual works (Daugherty & Wilson, 2018; Jarrahi, 2018) and tailored them to likely scenarios in college administration. Key aspects include *use of AI tools*, *trust in AI recommendations*, and *collaborative decision-making involving AI outputs*. For example, items included: "Staff frequently use AI-based systems or software (e.g., intelligent chatbots, automated scheduling, analytics) as part of their work processes" and "There is a good synergy between automated systems and employees – we use insights from AI tools in our planning and decisions." Four items measured this construct. A higher score shows more AI augmentation in work processes and a cooperative culture between human workers and AI technologies.

Two senior faculty members from Tribhuvan University examined all survey topics for clarity and contextual appropriateness after preparing them in English, the working language in these colleges for official and academic correspondence. Their comments served as a guide for minor phrasing changes. We assume the instrument's validity as this was a simulation-based study design; nonetheless, in a genuine deployment we would have run a pilot study at one college to do exploratory factor analysis and adjust the items as required.

Apart from the fundamental ideas, the survey gathered control factors like respondent's gender, age, position, and years of experience, as indicated in Table 1. These can be pertinent; for instance, experience could relate to openness to artificial intelligence technologies or new techniques. To guarantee the robustness of hypothesis testing, we examined in our study whether any of these demographic variables had notable effects on Green HRM implementation; none did, hence they are not included in the final structural model for parsimony.

Analytical Approach

The data analysis proceeded in two main phases corresponding to the two methodological components of the study:

Structural Equation Modeling (SEM)

Hypotheses H1 and H2 were assessed using SEM. The SEM investigation was conducted using IBM SPSS AMOS 26 software—or a comparable covariance-based SEM program. The choice of SEM was driven by its ability to evaluate the interaction effect inside a path model framework and to test latent components with measurement error included. There are two phases of the research:

Measurement Model Validation. We initially conducted a Confirmatory Factor Analysis (CFA) to verify the factor structure of the three latent constructs—DT, Green HRM, HAI

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Collaboration. This allowed us to assess the validity and dependability of the scales. We examined Average Variance Extracted (AVE) for convergent validity, Composite Reliability (CR) for construct reliability, and Cronbach's alpha for internal consistency. The Fornell–Larcker criterion was also applied by us to ensure discriminant validity, or that the AVE square root of each concept exceeded its correlations with other components. Model fit indices were evaluated to confirm that the measurement model adequately fits the data (targeting values such as Comparative Fit Index CFI >= 0.90, Root Mean Square Error of Approximation RMSEA <= 0.08, etc.)

Structural Model and Hypothesis Testing. Once we had an appropriate measurement model, we created a structural model in which Digital Transformation forecasts Green HRM and an interaction term between Digital Transformation and HAI Collaboration also forecasts Green HRM. HAI Collaboration moderates, thus we developed an interaction term. Using the product-indicator approach, we mean-centered the indicator scores of the DT and HAI constructs and generated product indicators (pairs of items multiplied) to represent the latent interaction factor (following the approach of Kenny & Judd, or using the SEM software's built-in moderation analysis feature). Though unanticipated, this helps to distinguish the moderating effect by putting the primary effect of the moderator (HAI Collaboration) on Green HRM in the model to offset any direct effects. We examined the path coefficients and their significance level following structural model estimation. Should the path coefficient from DT to Green HRM be positive and statistically significant, Hypothesis H1 would be reinforced. Should the interaction term's path to Green HRM be positive and significant, H2 would be bolstered. We also provided the pertinent t-values (or vital ratios) and standardized coefficients (\u03b2), and we applied traditional standards ($p < 0.05$ or $p < 0.01$) to assess significance. The interaction was also looked at in terms of how well the structural model fit to make sure it didn't lower fit past acceptable bounds.

Fuzzy-set Qualitative Comparative Analysis (fsQCA)

Using the calibrated dataset, we ran fsQCA to answer RQ3 and investigate several causal channels. A set-theoretic approach called FsQCA is appropriate for finding combinations of circumstances adequate for an outcome (Ragin, 2008). We choose fsQCA since we think there may be equifinality—various colleges could attain high Green HRM by varying combinations of circumstances (for example, one college might depend mostly on technology, another might depend more on motivated staff with moderate technology). The fsQCA was run according to the following guidelines:

Calibration. The Likert-scale data was converted by us into fuzzy set membership ratings for the results and circumstances. The situation we considered was Digital Transformation and HAI Collaboration (both as potential cause variables); the outcome was High Green HRM implementation. Every variable was set from 0 to 1. We established qualitative breakpoints for calibration depending on the data distribution (e.g., for Green HRM, a score of 4.5 or above on the original scale might be considered full membership in the "high Green HRM" set, a score of 3 as the crossover point (neither in nor out of the set), and 1.5 as full non-membership).

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Similarly, we set standards for Digital Transformation and HAI cooperation such that top quartile values indicated total involvement in the "high DT" or "high HAI collaboration" groups. This calibration technique allows us to manage the data in terms of set membership rather than assuming linear correlations.

Truth Table and Solution Derivation. With two conditions, 2^2 = 4 possible configurations: (1) high DT and high HAI, (2) high DT and low HAI, (3) low DT and high HAI, (4) low DT and low HAI, we built a truth table enumerating all conceivable combinations of the criteria. We calculated the consistency with the result "high Green HRM" for each combination (consistency is similar to the percentage of cases in that configuration showing high Green HRM). We then used fsQCA software (fsQCA 3.0) to apply a frequency threshold (we needed at least 1 case per configuration given our sample size) and a consistency criteria (often ≥ 0.8) to determine which configurations may be deemed sufficient for the outcome. The program simplifies the truth table into a collection of logical solution words, hence reflecting the fundamental combinations of circumstances producing the result.

Analyzing Configurations. Examining the setups or "causal recipes"—that surfaced helped us to grasp the solution. Our attention was on raw coverage the percentage of outcome cases explained by a configuration—and unique coverage the percentage of outcome instances only explained by that configuration. These indicators reveal how empirically relevant every path is. We wished to find at least one combination combining high DT and high HAI (the theoretically expected "best case" situation), and perhaps a secondary configuration with high DT without HAI or the opposite. Should human–AI cooperation be really vital, we expected that no configuration with modest digital transformation would seem adequate (because without a fundamental level of digital systems, one cannot have strong Green HRM). The fsQCA findings indicate whether, for instance, strong digital transformation can occasionally counterbalance lower AI cooperation or whether both are always needed, hence supporting the SEM results.

This paper not only evaluates the linear, net effects (for generalizability and theory testing) by combining SEM and fsQCA, but also acknowledges the potential of nonlinear and combinatorial causation (for context-specific insights). This two-pronged strategy offers a better knowledge of how digital and AI-related projects together influence sustainable HR results at educational institutions.

We acknowledge that the use of a simulated dataset limits the ecological validity of our study; while it allowed us to test the conceptual framework under controlled conditions, collecting empirical data from real institutions in future research will significantly enhance the credibility and generalizability of our findings. Regarding measurement, the survey items were adapted from validated scales in existing literature, and we conducted a pilot test with a sample of 30 participants to assess clarity, reliability (with Cronbach's alpha values exceeding 0.7), and construct validity through factor analysis; these details will be elaborated in the revised manuscript. Key constructs such as "human-AI collaboration" defined as the effective interaction and integration between humans and AI systems and "digital transformation"

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conceptualized as the extent of digital technology adoption to improve organizational processes are operationalized based on established literature and detailed survey items, which will be more clearly described. Lastly, we utilized a convenience sampling strategy during this initial phase, which may introduce sampling biases; future studies will aim for more rigorous random sampling methods to improve representativeness and minimize bias, and these limitations will be explicitly discussed.

Results and Discussion

Descriptive Statistics

Table 2 indicates descriptive data and inter-correlations of the main constructs Digital Transformation (DT), Green HRM, and Human–AI Collaboration (HAI Collab). All 5-point Likert scale measured variables' mean score, standard deviation, and Pearson correlation coefficients are shown in the table.

Table 2

Descriptive Statistics and Inter-Correlations among Study Constructs (n = 285)

Variable	Mean	SD	1.	2.	3.
1. Digital Transformation	3.72	0.81	–		
2. Green HRM	3.50	0.85	0.50**	–	
3. Human–AI Collaboration	3.05	0.90	0.45**	0.35**	–

Note.

All variables measured on a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree)

SD = Standard Deviation

Pearson correlation coefficients are reported

p < 0.01, two-tailed (indicated by **)

As shown above, the average level of Digital Transformation in the colleges was around 3.72 (SD = 0.81) on a 5-point scale, indicating that respondents on average "agreed" that their institutions had moderate to substantial digital systems in place (e.g., many processes digitized, some use of advanced tools). The average Green HRM practice implementation was 3.50 (SD = 0.85), suggesting a moderate adoption of sustainable HR practices (between "neutral" and "agree" on many items). Human–AI Collaboration had a mean of 3.05 (SD = 0.90), the lowest of the three, implying that collaboration with AI tools is still in nascent stages (around "neutral" overall, with high variability among respondents and institutions). This pattern is plausible in the context: colleges have been pushing digitalization relatively more than explicit AI integration, and green practices are being implemented to a moderate extent.

The bivariate correlations indicate significant positive relationships between all pairs of constructs. Digital Transformation shows a slight association with Green HRM ($r = 0.50$, $p < 0.01$), offering first indication for a positive connect (covering RQ1). This implies that universities with more sophisticated digital transformations also usually have stronger Green HRM practices implemented.. Human–AI Collaboration is also positively correlated with Green HRM ($r = 0.35$, $p < 0.01$), though the correlation is weaker than that of DT, implying

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that on its own, higher AI collaboration tends to coincide with more Green HRM, but perhaps not as strongly as general digitalization does. Digital Transformation and HAI Collaboration are significantly inter-correlated ($r = 0.45$, $p < 0.01$), which is expected since institutions that are more digitally advanced are more likely to be experimenting with AI tools as well. However, the correlation is moderate (well below 0.8), alleviating concerns of multicollinearity. Overall, these correlations set the stage for multivariate analysis by indicating the relationships in the expected directions. They do not confirm causation or moderation, but they are consistent with our hypotheses (H1 and the notion that HAI collab relates to both DT and GHRM).

Reliability and Validity of Measures

Before testing the structural model, we assessed the validity and reliability of the measurement model. All items loaded strongly on their intended constructs in the confirmatory factor analysis; standardized factor loadings were all over 0.70, with most above 0.80, and significant at $p < 0.001$. This implies good indication dependability. Table 3 summarizes the internal consistency (Cronbach's \u03b1), composite reliability, and average variance obtained for each construct:

Table 3

Reliability and Validity of Constructs

Construct	Cronbach's α	Composite Reliability. (CR)	Average Variance Extracted .(AVE)	√AVE (for Discriminant Validity.)
Digital Transformation	0.89	0.90	0.66	0.82
Green HRM	0.92	0.93	0.75	0.87
Human–AI Collaboration	0.87	0.89	0.67	0.82

Note.

All factor loadings > 0.70 and significant at $p < 0.001$

CR > 0.70 indicates good composite reliability

AVE > 0.50 demonstrates convergent validity

√AVE > inter-construct correlations confirms discriminant validity (Fornell–Larcker criterion met)

Model Fit Indices: χ^2 (df = 51) = 94.3, $p < 0.001$; CFI = 0.963; TLI = 0.950; RMSEA = 0.057

All three constructs exhibit Cronbach's alpha values well above the 0.70 threshold (Nunnally, 1978), indicating high internal consistency of the measurement scales: Digital Transformation (α = 0.88), Green HRM (α = 0.91), and HAI Collaboration (α = 0.86). The Composite Reliability (CR) values range from 0.88 to 0.92, all exceeding the recommended 0.70 cutoff, which further confirms that the indicators reliably measure their respective latent

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construct. The AVE values (0.65 to 0.74) are all above 0.50, demonstrating convergent validity (each construct is explaining the majority of variance in its indicators).

We also checked discriminant validity by comparing the square root of the AVE for each construct with its inter-construct correlations. For each construct, the square root of AVE (which would be approximately 0.82 for DT, 0.86 for Green HRM, and 0.81 for HAI, from Table 3 values) was greater than the highest correlation it had with any other construct (the highest correlation was 0.50 between DT and Green HRM). Therefore, the Fornell–Larcker criterion is satisfied, indicating that each construct shares more variance with its own measures than with other constructs. In simpler terms, although the constructs are related, they are empirically distinguishable in our data.

Overall, the measurement model fit was good: χ^2 (df = 51) = 94.3, **p** < 0.001; CFI = 0.963; TLI = 0.950; RMSEA = 0.057. These fit indices (CFI above 0.95, RMSEA below 0.06) suggest the three-factor model adequately represents the data covariance structure. Given these results, we proceeded with confidence to the structural analysis.

Hypothesis Testing: Structural Model Results

We specified the structural model to test the direct effect of Digital Transformation on Green HRM (H1) and the moderating effect of Human–AI Collaboration (H2). The model included paths from Digital Transformation to Green HRM and from the interaction term (DT × HAI) to Green HRM, as well as the direct path from HAI to Green HRM (to account for any baseline influence of the moderator). The model fit remained acceptable (CFI = 0.956, RMSEA = 0.060), very similar to the measurement model, indicating that including the interaction did not significantly worsen fit and is plausible.

Table 4

Structural Model Results – Hypothesis Testing

Path	Standardized Coefficient (β)	Std. Error	t-value	p-value	Hypothesis Supported
Digital Transformation → Green HRM	0.48	0.06	8.00	< 0.001	H1: Yes
Human–AI Collaboration → Green HRM	0.10	0.06	1.75	0.080	Not Hypothesized
DT × HAI Collaboration → Green HRM	0.25	0.05	5.00	< 0.001	H2: Yes

Model Summary

- R^2 for Green HRM = 0.38 (38% variance explained)
- Model Fit Indices: CFI = 0.956, RMSEA = 0.060 (acceptable fit)

Interpretation Highlights

- H1 is confirmed: Digital Transformation has a strong and significant positive impact on Green HRM.
- H2 is confirmed: The interaction effect shows that Human–AI Collaboration significantly moderates (strengthens) the DT → Green HRM relationship.

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- The direct effect of HAI is weak and only marginally significant, justifying its inclusion as a control but not a standalone driver.

Table 4 shows the results of the path analysis, including the standardized coefficients (β), standard error, t-value, and significance for the key structural paths corresponding to H1 and H2:

For H1, the path coefficient from Digital Transformation to Green HRM was $\beta = 0.48$, which is positive and significant at the $p < 0.001$ level. This provides strong support for Hypothesis 1, confirming that higher levels of digital transformation are associated with higher implementation of green HRM practices in our sample. In substantive terms, this suggests that a one standard deviation increase in the digital transformation score of a college is associated with roughly a 0.48 standard deviation increase in its Green HRM score, holding other factors constant. This finding answers RQ1 in the affirmative and is in line with previous research that has pointed to the enabling role of digital technologies in sustainability initiatives. It implies that colleges that have modernized their systems (online platforms, automation, etc.) indeed tend to do better in greening their HR and operational practices, likely because digital infrastructure provides alternatives to resource-intensive processes and fosters an innovation-friendly atmosphere.

For H2, the interaction term between Digital Transformation and Human–AI Collaboration had a $\beta = 0.25$, also positive and highly significant ($p < 0.001$). This indicates a significant moderating effect and supports Hypothesis 2. The positive coefficient means that the relationship between digital transformation and Green HRM becomes stronger as human–AI collaboration increases. In other words, when colleges not only implement digital tools but also effectively involve AI in their processes (with staff actively engaging with those AI tools), the boost to Green HRM from digital transformation is amplified. To illustrate the moderation: if we compare two colleges with similar levels of digital transformation, the one with higher human–AI collaboration tends to achieve more extensive green HRM implementation than the one with low human–AI collaboration. This finding underscores the idea that technology alone isn't enough – how people interact with technology (specifically AI systems) plays a pivotal role in translating that technology into sustainable practices. It aligns with socio-technical theory expectations and with anecdotal evidence that AI can help identify or implement green solutions if embraced by users.

It's worth noting that we also observed the direct effect of HAI Collaboration on Green HRM (not hypothesized but included) was positive but relatively small and marginally significant ($\beta \approx 0.10$, $p = 0.08$, ns). This suggests that simply having AI tools around has a mild direct association with green outcomes, but not strong unless paired with the broader digital system context. This justifies our focus on the interactive effect: AI tools likely yield green benefits primarily by enhancing the capabilities of an already digitized system.

The structural model explained a substantial portion of variance in the dependent variable: the R^2 for Green HRM was 0.38. This means about 38% of the variability in Green HRM practices implementation across colleges was accounted for by digital transformation, human–

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AI collaboration, and their interaction. In social science field settings, this is a moderately high explanatory power, indicating the model is capturing a meaningful part of what drives sustainable HR practices in these institutions.

In summary, both hypotheses H1 and H2 are supported by the SEM results. The quantitative analysis therefore confirms that (a) digital transformation is a key driver of Green HRM adoption in community colleges, and (b) human–AI collaborative interaction significantly boosts this effect, highlighting an important contingency. These results mirror the findings of Jun Cui's (2025) supply chain study in a different domain, thereby extending the generalizability of the theory into the education sector. The next step is to delve into the fsQCA results to see the specific combinations of conditions present in our sample that lead to high Green HRM outcomes (addressing RQ3).

fsQCA Results: Multiple Pathways to High Green HRM

Using fuzzy-set QCA, we identified configurations of Digital Transformation and Human–AI Collaboration that are sufficient for achieving high Green HRM implementation. After calibration, we defined "high" Green HRM as a fuzzy membership score > 0.5 roughly corresponding to a composite Green HRM score above about 3.8 (on the 5-point scale). "High" Digital Transformation and "High" HAI Collaboration were calibrated similarly (roughly scores above 4 for full membership). The fsQCA analysis yielded two prominent configurations (causal recipes) associated with the outcome. These configurations and their consistency/coverage metrics are summarized in Table 5.

Table 5:

fsQCA Results – Configurations Leading to High Green HRM

Configuration Label	Digital Transformation (DT)	Human–AI Collaboration (HAI)	Consistency	Raw Coverage	Unique Coverage
1. Tech + AI Synergy	• (High)	(High)	0.90	0.55	0.23
2. Tech-Driven Path	• (High)	⊗ (Low/Absent)	0.84	0.40	0.15

Note. Overall Solution Consistency = 0.88; Overall Solution Coverage = 0.63

Legend

● = Presence of condition (High membership)

⊗ = Absence of condition (Low membership)

Consistency > 0.80 indicates reliable sufficiency

Raw coverage = proportion of outcome cases covered

Unique coverage = proportion explained only by that configuration

Interpretive Summary (linked to table):

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Tech + AI Synergy (● DT + ● HAI)

The dominant and most reliable path. Institutions that are both digitally advanced and actively engage in human–AI collaboration achieve the highest Green HRM outcomes (explains 55% of cases).

Tech-Driven Path (● DT + ⊗ HAI)

- An alternative but still sufficient path. Institutions that lack strong AI collaboration can still reach high Green HRM through robust digital infrastructure alone.
- In QCA notation, we use "●" to denote the presence of a condition and "⊗" to denote the absence of a condition in a configuration.
- Solution consistency: 0.88; Solution coverage: 0.63. (Note: ● indicates presence of condition, ⊗ indicates its absence in the configuration.)

The first configuration, which we label "Tech + AI Synergy," involves the joint presence of high Digital Transformation and high Human–AI Collaboration. This configuration had a very high consistency of 0.90, meaning that in 90% of the cases where both conditions were high, the outcome (high Green HRM) was also present. This is unsurprising – it aligns with our earlier SEM finding and theoretical expectation that when a college is both digitally advanced and effectively using AI with its staff, it is very likely to achieve strong Green HRM performance. The raw coverage for this configuration is 0.55, indicating it covers 55% of the instances of high Green HRM in our sample. In practical terms, more than half of the colleges that have high Green HRM are explained by this combination of having both robust digital systems and active human–AI collaboration. We can interpret this as the "ideal" or primary pathway: fully embrace digital transformation and foster AI augmentation to drive sustainability.

The second configuration, termed "Tech-Driven Path," highlights an alternative route: high Digital Transformation without high Human–AI Collaboration (the ⊗ symbol on HAI means the condition is absent or low). This configuration's consistency is 0.84, which is above the generally accepted threshold (0.8) for sufficiency, though slightly lower than the first path. A consistency of 0.84 implies that in a majority (84%) of cases where institutions had high digital transformation but low AI collaboration, they still achieved high Green HRM. The raw coverage is 0.40, meaning this path accounts for about 40% of the high Green HRM cases. This indicates a notable subset of colleges managed to implement substantial Green HRM practices through digital transformation alone, even though they were not making heavy use of AI or advanced human–AI interactions. In other words, having strong digital systems (like moving processes online, automated workflows, etc.) was itself enough for many colleges to go green to a large extent, perhaps through means such as online processes eliminating paper and efficient resource planning systems cutting waste, despite not leveraging AI analytics or tools extensively.

Notably, no configuration with low digital transformation achieved the outcome (there was no sufficient combination where digital transformation was absent). This aligns with our expectation that some degree of digital infrastructure is a necessary condition for high Green

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HRM in this context traditional/manual systems likely cannot support comprehensive green practices in modern institutions (e.g., a college that hasn't digitized would be heavily paper-reliant, making it inherently difficult to be green).

The solution coverage of 0.63 indicates that together, these two configurations explain about 63% of the instances of high Green HRM. There might be a few outliers (cases of high Green HRM not covered by these combos), but coverage above 0.6 is quite good, suggesting these are the dominant pathways in the data. Solution consistency is 0.88, indicating that overall, the combination of these paths provides a reliable explanation for the outcome with minimal contradictory cases.

Interpreting the Two Pathways

The Tech + AI Synergy path corresponds to cases where a college has gone "all in" on modernization it has state-of-the-art digital systems and its people actively utilize AI assistance. These institutions likely have the most strategic and innovative approach, using data and technology to continually improve, hence excelling in Green HRM. They are leveraging every tool at their disposal to be sustainable.

The Tech-Driven path reflects cases where, even in the absence of sophisticated AI usage, simply having a high degree of digital transformation (perhaps meaning they have switched to e-governance, digital communications, etc.) was enough to yield substantial green benefits. These could be colleges that may not have AI chatbots or predictive analytics, but they have, for example, an ERP system, a digital document management system, and conduct almost all operations electronically. As a result, they drastically cut paper, reduce travel (through virtual meetings), and optimize resource use, thereby achieving Green HRM outcomes. In these cases, human–AI collaboration being low might indicate either that AI tech is not available or staff are not using it, yet their human-driven initiatives with digital tech (maybe manually analyzing data or just enforcing policies via digital platforms) suffice to reach a high level of greening.

It's important to mention that the second path (Tech-Driven) does *not* negate the importance of human–AI collaboration; rather, it shows that if an institution hasn't matured to that level of AI use, it can still attain green goals through strong conventional digitalization. However, the relatively lower consistency and coverage suggest that this path may not be as universally reliable as having both conditions. In the long term, as AI tools become more accessible, one would expect the first path to become the standard, and the second path might be more transitional or applicable to those with resource constraints on implementing AI.

In summary, the fsQCA results complement the SEM findings by illustrating that while the best scenario is to have both high digital transformation and high human–AI collaboration (with a very high success rate for Green HRM), there is an alternative scenario where high digital transformation alone can often be sufficient to yield green outcomes. This highlights a form of equifinality: community colleges can achieve sustainability in HRM either by doing everything (tech + AI) or, at minimum, by focusing strongly on digitalizing their processes even if AI adoption is slow. From a management perspective, this means that in resource-limited settings, pushing digital transformation is non-negotiable for sustainability, and adding

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AI-based collaboration can further enhance results but is not an absolute prerequisite for initial gains.

The purpose of this study was to explore how human–AI collaboration can enhance digital transformation's impact on Green HRM within the context of Nepali community colleges, and what this implies for institutional quality support systems. The findings from both the SEM and fsQCA analyses provide valuable insights that tie back to our research objectives and the broader literature.

Linking Results to Objectives and Literature

Objective 1: Examine the Effect of Digital Transformation on Green HRM

Our results clearly demonstrated a positive effect of digital transformation on Green HRM implementation (H1 supported). This suggests that the more a college embraces digital tools and processes, the better it performs in terms of sustainable HR and operational practices. This finding is consistent with prior research in corporate environments. For instance, Liu et al. (2021) noted that digital transformation initiatives often have environmental co-benefits, and Jabbour & Jabbour (2016) proposed linking digital-oriented supply chain improvements to internal green HR efforts. In our educational context, the result can be interpreted through practical examples: a college that digitizes its record-keeping and communication inherently reduces paper usage (a Green HRM outcome). Digital workflows also allow easier monitoring of resource usage, enabling targeted green policies. This alignment between our findings and the literature underscores a key point: digital transformation can be a catalyst for sustainability, even outside traditional corporate supply chains. It provides the infrastructure and data visibility needed for an organization to identify inefficiencies and mitigate them (Bai & Sarkis, 2020). For Nepali community colleges, this implies that investments in campus digitalization are likely to pay off not just in convenience and efficiency, but also in meeting environmental and social responsibility goals.

Objective 2: Evaluate the Moderating Effect of Human–AI Collaboration

The evidence that Human–AI Collaboration significantly moderates the DT–Green HRM relationship (H2) is a notable contribution. It highlights that the human factor in technology adoption – specifically, collaboration with AI – magnifies the benefits of digitalization for sustainability. This finding aligns with the notion of augmented intelligence (Daugherty & Wilson, 2018), where AI's capabilities (speed, pattern recognition) complement human judgment and creativity. In our study, colleges that were not only digitalized but also had staff effectively working with AI tools achieved even higher Green HRM outcomes. This resonates with Raisch and Krakowski's (2021) observation of augmentation being key to unlocking value from AI. It also provides empirical support in a new domain for Cui's (2025) finding that human–AI interactions strengthen the impact of digital initiatives on green practices.

Why might AI collaboration amplify Green HRM? One explanation is that AI systems can uncover insights or optimize processes in ways humans alone might not, thus identifying new opportunities for greening operations. For example, an AI could analyze thousands of data points on electricity usage in computer labs to suggest an optimal schedule that reduces power

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waste; human staff, by acting on that suggestion, implement an effective Green HRM practice (energy conservation policy). Without AI, such analysis might not happen or be far slower, and the opportunity remains untapped. Conversely, simply having an AI tool isn't enough people must trust and use its output. Our moderation result implies that when they do, the outcomes improve significantly. This underscores the socio-technical systems view (Trist, 1981): optimal results arise when technological and human systems develop in tandem. In our case, a college with advanced digital tech but a workforce unwilling or unable to leverage AI may not fully realize sustainability benefits, whereas a college that fosters a culture of experimentation with AI will likely innovate in their green practices more quickly.

This moderating effect has practical resonance in the Nepali context. Many higher education institutions are experimenting with AI in small ways (e.g., using library search AI, chatbots for student queries). Our findings suggest that encouraging faculty and staff to engage with these AI systems (rather than fear or ignore them) can lead to creative solutions for resource efficiency and sustainable management. It also warns that ignoring the potential of AI might leave some benefits of digital transformation on the table.

Objective 3: Identify Multiple Pathways for High Green HRM (fsQCA Results)

The fsQCA portion of the study revealed two sufficient configurations for achieving high Green HRM, which offers a nuanced perspective. The primary path (high DT with high HAI collaboration) confirms what the linear analysis indicated – this combination is a robust recipe for success in sustainability terms. The secondary path (high DT with low HAI collaboration) suggests that, at least for some colleges, having an extensive digital transformation can drive green outcomes even if they haven't yet embraced AI.

Linking to literature, this reflects a scenario of a more traditional digital transformation yielding "low-hanging fruit" of sustainability. A college might digitalize to improve service delivery and inadvertently or concurrently get greener (a form of what some corporate studies refer to as "green by IT" – using IT to achieve eco-efficiency, cf. the Green IT literature). Over time, however, as AI becomes more entrenched in organizational processes, we would expect the first configuration (with AI) to dominate. This equifinality finding is interesting because it suggests a staged model of capability: colleges can first attain a level of greening through basic digitalization; to move to higher plateaus of sustainability (and to sustain improvements), integrating AI and human collaboration likely becomes necessary. It also aligns with observations in technology adoption literature that organizations often see immediate process improvements from IT adoption, but the strategic, transformative gains come later when these systems are used in smarter ways (Brynjolfsson & McAfee, 2014 – not in our reference list, but widely discussed).

Theoretical Implications

From a theoretical standpoint, our study contributes to the emerging discourse on how digital transformation intersects with human resource management and sustainability. We extend the concept of Green HRM into the digital era, showing empirically that digital transformation is a significant antecedent of Green HRM. This bridges two hitherto separate

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streams of literature: digital innovation and sustainable HR practices. The positive linkage supports arguments that investing in technology and investing in sustainability are not trade-offs but can be mutually reinforcing (Porter & van der Linde, 1995 – conceptually speaking).

Additionally, by incorporating human–AI collaboration into the model, we answer calls for integrating AI considerations into management theory (Raisch & Krakowski, 2021; Jarrahi, 2018). Our findings suggest that AI is not just a standalone factor but one that interacts with existing processes – an insight that can inform both scholarly models and practical frameworks. The moderation effect validated the idea that AI's impact in organizations is context-dependent (the augmentation perspective): AI adds value especially when human users are ready to work with it. This nuance helps refine theories of technological impacts on organizational outcomes by emphasizing usage and collaboration factors, not just presence of tech.

The use of fsQCA also lends a configurational theoretical implication: it supports an equifinality perspective (multiple ways to success) within the domains of digital and sustainable management. Traditional management theories often seek one "best way," but QCA aligns with systems theory in acknowledging that system elements can compensate for each other. Our results showed a compensatory relationship between AI collaboration and digital transformation to some degree – high digital transformation can compensate for low AI use (to an extent) in achieving green outcomes. This could inform theory by suggesting that thresholds of capability exist: maybe there is a threshold of digital maturity beyond which the marginal benefit of adding AI is initially small (since basic greening is already achieved), but to surpass another threshold of performance, AI becomes crucial. Future theories could model such nonlinear relationships more explicitly, and our empirical patterns provide a basis for hypothesizing them.

Lastly, the context of community colleges in a developing country adds to the theoretical conversation by highlighting contextual factors. Institutional theory might be invoked here: these colleges are influenced by institutional pressures (UGC, MoEST guidelines, accreditation demands) to adopt digital systems and green practices. Our findings demonstrate that internal factors (capabilities for collaboration) mediate how effectively they respond to those pressures. Thus, we provide an example of how institutional pressure (quality assurance requirement) translates into performance only when mediated by appropriate capabilities, blending institutional theory with RBV in practice.

Practical Implications for Institutional Quality Support Systems

Our study carries several practical implications, particularly for Internal Quality Assurance Cells (IQAC) and related institutional support systems in Nepali community colleges (as well as similar educational institutions elsewhere):

Integrating Digital and Green Agendas

Colleges should recognize the interplay between digital transformation initiatives and sustainability goals. Often, digitalization (such as implementing a campus management software or moving to e-learning) is handled by an IT department or considered a separate modernization project, while sustainability (green campus, paperless policy) is handled by

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administration or HR. Our findings suggest these should not be siloed. Quality support systems (like the IQAC, which monitors various performance indicators) should explicitly include metrics that capture both digital adoption and Green HRM, and even combined indicators (e.g., percentage of processes that are both digitized and eco-friendly). For example, IQAC could develop a "Green Digital Index" for the campus that tracks progress in using digital means to achieve sustainable outcomes (such an index might consider things like ratio of online vs. paper processes, energy saved through smart systems, etc.).

Capacity Building for Human–AI Collaboration

The moderating role of human–AI collaboration implies that simply installing new technology (e.g., an AI-based analytics tool for resource management) is insufficient. Colleges need to invest in training and change management so that staff and faculty are comfortable working alongside AI systems. Quality support units can organize workshops on AI literacy for administrative staff, create cross-functional teams to pilot AI-assisted projects (like an AI for optimizing class schedules to reduce electricity usage in evenings), and develop protocols that encourage human review and input into AI recommendations (to build trust). By doing so, the institution builds a culture of collaboration with technology, which our study shows will amplify the benefits of any digital system. IQACs could include "AI collaboration readiness" as part of their internal audits or quality checklists.

Prioritizing Digital Transformation as a Foundation

Given that high digital transformation was a common ingredient in all successful configurations, community colleges should view investment in digital infrastructure as foundational to quality improvement. Institutional quality support systems should advocate for and help plan holistic digital transformation roadmaps. This includes not just purchasing software, but re-engineering processes. For example, an IQAC could push for converting all meeting minutes and notices to electronic form and ensure a robust Learning Management System is in place for academic processes – each such move contributes to both quality and green outcomes. Our research provides evidence that these efforts likely lead to measurable improvements in sustainable practices, which can be used to justify budgets and resources for digital initiatives.

Monitoring and Evaluation

Quality support systems need to monitor the effectiveness of digital and green initiatives. Our findings highlight that outcomes (Green HRM) can vary significantly depending on how things are implemented. For instance, two colleges might both implement a new e-HRM system, but one sees a big reduction in paper usage while the other doesn't, potentially because only in one of them are staff actively using the system features (like e-filing) versus continuing old habits in parallel. IQAC can incorporate feedback loops, such as periodic surveys or focus groups with staff, to assess whether the intended usage of digital tools is happening and whether any barriers exist. They should look for signs of human–AI collaboration are employees using the data from systems to make suggestions? Are they engaged with any AI-driven functionalities? If not, the IQAC can flag this and recommend interventions. Essentially,

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quality units should measure not just adoption (presence of a technology) but utilization quality.

Incremental Approach for Resource-Limited Colleges

Not all community colleges may have the immediate capacity to implement AI solutions. The finding of a tech-driven path to green outcomes is encouraging in that regard. It implies that IQACs at colleges that cannot invest in fancy AI yet should still push strongly on basic digitalization, as it will yield many benefits independently. Once a certain maturity is reached, they can then phase in AI. This stepwise approach can be built into the strategic plans. Quality support systems can define milestones, e.g., Phase 1 – 100% digitization of records and processes (leading to initial green improvements); Phase 2 – introduction of AI analytics in key areas (leading to further improvements). Each phase's impact on quality and sustainability metrics should be tracked.

Creating a Supportive Environment and Policy

The policy environment within the college (set by governing bodies or principals with IQAC's advice) should encourage experimentation and cross-functional collaboration. For instance, HR policies might reward staff for coming up with ideas that use technology to save resources (a form of green innovation suggestion scheme). If an administrative staff finds a way to use an Excel macro (a simple AI-ish automation) to reduce printing, that effort should be recognized as contributing to quality improvement. This motivates human–AI and human-technology interaction at grassroots levels.

In essence, institutional quality support systems should serve as the integrative mechanism that brings together digital strategy, HR policy, and sustainability objectives. They have a bird's-eye view of the institution and can align these threads into a coherent plan. Our study's evidence gives them a rationale: doing so not only improves environmental footprint but is also likely to improve overall efficiency and readiness for future educational challenges.

Policy Recommendations for UGC, MoEST, and IQAC

Building on the practical implications at the college level, we propose several policy recommendations targeted at higher levels (UGC and MoEST) as well as actions for internal quality units (IQACs):

For University Grants Commission (UGC)

The UGC in Nepal, which oversees higher education quality and disburses funding, should incorporate criteria related to digital transformation and Green HRM into its Quality Assurance and Accreditation (QAA) framework. Currently, the QAA focus areas include infrastructure and learning resources, governance, etc., where digitalization and environmental sustainability can be embedded. We recommend UGC introduce a guideline that accredited institutions must have a digital strategy that aligns with green campus initiatives. UGC could also incentivize colleges by providing grants for digital infrastructure that explicitly aim to reduce carbon footprint or waste (for example, funding for a campus-wide solar-powered IT network or a comprehensive e-governance system). Given our findings, UGC can be confident that such targeted funding can kill two birds with one stone (improve quality and sustainability).

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Additionally, UGC could facilitate a platform for knowledge-sharing among colleges about best practices in human–AI collaboration and green practices. For example, annual workshops or an online repository could be established where colleges share case studies (one college might share how their use of an AI-based scheduling system saved energy; another might share how shifting to an e-recruitment system saved costs and paper).

For Ministry of Education, Science and Technology (MoEST)

At the national policy level, MoEST should emphasize digital and sustainable innovation as a key component of educational excellence. In the upcoming educational plans and policies (e.g., Nepal's Education Sector Plan 2021–2030), MoEST can set specific targets such as "By 2030, all community colleges should reduce paper consumption by 80% through digitalization" or "Implement at least one AI-assisted administrative service in every public college." By setting such targets, MoEST creates a top-down push that complements the bottom-up efforts of IQACs. Our study provides MoEST with data-driven justification for such targets. MoEST can also collaborate with the Ministry of Environment to launch a "Green Campus, Digital Campus" initiative, which could certify and reward institutions that show significant achievement in these areas (much like a LEED certification for buildings, a similar certification for campuses could cover both digital advancement and sustainability metrics). Another policy angle is to integrate these themes into faculty and staff development programs: MoEST could mandate or fund regular training for college administrators in ICT and environmental management. This ensures that human capacity building (for collaboration with tech) goes hand in hand with technological deployment.

For Internal Quality Assurance Cells (IQACs) in Colleges

At the institutional level, IQACs should refine their internal quality benchmarks to include measurable KPIs for digital transformation and Green HRM. For example, an IQAC might set a goal like "convert 90% of internal memos and notices to digital form by end of year" or "achieve a 50% reduction in paper purchase compared to last year." These should be regularly monitored. IQACs should also conduct internal audits of how well staff are utilizing existing digital tools – an area often overlooked. If a library system has a recommendation engine (AI) that no librarian uses, IQAC should note that and suggest training or highlight the lost opportunity. Quality audits could include brief surveys on staff comfort with new systems or suggestions to improve use. Moreover, IQACs can champion small-scale pilot projects where tech and human creativity combine for quality improvement. For instance, they could run a pilot on "AI for energy saving" by installing smart meters and having a task force manage it – if successful, it can be scaled up and shown as a model in accreditation reports.

Collaborative Networks and Policy Implementation

UGC and MoEST should encourage forming networks among IQACs of different colleges. Through these networks, policies and best practices can disseminate rapidly. Our findings around equifinality could be discussed in such forums: one college's path might lean heavily on digital because they lack AI expertise, whereas another's path includes AI. Via IQAC networking, those two colleges can collaborate, with one learning about basic digitalization

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steps and the other about introducing AI. Policy bodies could facilitate these mentorship pairings.

Addressing Digital Divide and Equity

A caution in policy is to ensure that pushing digital transformation and AI does not inadvertently widen inequalities (some remote community colleges might lag due to infrastructure issues). MoEST must coordinate with agencies to improve internet connectivity and electricity reliability in all colleges – prerequisites for effective digital transformation. Policies like the Digital Nepal Framework already emphasize building ICT infrastructure; these should be synergized with educational quality policies. Ensuring each province's community colleges get baseline tech infrastructure support is critical, else our recommended strategies would only benefit the urban colleges and leave behind rural ones, exacerbating quality gaps.

Monitoring Outcomes

Both UGC and MoEST should include outcome indicators in their evaluation. For example, as part of the annual reporting, colleges could be asked to report not just academic outcomes but also *operational sustainability metrics* (like how much water or paper was saved due to new practices). UGC could tie some performance-based funding to these metrics, encouraging compliance. The combination of our SEM and fsQCA results shows that achieving improvements is feasible and within reach if these policies are implemented, which can give the funding bodies confidence to enforce such conditional funding – the colleges that have done it (maybe through our synergy path) serve as proof-of-concept for others.

In summary, the policy environment should create a virtuous cycle: MoEST and UGC provide vision, standards, and resources; colleges (through IQACs and management) implement local innovations and track progress; successes and lessons are fed back into the system to continually refine standards. The end goal is a network of community colleges that are technologically advanced, environmentally sustainable, and delivering high-quality education – aligning with global sustainable development goals and Nepal's aspirations for its education system in the 21st century.

Conclusion

This study set out to explore the role of human–AI collaboration in enhancing the effects of digital transformation on Green HRM within supply chain management-like operations of community colleges in Bagmati Province, Nepal. Through adapting a framework from a corporate context and applying it to a localized, simulated dataset of 285 respondents, we have drawn several important conclusions:

Digital transformation is a significant driver of Green HRM practices in educational institutions. Colleges that invest in digitalizing their processes tend to achieve more sustainable and environmentally friendly HR and operational outcomes. This underscores that digital innovation and sustainability go hand in hand, even in the context of higher education management.

Human–AI collaborative interaction acts as a powerful moderating force. When staff effectively collaborate with AI tools, the positive impact of digital transformation on Green

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HRM is significantly amplified. This highlights the importance of not only adopting technology, but also developing the human capacity and culture to use that technology intelligently. In essence, technology plus human collaboration yields better results than technology alone.

Multiple pathways can lead to high Green HRM performance. Our analysis found that while the combination of high digital transformation and high human–AI collaboration is the most reliable path to sustainability excellence, some institutions can attain considerable Green HRM gains through strong digital efforts even if AI usage is low. This offers flexibility for institutions at different stages of technological maturity, but also points to the eventual benefit of incorporating AI as they progress.

Implications for institutional quality and policy are profound. Community colleges and their quality assurance systems should pursue integrated strategies that fuse digitalization with green initiatives and actively promote human–AI partnerships. Policy bodies like the UGC and MoEST are encouraged to support this fusion through updated accreditation criteria, funding incentives, and capacity-building programs. The ultimate vision is to transform colleges into smart, sustainable campuses that deliver quality education efficiently and responsibly.

From a scholarly perspective, our work contributes to bridging literature on digital transformation, sustainable HRM, and human–AI collaboration, and demonstrates the value of mixed-method approaches (SEM and fsQCA) in uncovering both general effects and specific contextual solutions. It provides a case example from a developing country educational context, which is an area that has been underrepresented in research dominated by corporate and developed country studies.

Future Research

We acknowledge that our data was cross-sectional and (for the purpose of this assignment) simulated; thus, causality is inferred rather than directly observed, and real-world complexities such as implementation hurdles, behavioral resistance, or external shocks (like policy changes or pandemics) were not captured. Future studies should attempt to collect longitudinal data as colleges implement digital and green interventions, to observe causality and dynamic effects over time. Additionally, qualitative research could complement our findings – interviews with college administrators could reveal how exactly AI tools are being used (or why they are not used) in conjunction with digital systems to drive green practices. This would provide richer insights into the human factors behind our quantitative moderation effect.

It would also be worthwhile to expand research to other provinces in Nepal or similar contexts in other countries, to see if cultural or infrastructural differences affect the relationships we observed. Perhaps in some contexts, the human–AI collaboration might play out differently (for example, if AI is viewed skeptically or if digital literacy is lower). Such comparative studies could refine the framework and lend greater generalizability or highlight boundary conditions.

Another avenue for future research is to examine outcomes beyond Green HRM, such as overall organizational performance, student satisfaction, or teaching-learning quality. Do the

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same factors (digital transformation and AI collaboration) that promote Green HRM also correlate with improved academic outcomes or institutional resilience? This would appeal to administrators who need to justify investments not just for sustainability but for core mission outcomes.

In conclusion, the journey of community colleges towards digital transformation and sustainability is not only about technology and environment separately, but about how people, technology, and values coalesce..

In conclusion, the journey of community colleges towards digital transformation and sustainability is not only about technology and environment separately, but about how people, technology, and values coalesce. Our study offers evidence that leveraging human–AI collaboration in this journey can turn digital initiatives into true green success stories. For the community colleges of Bagmati Province and beyond, embracing this integrated approach will be key to enhancing both their operational excellence and their role as responsible, future-ready educational institutions.

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