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Students' Intention to Adopt Green ICT Practices in the Digital Transformation of Higher Learning Institutions: Evidence from Tanzania

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Abstract

Digital technologies have become deeply embedded in university life, but their use also brings familiar environmental challenges like increasing piles of e-waste, high energy demands, and an expanding carbon footprint that often goes unnoticed. These concerns prompted this study to look more closely at what actually motivates students in Tanzanian higher learning institutions to adopt Green ICT practices. This study uses Schwartz's Norm Activation Theory (NAT) to investigate the factors that influence students' intentions to embrace Green ICT practices. According to NAT, awareness of consequences (AGM) and ascription of responsibility (ARG) activate personal norms (PNG), a sense of moral obligation, and drive pro-environmental intentions. Based on this model, it was hypothesized that greater AGM and ARG would strengthen students' PNG and thereby increase their intention to use Green ICT. Through convenient sampling, a web-based survey was carried out with 536 students responding, and then the data were analyzed using Partial Least Squares Structural Equation Modeling. The findings provide strong empirical support for NAT variables, where awareness of consequences, ascription of responsibility, and personal norms significantly positive influence on students' intention to adopt green ICT practices, with PNG emerging as the strongest determinant. ARG exerts a greater influence on PNG than AGM, highlighting the role of students' accountability in activating moral norms. Importance–Performance Map Analysis reveals that PNG has the highest total effect but moderate performance, suggesting opportunities for targeted interventions. This study contributes theoretically by extending NAT to the context of digital sustainability in African higher education and demonstrates methodological rigor via PLS-SEM and IPMA. Further, the findings provide that universities and policymakers should enhance students' awareness of ICT environmental consequences and reinforce their sense of personal responsibility. Integrating green computing topics into curricula and promoting institutional policies can thus strengthen the students' personal norms toward eco-friendly ICT, fostering sustainable practices in higher education.

Keywords: Green ICT practices, Norm Activation Theory, Intention to Adopt, Higher Learning Institutions, Tanzania

Introduction

Higher learning institutions (HLIs) worldwide are rapidly embracing digital transformation, integrating Information and Communication Technologies (ICT) into teaching, learning, and administrative processes. While this shift enhances access, efficiency, and competitiveness, it also introduces environmental challenges that demand urgent attention. The increasing dependence on ICT is associated with higher energy consumption, greenhouse gas (GHG) emissions, and electronic waste, underscoring the need for sustainable digital strategies. Green ICT offers a pathway to mitigate these impacts by promoting energy efficiency, extending device lifespans, reducing ICT-related waste, and conserving natural resources (Tariq & Khalid, 2023).

Green ICT, also referred to as Green IT, encompasses the environmentally responsible design, manufacturing, use, and disposal of ICT resources, including computers, servers, monitors, printers, storage devices, networking infrastructure, and communication systems (González-Zamar et al., 2020). Drawing on Molla et al. (2009), Freitag et al. (2021), and Charfeddine and Umlai (2023), as a coordinated approach involving policies and practices that reduce ICT's environmental footprint through efficient use, responsible sourcing, and sustainable end-of-life management. In the context of HLIs, Green ICT is particularly relevant given the increasing integration of digital tools into teaching, learning, and administration. The rising number of ICT devices in use, coupled with rapid technological obsolescence, has intensified environmental pressures in areas where e-waste management systems are often underdeveloped. Scholars emphasize that addressing these challenges requires a holistic approach across the ICT life cycle, including green design, manufacturing, usage, and disposal (Bazila et al., 2022). Within an HLI setting, green ICT may include user practices such as the frequency of using energy-efficient device operation, responsible e-waste recycling, and the adoption of cloud-based services to reduce physical resource consumption. For students, who represent the largest ICT user group in universities, understanding and adopting such practices is essential for aligning institutional digital transformation with broader environmental sustainability goals.

Although research on Green ICT adoption is well established at the organizational level, the sustainability of digital transformation in higher education also depends on the behavior of individual users. Students, as the majority primary ICT consumers in HLIs, influence energy demand, device usage patterns, and e-waste generation. Examining their behavior is therefore essential for developing effective institutional strategies that ensure ICT use is environmentally friendly. This study adopts the Norm Activation Theory (NAT) as its guiding framework. Originally proposed by Schwartz (1977), NAT is widely used to explain pro-environmental behavior by focusing on personal norms, awareness of consequences, and ascription of responsibility. It provides that individuals are more likely to engage in environmentally responsible actions when they feel a moral obligation activated by their awareness of environmental harm and their perceived responsibility to act.

The urgency for HLIs to embrace Green ICT is amplified by growing global environmental awareness and the rising scale of ICT integration in essential academic and administrative services. In Tanzania, student enrollment in HLIs exceeded 200,000 by 2022 (United Republic of Tanzania (URT), 2022), necessitating expanded ICT infrastructure to manage functions such as admissions, registration, payments, course management, grading, and communication (Ali & Frew, 2010; Masele & Rwehikiza, 2024; Kayanda et al., 2020). While these systems improve information flow, stakeholder engagement, and institutional visibility, they also contribute to environmental pressures if not managed sustainably. Recent reports highlight that higher learning institutions in Tanzania face growing challenges related to e-waste accumulation and inefficient energy use. For instance, Bazila et al. (2022) found that public universities experience frequent power overuse due to outdated ICT infrastructure and poor energy management, while discarded computers and electronic peripherals from university labs and offices contribute significantly to the country's estimated 7,000 to 10,000 tonnes of annual e-waste (URT, 2023). The absence of formal e-waste recycling programs within most HLIs further exacerbates environmental risks, underscoring the urgency of adopting Green ICT practices. Hazardous substances such as lead, cadmium, and mercury from discarded electronics often contaminate soil and water, posing severe health and environmental risks. Alarmingly, less than 1% of e-waste in Africa is formally recycled, underscoring the lack of infrastructure and policy enforcement. The triple bottom line approach underscores that institutions aiming for global digital competitiveness must integrate environmental considerations into their digital transformation processes (Hashim et al., 2022).

The environmental costs of ICT use are significant. Data centers alone contribute an estimated 3% of global GHG emissions—comparable to the airline industry—due to their intensive energy demands for data storage, processing, and cooling (Zhu et al., 2023). Additionally, the entire ICT lifecycle, from production to disposal, generates e-waste containing hazardous materials (Velte et al., 2008; Molla et al., 2009; Bhaskar & Kumar, 2018). Green ICT strategies such as energy-efficient data centers, cloud computing, and responsible e-waste management can reduce these impacts while maintaining operational performance (Velte et al., 2008; Hashim et al., 2022). Scholars like Mattern, Staake, and Weiss (2010) advocate for smart ICT use that is both ecological and energy-efficient, while Parmentola et al. (2022) highlight that Green ICT and ICT for Green are complementary, converging in the vision of Green ICT for Green.

Despite these environmental concerns and the documented benefits of Green ICT, research on user-level practices in HLIs, particularly in developing countries like Tanzania, remains limited (URT, 2023). Existing studies tend to focus on institutional adoption (Kirui et al., 2023; González-Zamar et al., 2020; Suryawanshi & Narkhede, 2015), however, a significant research gap exists in understanding the individual-level adoption of Green ICT practices within Tanzania's HLIs**.** While institutional policies and infrastructure are often studied, there is limited empirical evidence on how students perceive, engage with, and contribute to sustainable ICT use. This gap is critical because students' behaviors directly affect the success of green initiatives, especially in environments where policy enforcement and technical infrastructure are still evolving (Gholami et al., 2013; Tushi et al., 2014). Evidence also suggests a gap between users' intentions and their actual sustainable ICT practices (Pollard, 2015), pointing to the importance of identifying behavioral drivers and barriers. From an operations and management perspective, Green ICT adoption is not only an environmental concern but also a resource-efficiency issue affecting energy use, e-waste control, digital infrastructure sustainability, and institutional cost management. By applying PLS-SEM and IPMA, this study offers decision-support evidence for prioritizing behavioral interventions that can improve sustainable ICT operations in higher learning institutions in three ways; First, it extends the Norm Activation Theory to Green ICT adoption intentions among students in Tanzanian higher learning institutions, a context that remains underrepresented in digital sustainability literature. Second, it shifts attention from institutional-level Green ICT adoption to student-level behavioral intention, thereby addressing the role of individual users in sustainable digital transformation. Third, it applies PLS-SEM and IPMA to identify not only statistically significant predictors but also priority areas for managerial intervention.

Literature Review

The Norm Activation Theory

Although the field of technology adoption research is rich with established models such as the Technology Acceptance Model (TAM), the Theory of Planned Behavior (TPB), and the Unified Theory of Acceptance and Use of Technology (UTAUT), these frameworks mainly explain adoption from a rational or utilitarian perspective. Their core predictors, such as perceived usefulness, ease of use, performance expectancy, or effort expectancy, assume that individuals adopt technology because it improves efficiency or enhances functional performance (Davis, 1989; Ajzen, 1991; Venkatesh et al., 2012). While this logic fits general ICT adoption, it does not align well with behaviors motivated primarily by environmental protection rather than personal efficiency. Green ICT practices differ because they often require self-sacrifice, involve collective environmental outcomes, and may not offer immediate personal benefits (Onwezen et al., 2013). As Jaffar and Latiff (2024) and Steg et al. (2014) note, pro-environmental actions are usually driven by altruistic, moral, and normative motivations, not just instrumental ones. For example, recycling electronic waste, reducing unnecessary printing, or buying energy-efficient devices are behaviors valued more for environmental stewardship than for functional gain. In these cases, traditional ICT adoption constructs like performance expectancy or perceived usefulness are weak predictors of intention (Kaiser et al., 2020).

Furthermore, the Value Belief Norm theory (Stern et al., 1999) is closely related to the NAT (Schwartz, 1977), as both emphasize moral and normative drivers of pro-environmental behavior. However, VBN incorporates broader value orientations and general ecological worldviews, making it more suited to explaining long-term environmental activism and lifestyle choices. This study adopts the NAT because its major focus is on specific, context-bound behaviors. The behaviors are articulated when are understand the consequences of their actions and take responsibility; in turn, these pro-environment behaviors trigger personal moral norms. Once activated, personal norms exert a strong motivational force toward action. In Sub-Saharan Africa (SSA), several studies have used NAT to understand environmental and sustainability behaviors, though applications in the ICT domain are sparse. For instance, research in Ghana and Nigeria (Abalansa et al., 2021) demonstrates that moral obligation and environmental awareness strongly influence waste management and conservation practices, even in low-resource settings. However, ICT specific applications such as e-waste recycling, energy-efficient device use, and digital carbon footprint reduction are rarely investigated through NAT in SSA.

Recent empirical evidence confirms the superior suitability of NAT for explaining sustainability-related ICT behaviors, particularly in higher education contexts where moral values and environmental consciousness are key behavioral drivers (Dalvi-Esfahani et al., 2020; Jang & Kim, 2023; Tariq & Khalid, 2023). Unlike other behavioral models that emphasize intention or external control, NAT provides a deeper understanding of internal motivations, making it particularly suitable for exploring student behavior in Tanzanian HLIs, where formal enforcement mechanisms are limited, and personal values play a critical role in shaping sustainable outcomes. By grounding the study in NAT, this research foregrounds the moral–normative mechanisms that underpin students' Green ICT adoption intentions, offering a theoretically distinct and contextually appropriate alternative to mainstream technology-adoption models whose explanatory power is limited in pro-environmental domains.

Personal Norms and Green ICT Adoption

While the adoption of Green ICT practices shares some similarities with the adoption of other technological innovations, the literature underscores important distinctions grounded in environmental ethics and sustainability concerns. Unlike general ICT adoption, Green ICT decisions often involve a moral dimension where individuals perceive an obligation to act in environmentally responsible ways. Within the NAT framework, this moral dimension is captured through *personal norms*, which represent a self-expectation to engage in green behaviors when an individual is aware of the consequences and feels personally responsible for them (Schwartz, 1977). Prior research on technology adoption models such as the Green IT Adoption Model (GITAM) (Molla et al., 2009) highlights the role of organizational, technological, and environmental factors in shaping adoption intentions. However, in individual-level contexts like HLIs, moral drivers may play an equally, if not more, significant role. Studies in Sub-Saharan Africa have shown that when students internalize environmental values, they are more likely to translate those values into concrete behavioral intentions (Abalansa et al., 2021; Masele & Rwehikiza, 2024).

Further, when organizations adopt green ICT, financial cost, infrastructure readiness, and leadership commitment dominate the decision (Molla et al., 2011; Hankel et al., 2019), while student adoption is dominated by the behavioral ecosystem shaped by institutional culture, peer norms, and resource access. In the context of Tanzania's digital transformation of HLIs, personal norms function as an ethical anchor, motivating students to align their ICT practices with sustainability goals. Strengthening these norms through awareness programs, experiential learning, and institutional policy could be instrumental in translating environmental values into sustained behavioral intentions toward Green ICT. Thus, we hypothesize that:

H1: Students' personal norms have a positive influence on their intention to adopt Green ICT practices.

Awareness of Consequences and Personal Norms

Studies have explored the significant role of awareness of consequences (AGM) in recognizing the environmental harm of unsustainable behaviors that influence personal moral norms (PNG), which in turn drive pro-environmental intentions. For instance, recent research in tourism demonstrated that visitors who perceived the environmental impact of plastic waste developed stronger moral obligation norms, which were the most influential predictors of their waste-reduction intentions (Jaffar & Latiff, 2024). Likewise, in a consumer behavior context, personal norms were shown to mediate the effects of environmental concern on sustainable purchasing decisions (Dong et al., 2024). Furthermore, integrated behavioral models applied to energy-efficient smart home usage reaffirm that AGM significantly contributes to the formation of PNG, which then strongly influences behavioral intention, more likely than traditional cognitive drivers, such as attitude or perceived behavioral control (Zharova & Lee, 2022). These findings illustrate how awareness contributes more to displaying moral obligation, even in technology-related sustainability contexts.

Recent empirical work demonstrates that AGM can also independently predict behavioral intention by emphasizing the sense of urgency and perceived moral salience of individuals (Bamberg & Möser, 2007; Dong et al., 2024). For example, in studies on sustainable consumption, individuals with high levels of understanding the environmental impacts of electronic waste displayed stronger direct intentions to recycle and adopt energy-saving practices, even before fully activating their personal norms (Nguyen et al., 2019; Cudjoe et al., 2022). In technology adoption contexts, AGM has been found to significantly shape green innovation intentions through an increasing perceived relevance and personal responsibility of consumers toward environmental issues (Liu et al., 2022). In higher education, awareness campaigns and sustainability training have been shown to directly enhance individuals' willingness to engage in environmentally friendly ICT practices, such as reducing unnecessary device usage, adopting cloud-based storage, and participating in e-waste collection programs (Hashim et al., 2022). Therefore, we hypothesize that:

H2: Students with high levels of awareness of consequences positively influence their intention to adopt green ICT practices.

H3: Students with high levels of awareness of consequences positively influence their personal norms.

Ascription of Responsibility and Behavioral Intention

In NAT, ascription of responsibility (ARG) is an important variable that connects awareness of consequences and the development of personal norms (Schwartz, 1977). ARG refers to the extent to which individuals feel personally accountable for the negative environmental consequences that may result from their actions (Han, 2021). While personal norms represent an internalized moral obligation, ARG reflects the cognitive acknowledgment that an individual has a role in ensuring a green environment (Onwezen et al., 2013). Studies have consistently argued that individuals with levels of ascription of responsibility and those with higher levels are more likely to ascribe responsibility when confronted with pro-environmental behaviors, and they perceive environmental stewardship as part of their personal responsibility (Zhang et al., 2023; Dong et al., 2024). In higher education settings, students who believe they are personally responsible for mitigating the environmental consequences of ICT use may be more likely to develop behaviours that trigger their intention to adopt Green ICT practices, even in the absence of strong external pressures (Abdulrazak & Quoquab, 2018). This supports the idea that internal responsibility can function as an independent motivational driver,

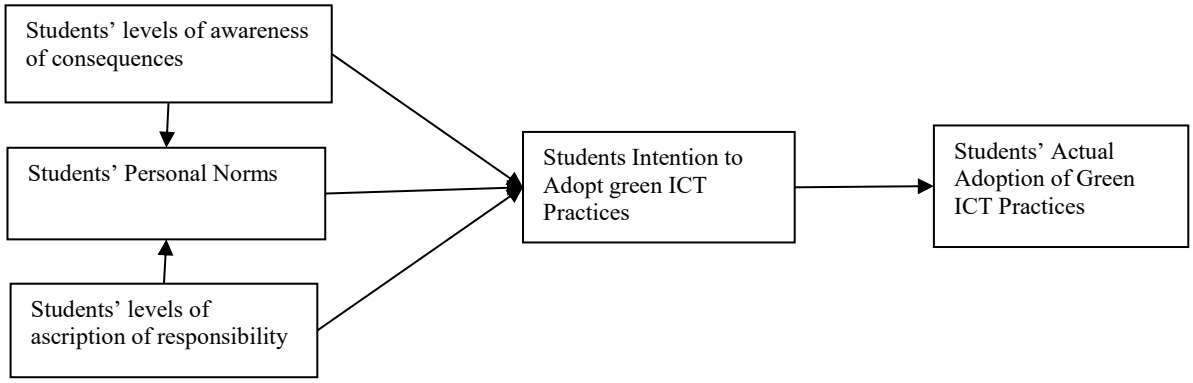
Moreover, ARG plays a central role in shaping personal norms. When individuals ascribe that their actions have direct environmental consequences, they are more likely to develop a moral obligation to act sustainably (Han & Hyun, 2018; Chwialkowska, 2019). For example, in studies of sustainable tourism and energy conservation, individuals with some levels of ascription of responsibilities in a consistent manner demonstrated stronger personal norms, which in turn mediated environmentally responsible intentions (Stern et al., 1999). In the Green ICT context, this suggests that students who develop individual responsibility for digital transformation practices are more likely to cultivate enduring personal norms that reinforce sustainable ICT adoption. Thus, we hypothesize that:

H4: Students with higher levels of ascription of responsibility positively influence their intentions to adopt Green ICT practices.

H5: Students with higher levels of ascription of responsibility positively influence their personal norms.

Combining the empirical and theoretical reviews, a robust framework for connecting the NAT variables and students' intentions to adopt Green ICT practices in higher learning institutions is developed, as shown in Figure 1.

Figure 1. The conceptual model



Methods

The study looked at students' intentions in Tanzanian HLIs. Because students are easily accessible via institutional communication channels and web-based surveys are appropriate for this demographic, a convenience sampling strategy was used. Convenience sampling is commonly used in behavioral and educational research, especially when testing a theory rather than generalization to the population level (Hair et al., 2019). It also complies with the requirements of using partial least squares structural equation model (PLS-SEM) as analytical methodology (Sarstedt et al., 2022). Although this strategy may limit the overall generalizability of the findings, efforts were made to recruit students from a variety of academic backgrounds and levels of study in order to increase diversity and representativeness. An online poll was conducted between November 2023 and March 2024 among university students in Tanzania. The questionnaire reached over 1,000 students from various disciplines and years of study, including engineering, computer science, business, geology, chemistry, and wildlife studies. Before filling out the survey, students were required to read the explanations of the key terms on green ICT practices provided online as a requirement to open the online survey. Only 989 students met the requirement of the survey, out of which 880 completed it, yielding an 89% response rate. After data cleaning to remove incomplete or inconsistent responses, the final sample comprised 536 students (60.9%). The sample was gender-balanced (42.9% male, 57.1% female) and represented a range of academic programs. Most respondents were first-year students and had completed at least two online courses, indicating substantial exposure to ICT-supported learning environments. Table 1a presents the demographic characteristics of the respondents, while Table 1b summarizes their academic background and online-course experience.

Table 1a: Demographic characteristics of respondents

Demographic characteristic	Category	Frequency	Percentage
Gender	Male	230	42.90%
	Female	306	57.10%
Total		536	100.00%

Note. Percentages were recalculated based on the final valid sample size, n = 536.

Table 1b. Academic and online-course experience of respondents

Academic/experience characteristic	Category	Frequency	Percentage
Degree discipline	Accounting	182	34.00%
	Finance	75	14.00%
	Banking and Financial Services	59	11.00%
	Marketing	48	9.00%
	Human Resources Management	43	8.00%
	Business Information Technology	43	8.00%
	Procurement and Supply Chain Management	21	3.90%
	Chemistry	11	2.10%
	Wildlife and Conservation	11	2.10%
	Computer Science	1	0.20%
	Petroleum Chemistry	5	0.90%
	Geophysics	5	0.90%
	Geology	5	0.90%
	Tourism Management	2	0.40%
	Other disciplines	25	4.60%
		536	100.00%
Experience in online courses	One course	59	11.00%
	Two courses	247	46.10%
	Three courses	129	24.10%
	Four courses	32	6.00%
	Five courses	21	3.90%
	More than five courses	48	9.00%
		536	100.00%
Year of study	Year 1	476	88.7%
	Year 2	11	2.1%
	Year 3	38	7.1%
	Year 4	11	2.1%
		536	100.00%

Measurements

All constructs in this study were measured using reflective indicators grounded in the NAT. The items were adapted from previous studies and tailored to the study context. Students' awareness of consequences, ascription of responsibility, personal norms, and intention to adopt Green ICT practices were assessed through relevant indicators. Data analysis was conducted using Structural Equation Modeling (SEM) by the use of SmartPLS 4.0 (Sarstedt et al., 2022). The descriptive statistics, outer loadings, composite reliability (CR), and average variance extracted (AVE) were measured to assess the quality. Instrument reliability was examined using Cronbach's alpha and CR, while discriminant validity was assessed by comparing the square root of AVE values with inter-construct correlations (Hair et al., 2024; Henseler et al., 2015) and the HTMT ratios. A preliminary study was carried out by distributing online survey forms to a student WhatsApp group from one of the universities in Tanzania to assess the feasibility of conducting the main study. A total of 30 students completed the survey. The responses were analyzed using SPSS 26.0, and the results showed that the Cronbach's alpha values for all variables exceeded 0.7. Based on these findings and following the recommendations of Hair et al. (2019), the questionnaire was considered reliable. As shown in Table 2, all CR values ranged between 0.7 and 0.95, confirming internal consistency of the constructs. Further, all the AVE values exceeded the recommended threshold of 0.5, indicating satisfactory convergent validity existed.

Table 2: Descriptive Statistics, Construct Reliability and Validity

Construct	Items	Loading	Mean	SD	CR	AVE
Students' levels of awareness of consequences (AGM)	I am aware that e-waste generated from computing equipment increases global warming. (AGM1)	0.802	7.8	0.5	0.872	0.643
	I am aware that disposing off e-items informally is harmful to our environment. (AGM2)	0.786				
	I am aware that formally disposing off e-items is costly but sustainable to our environment (AGM3)	0.770				
	I am aware that computers and other e-devices generate carbon dioxide (CO2) and its negative consequences. (AGM4)	0.814				
	I am aware that Environmental quality will improve if we manage e-waste more efficiently (AGM5)	0.836				
	I am aware that energy-saving e-devices help reduce global warming (AGM6)	0.769				
	I am aware that printing both sides saves the use of paper and thus the environment (AGM7)	0.786				
Students' levels of ascription of responsibility (ARG)	I feel responsible that practicing green computing is beneficial for green universities (ARG1)	0.870	5.3	0.6	0.891	0.587
	I feel responsible that practicing green computing can save the university's budget (ARG2)	0.833				
	I feel responsible that green computing practices are valuable in reducing local environmental damage (ARG3)	0.812				
	I feel responsible that practicing green computing can reduce global warming (ARG4)	0.816				
	I feel responsible for the disposal of solid and toxic e-wastes (ARG5)	0.786				
	I ascribe more to e-documents than paper documents (ARG6)	0.813				
Students' Personal Norms (PNG)	It would be against my moral principles not to use five-star energy e-devices in my university studies (PNG1)	0.731	5.6	0.7	0.845	0.610
	Not caring about the environment would go against my principles (PNG2)	0.812				
	I have a moral obligation to use green e-devices in my university studies (PNG3)	0.799				
	I would feel guilty about not using green e-devices in my university studies (PNG4)	0.783				
	If I were to buy a new appliance, I would feel morally obliged to buy an energy-efficient one (PNG5)	0.805				
	People like me should do everything they can to reduce e-waste (PNG6)	0.642				
Students' Intention to Adopt Green ICT Practices (IAG)	I may make extra efforts to purchase green IT devices. (IAG1)	0.79	5.8	0.5	0.860	0.647
	I may inform my colleagues about green computing benefits. (IAG2)	0.774				
	I may inform the administration about savings from green computing. (IAG3)	0.792				
	I may encourage colleagues to be more paperless in their studies. (IAG4)	0.805				
	I may install software on my devices that reduces overall greenhouse gas emissions. (IAG5)	0.857				
	I may encourage colleagues to use e-resources as compared to library printed books. (IAG6)	0.807				

Note: n = 536

Further, the study examined discriminant validity, which assures that the constructs are distinct. According to Sarstedt et al. (2020), discriminant validity is verified when the cross-loading of a latent variable exceeds that of any other construct. The Heterotrait-Monotrait ratio (HTMT) of correlations was employed to determine discriminant validity because it is the most accurate method (Sarstedt et al., 2020).

The HTMT values of 0.85 and 0.90 serve as reference points for determining discriminant validity between independent and dependent constructs. Three main characteristics of the HTMT analysis stand out: (a) the more conservative critical value (0.85); (b) the more liberal critical value (0.90); and (c) the HTMT inference, which should be less than the bootstrapping threshold of 1. HTMT inference is utilized to confirm the discriminant validity of all construct measures. The results confirmed discriminant validity, as all HTMT values were below the threshold of 0.85, as shown in Table 3. It was also confirmed that all HTMT values are significantly different from 1, indicating discriminant validity.

Table 3. Heterotrait-Monotrait Values

	AGM	PNG	IAG	ARG
AGM				
PNG	0.731 $CI_{0.90}$[0.646; **0.805**]			
IAG	0.608 $CI_{0.90}$[0.500; **0.706**]	0.576 $CI_{0.90}$[0.467; **0.674**]		
ARG	0.737 $CI_{0.90}$[0.639; **0.820**]	0.648 $CI_{0.90}$[0.548; **0.737**]	0.439 $CI_{0.90}$[0.316; **0.549**]	

Common Method Bias Analysis

Given the reliance on self-reported surveys, the potential for common method bias (CMV) was recognized. CMV can arise from systematic biases in the measurement instrument, which could artificially inflate relationships between variables (Podsakoff et al., 2003). To address this concern, a two-step approach was employed. First, Harman's single-factor test (Podsakoff et al., 2003) was conducted using unrotated factor analysis in SPSS. The results showed that the first unrotated factor accounted for 29.62% of the variance, well below the critical threshold of 50% (Hair et al., 2017). Second, Mardia's test (Hair et al., 2017) was applied to assess multivariate normality using Web Power. Although significant deviations from normality were detected (Mardia's skewness: $\beta = 2.798283$, $p < 0.01$; Mardia's kurtosis: $\beta = 72.311914$, $p < 0.01$), PLS-SEM is known to be robust to such violations (Hair et al., 2017). These findings indicate that CMV is unlikely to significantly threaten the validity of the results.

Validation of the structural model

The effectiveness of a theoretical model is determined by the strength of each structural path and the overall predictiveness (R^2) of its exogenous constructs (Hair et al., 2019). As shown in Figure 2, the R^2 value was 0.413, indicating that the three sets of latent variables—awareness of consequences, personal norms, and ascription of responsibility—accounted for 41% of the variance in the dependent variable (Intention to adopt Green ICT). According to the results obtained from PLS (Ringle et al., 2020), the model demonstrates strong predictability, with an R^2 of 0.413 for the dependent variable. Additionally, the Q^2 value was used to evaluate the model's predictive relevance, which reflects the model's out-of-sample predictive power. In SEM, a Q^2 value greater than 0 indicates predictive relevance for a given endogenous construct. Blindfolding was performed at a distance of seven to calculate the Q^2 values (Hair et al., 2017). The Q^2 values for IAG, PNG, and ARG were 0.215, 0.294, and 0.271, respectively. Since all Q^2 values exceeded zero, they provide evidence of the model's predictive relevance for each endogenous latent variable.

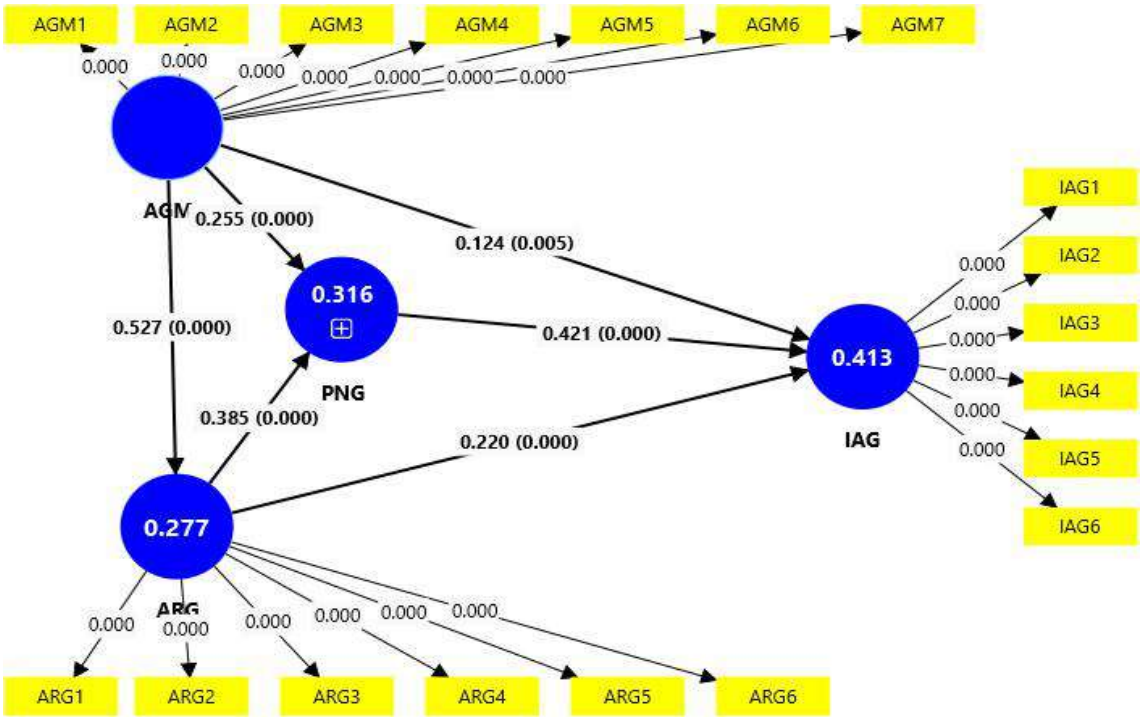


Figure 2: Structural model results

Hypotheses Results

To achieve a comprehensive analysis, SEM can assess the measurement model by evaluating the loading of observed items onto their corresponding constructs. It can also examine the structural model, which reflects the assumed causal relationships between dependent and independent latent variables (Hair et al., 2017). By analyzing the significance of T-values for each path coefficient and the bias-corrected confidence intervals, the significance of the path coefficients (b1-b6) can be determined (Sarstedt et al., 2020). The properties of the causal paths, including standardized path coefficients (β), t-values, and explained variances (R^2), are provided in Table 4. Regarding the intention to adopt Green ICT practices in HLIs, the findings show that awareness, personal norms, and ascription of responsibility (PNG) significantly influence intention to adopt Green ICT (IAG) ($\beta = 0.421$, $p < 0.001$). Additionally, awareness of Green ICT management (AGM) has a significant effect on IAG ($\beta = 0.124$, $p < 0.01$), and AGM also significantly influences personal norms (PGN) ($\beta = 0.255$, $p < 0.001$). Furthermore, ARG significantly impacts IAG ($\beta = 0.220$, $p < 0.001$) and PNG ($\beta = 0.385$, $p < 0.001$). Therefore, hypotheses H1-H5 are statistically supported.

Table 4: Direct Effect between the constructs

Hypotheses	Path	Beta	SD	t-Value	*P-Values*	Confidence interval (95%)	Decision
H1	PNG -> IAG	0.421	0.097	4.350***	0.000	[0.314;0.515]	Confirm
H2	AGM -> IAG	0.124	0.048	2.588**	0.005	[0.036;0.208]	Confirm
H3	AGM -> PNG	0.255	0.038	6.742***	0.000	[0.162;0.348]	Confirm
H4	ARG -> IAG	0.220	0.056	3.949***	0.000	[0.111;0.322]	Confirm
H5	ARG -> PNG	0.385	0.090	4.281***	0.000	[0.285;0.478]	Confirm

Notes: ** P<0.01, ***p<0.001

Importance-Performance Map Analysis

To complement the structural model results, an Importance–Performance Map Analysis (IPMA) was conducted using students' intention to adopt Green ICT practices as the target construct. IPMA extends the interpretation of PLS-SEM results by combining each predictor's total effect, representing importance, with its average latent variable score, representing performance. This approach helps identify constructs that are important for explaining intention but have relatively lower performance, thereby indicating priority areas for managerial intervention. As illustrated in Figure 3, the IPMA results show that personal norms had the highest importance in predicting intention to adopt Green ICT practices, while its performance remained moderate. This suggests that interventions in higher learning institutions should prioritize strategies that strengthen students' moral obligation toward sustainable ICT use, such as Green ICT awareness campaigns, integration of green computing topics into curricula, and visible institutional support for responsible e-waste and energy management.

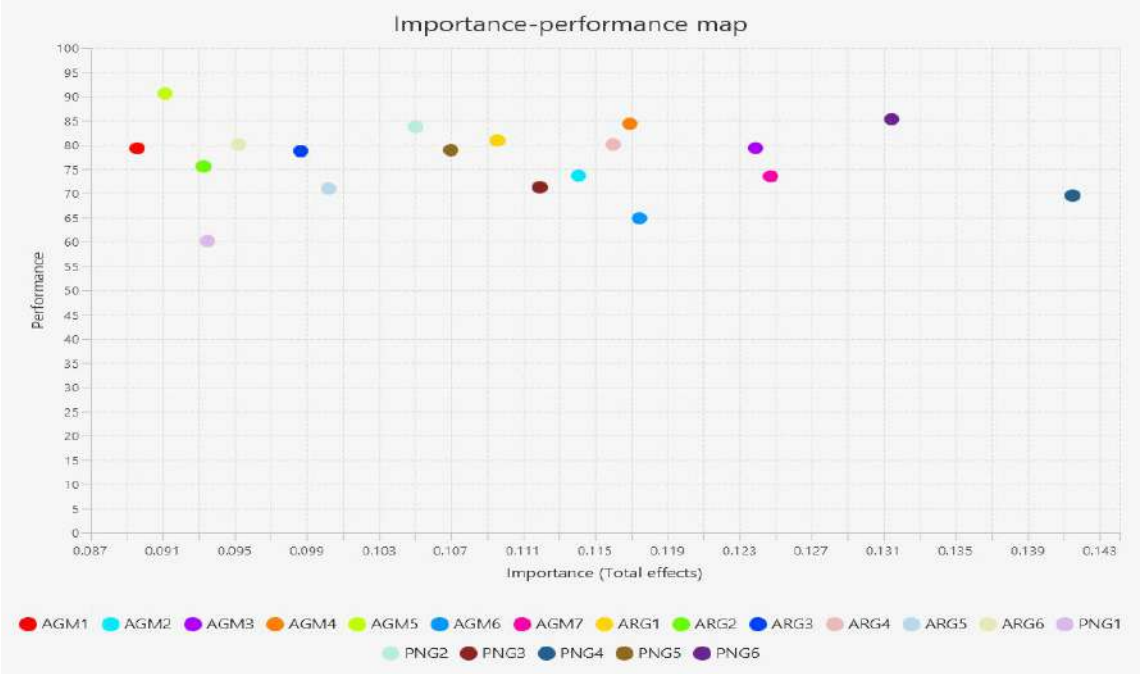


Figure 3: Importance-Performance Map matrix for IAG

Discussion of Findings

The study captured the NAT variables to test the students' intentions to adopt Green ICT practices in Tanzanian higher learning institutions results provide significant empirical support for NAT variables, providing that awareness of consequences (AGM), ascription of responsibility (ARG), and personal norms (PNG) are significant predictors of Green ICT practices adoption intentions. The model explained a significant fraction of the variance in intention ($R^2 = 0.413$), demonstrating that moral normative mechanisms are crucial for understanding environmentally responsible ICT behavior among students. Personal norms emerged as the strongest predictor of adoption intention ($\beta = 0.421$), which aligns with NAT's proposition that internalized moral obligation is the focal to triggering the pro-environmental behavior. This effect is likely amplified in Tanzanian HLIs by institutional and cultural emphasis on collective well-being and responsible citizenship, which are reinforced through codes of conduct, shared resource stewardship, and community engagement in academic life (URT, 2022; Mtebe & Raphael, 2017). Such institutional socialization aids in the transformation of environmental concerns into moral self-expectations, which are well-known motivators of sustainable behaviour.

ARG has a stronger influence on PN ($\beta = 0.385$) than AC ($\beta = 0.255$). In theory, awareness offers cognitive understanding of environmental harm; however, responsibility personalizes that hurt and translates information into a felt duty, which is precisely the activation pattern predicted by NAT. Contextually, Tanzanian HLIs encounter apparent constraints such as power outages, aged laboratory equipment, and limited institutional e-waste systems, making the environmental effects of ICT use visible and traceable to daily decisions. When students understand that keeping devices on, excessive printing, or informal peripheral disposal directly adds to campus-level consequences, ARG becomes a more powerful trigger of moral standards than AGM alone. Furthermore, while AGM is a strong predictor of PNG and intention ($\beta = 0.255$ for PN and $\beta = 0.124$ for intention), information alone does not typically lead to long-term behavior change without a moral framework and accountability. Competing demands in resource-constrained colleges, such as assuring assessment reliability using printed materials, procuring low-cost gadgets, or maintaining equipment operational to fulfill coursework deadlines, can weaken the motivational force of learning. Awareness is most effective when incorporated in narratives of stewardship and duty, especially when the environmental impact of digitalization (energy overuse, increased e-waste) is obvious locally. These contextual forces help to explain why AGM is substantial but less powerful than ARG in shaping PNG and intention to use Green ICT activities.

NAT holds that AGM and ARG predominantly impact behavior through PNG. The results found significant routes AGM→PNG, ARG→PNG, and PNG→ Intention suggests indirect effects from AGM and ARG to intention through PNG, consistent with moral-norm activation (Schwartz, 1977; De Groot & Steg, 2009). In practice, this means that interventions should go beyond simply providing information to pupils in order to foster ethical identity and personal responsibility. For example, by emphasizing sustainable ICT use, such as duplex printing, idle power management, and responsible e-waste disposal, as essential components of being a responsible member of the university community.

The Importance-Performance Map Analysis (IPMA) reveals that PNG has the greatest overall effect on intention but only modest performance, indicating unfulfilled potential. Indicators related to micro-behaviors have a high importance but variable performance, implying that little daily ICT choices are

underutilized moral triggers. Prioritizing these levers through curriculum integration, default settings, and peer-led campaigns can improve PNG performance where it counts the most (Hair *et al*., 2019). In Tanzanian HLIs, combining these micro nudges with visible institutional commitments to e-waste collection and energy management will align student responsibility with collective action. A vital step beyond awareness efforts is the formal incorporation of Green ICT principles into relevant courses such as introductory IT, business ethics, and sustainability modules. Including these principles in core curricula can help to establish moral norms from the bottom up, ensuring that students not only understand environmental effects but also absorb responsibility as part of their academic and professional identities. This approach progresses from ad hoc activities to a planned, long-term strategy for promoting pro-environmental ICT behaviors.

Conclusions

This study demonstrates that moral normative factors, as explained by the Norm Activation Theory, are pivotal in shaping students' intentions to adopt Green ICT practices in Tanzanian higher learning institutions. Through highlighting the influence of personal norms, responsibility, and awareness, the findings brought out that sustainable digital transformation depends not only on technical solutions but on fostering ethical commitment among users. The commitments were depicted as the individuals being aware of consequences, ascribing to responsibility, and developing personal norms. For universities, this means embedding sustainability into institutional culture and academic programs, ensuring that environmental responsibility becomes a core value rather than an optional practice. These insights provide a foundation for targeted strategies that align digital growth with ecological stewardship, contributing to broader sustainability goals in higher education.

Limitations and Future Research

This study provides useful information but has some limitations. First, the use of a student-only sample in Tanzanian HLIs restricts generalizability, especially since the majority of participants were income-dependent, which may have influenced Green ICT adoption decisions. Future research should include staff members like lecturers, administrators, and support staff to provide a more complete picture. Second, the sample used for analysis was strongly biased toward first-year students, which reflected institutional enrollment trends but limited representativeness. Stratified sample or balanced year-level inclusion is recommended, as well as comparison research to investigate how experience and academic development influence green ICT attitudes. Professional, practice-specific insights. Third, demographic characteristics were not controlled, leaving open questions about the impact of program type and enrollment number; future research should address these dimensions. Fourth, the difference between intention and actual usage is worth investigating, possibly through mediators such as perceived utility. Fifth, social conformity and institutional issues, particularly the involvement of higher education commissions, were not investigated. Future research should look into these external influences. Finally, this study evaluated Green ICT practices in general; specialized examinations on specific practices may give deeper and practice-specific insights.

References

Abalansa, S., El Mahrad, B., Icely, J., & Newton, A. (2021). Electronic waste, an environmental problem exported to developing countries: The good, the bad and the ugly. *Sustainability, 13*(9), Article 5302. https://doi.org/10.3390/su13095302

Abdulrazak, S. R., & Quoquab, F. (2018). Exploring consumers' motivations for sustainable consumption: A self-deterministic approach. *Journal of International Consumer Marketing, 30*(1), 14–28. https://doi.org/10.1080/08961530.2017.1354350

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Ali, A., & Frew, A. J. (2010). ICT and its role in sustainable tourism development. In U. Gretzel, R. Law, & M. Fuchs (Eds.), *Information and communication technologies in tourism 2010* (pp. 479–491). Springer. https://doi.org/10.1007/978-3-211-99407-8_40

Bamberg, S., & Möser, G. (2007). Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour. *Journal of Environmental Psychology, 27*(1), 14–25. https://doi.org/10.1016/j.jenvp.2006.12.002

Bazila, M., Kalinga, E., Ibwe, K., & Abdalla, A. (2022). Electrical power behavioral usage in public institutions and its intervention: A case of Tanzania higher learning institutions. *Journal of Electrical Systems and Information Technology, 9*, Article 12. https://doi.org/10.1186/s43067-022-00045-2

Bhaskar, K., & Kumar, B. (2019). Electronic waste management and sustainable development goals: Is there a business case for linking the two? *Journal of Indian Business Research, 11*(2), 120–137. https://doi.org/10.1108/JIBR-01-2018-0051

Charfeddine, L., & Umlai, M. (2023). ICT sector, digitization and environmental sustainability: A systematic review of the literature from 2000 to 2022. *Renewable and Sustainable Energy Reviews, 184*, Article 113482. https://doi.org/10.1016/j.rser.2023.113482

Chwialkowska, A. (2019). How sustainability influencers drive green lifestyle adoption on social media: The process of green lifestyle adoption explained through the lens of the norm activation model. *Journal of Promotion Management, 25*(5), 708–725. https://doi.org/10.1080/10496491.2019.1612495

Cudjoe, D., Nketiah, E., Obuobi, B., Adjei, M., Zhu, B., & Adu-Gyamfi, G. (2022). Predicting waste sorting intention of residents of Jiangsu Province, China. *Journal of Cleaner Production, 366*, Article 132838. https://doi.org/10.1016/j.jclepro.2022.132838

Dalvi-Esfahani, M., Alaedini, Z., Nilashi, M., Samad, S., Asadi, S., & Mohammadi, M. (2020). Students' green information technology behavior: Beliefs and personality traits. *Journal of Cleaner Production, 257*, Article 120406. https://doi.org/10.1016/j.jclepro.2020.120406

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319–340. https://doi.org/10.2307/249008

De Groot, J. I. M., & Steg, L. (2009). Morality and prosocial behavior: The role of awareness, responsibility, and norms in the norm activation model. *The Journal of Social Psychology, 149*(4), 425–449. https://doi.org/10.3200/SOCP.149.4.425-449

Dong, Z., He, C., Hu, T., & Jiang, T. (2024). Integrating values, ascribed responsibility and environmental concern to predict customers' intention to visit green hotels: The mediating role of personal norm. *Frontiers in Psychology, 14*, Article 1340491. https://doi.org/10.3389/fpsyg.2023.1340491

Freitag, C., Berners-Lee, M., Widdicks, K., Knowles, B., Blair, G. S., & Friday, A. (2021). The real climate and transformative impact of ICT: A critique of estimates, trends, and regulations. *Patterns, 2*(9), Article 100340. https://doi.org/10.1016/j.patter.2021.100340

Gholami, R., Watson, R. T., Hasan, H., Molla, A., & Bjørn-Andersen, N. (2013). Information systems solutions for environmental sustainability: How can we do more? *Journal of the Association for Information Systems, 14*(11), 727–755. https://doi.org/10.17705/1jais.00335

González-Zamar, M. D., Abad-Segura, E., López-Meneses, E., & Gómez-Galán, J. (2020). Managing ICT for sustainable education: Research analysis in the context of higher education. *Sustainability, 12*(19), Article 8254. https://doi.org/10.3390/su12198254

Hair, J. F., Ringle, C. M., & Sarstedt, M. (2017). *Partial least squares structural equation modeling (PLS-SEM): An updated guide for practical researchers*. Sage.

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European Business Review, 31*(1), 2–24. https://doi.org/10.1108/EBR-11-2018-0203

Hair, J. F., Sarstedt, M., Ringle, C. M., & Gudergan, S. P. (2024). *Advanced issues in partial least squares structural equation modeling (2nd ed.)*. Sage.

Han, H. (2021). Consumer behavior and environmental sustainability in tourism and hospitality: A review of theories, concepts, and latest research. *Journal of Sustainable Tourism, 29*(7), 1021–1042. https://doi.org/10.1080/09669582.2021.1903019

Han, H., & Hyun, S. S. (2018). Drivers of sustainable tourism: Norm activation model. *Journal of Sustainable Tourism, 26*(6), 962–979. https://doi.org/10.1080/09669582.2017.1423316

Hankel, A., Heimeriks, G., & Lago, P. (2019). Green ICT adoption using a maturity model. *Sustainability, 11*(24), Article 7163. https://doi.org/10.3390/su11247163

Hashim, M. A. M., Tlemsani, I., & Matthews, R. D. (2022). A sustainable university: *Digital transformation and beyond. Education and Information Technologies, 27,* 8961–8996. https://doi.org/10.1007/s10639-022-10968-y

He, X., & Zhan, W. (2017). How to activate moral norms to adopt electric vehicles in China? An empirical study based on extended norm activation theory. *Journal of Cleaner Production, 172*, 3546–3556. https://doi.org/10.1016/j.jclepro.2017.05.088

Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science, 43*, 115–135. https://doi.org/10.1007/s11747-014-0403-8

Jaffar, M., & Abdul Latiff, A. R. (2024). Pro-environmental conservation behavior through the lens of norm activation model: A systematic review (2018–2023). *PAPER ASIA, 40*(2b), 76–87. https://doi.org/10.59953/paperasia.v40i2b.76

Jang, Y. J., & Kim, F. (2023). Social and personal norms in shaping customers' environmentally sustainable behavior in restaurants' social media communities. *Sustainability, 15*(8), Article 6410.

https://doi.org/10.3390/su15086410

Kaiser, F. G., Byrka, K., & Hartig, T. (2010). Reviving Campbell's paradigm for attitude research. *Personality and Social Psychology Review, 14*(4), 351–367. https://doi.org/10.1177/1088868310366452

Kayanda, A., Busagala, L., & Tedre, M. (2020). User perceptions on the use of academic information systems for decision making support in the context of Tanzanian higher education. *International Journal of Education and Development Using Information and Communication Technology, 16*(1), 72–87.

Kirui, L. K., Nambiro, A. W., & Masinde, E. O. (2023). Green information technology strategies in institutions of higher learning in Kenya for sustainability: Challenges and opportunities. *International Journal of Computer Science Trends and Technology, 11*(1), 1–10.

Liu, P., Teng, M., & Han, C. (2022). How does environmental knowledge translate into pro-environmental behaviors? The mediating role of environmental attitudes and behavioral intentions. *Science of the Total Environment, 764*, Article 144393. https://doi.org/10.1016/j.scitotenv.2020.144393

Masele, J. J., & Rwehikiza, D. P. (2024). Usability of social media for promoting higher learning institutions' activities in Tanzania: A diffusion of innovation perspective. *Journal of Nonprofit & Public Sector Marketing, 36*(1), 91–122. https://doi.org/10.1080/10495142.2022.2133060

Mattern, F., Staake, T., & Weiss, M. (2010). ICT for green: How computers can help us to conserve energy. In Proceedings of the *1st International Conference on Energy-Efficient Computing and Networking* (pp. 1–10). Association for Computing Machinery. https://doi.org/10.1145/1791314.1791316

Molla, A., Pittayachawan, S., Corbitt, B., & Deng, H. (2009). An international comparison of Green IT diffusion. *International Journal of e-Business Management, 3*(2), 3–23. https://doi.org/10.3316/IJEBM0302003

Molla, A., Cooper, V., & Pittayachawan, S. (2011). The Green IT readiness (G-readiness) of organizations: An exploratory analysis of a construct and instrument. *Communications of the Association for Information Systems, 29*, 67–96. https://doi.org/10.17705/1CAIS.02904

Mtebe, J. S., & Raphael, C. (2017). A decade of technology-enhanced learning at the University of Dar es Salaam, Tanzania: Challenges, achievements, and opportunities. *International Journal of Education and Development Using Information and Communication Technology, 13*(2), 103–115.

Nguyen, H. T. T., Hung, R.-J., Lee, C.-H., & Nguyen, H. T. T. (2019). Determinants of residents' e-waste recycling behavioral intention: A case study from Vietnam. *Sustainability, 11*(1), Article 164. https://doi.org/10.3390/su11010164

Onwezen, M. C., Antonides, G., & Bartels, J. (2013). The norm activation model: An exploration of the functions of anticipated pride and guilt in pro-environmental behaviour. *Journal of Economic Psychology, 39*, 141–153. https://doi.org/10.1016/j.joep.2013.07.005

Parmentola, A., Petrillo, A., Tutore, I., & De Felice, F. (2022). Is blockchain able to enhance environmental sustainability? A systematic review and research agenda from the perspective of sustainable development goals. *Business Strategy and the Environment, 31*(1), 194–217. https://doi.org/10.1002/bse.2882

Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology, 88*(5), 879–903. https://doi.org/10.1037/0021-9010.88.5.879

Pollard, C. E. (2015). Applying the theory of planned behavior to individual computer energy saving behavioral intention and use at work. In *AMCIS 2015 Proceedings (Paper 11).* Association for Information Systems. https://aisel.aisnet.org/amcis2015/GreenIS/GeneralPresentations/11/

Ringle, C. M., & Sarstedt, M. (2016). Gain more insight from your PLS-SEM results: The importance-performance map analysis. *Industrial Management & Data Systems, 116*(9), 1865–1886. https://doi.org/10.1108/IMDS-10-2015-0449

Ringle, C. M., Sarstedt, M., Mitchell, R., & Gudergan, S. (2020). Partial least squares structural equation modeling in HRM research. *The International Journal of Human Resource Management, 31*(12), 1617–1643. https://doi.org/10.1080/09585192.2017.1416655

Sarstedt, M., Hair, J. F., Cheah, J.-H., Becker, J.-M., & Ringle, C. M. (2019). How to specify, estimate, and validate higher-order constructs in PLS-SEM. *Australasian Marketing Journal, 27*(3), 197–211. https://doi.org/10.1016/j.ausmj.2019.05.003

Sarstedt, M., Radomir, L., Moisescu, O. I., & Ringle, C. M. (2022). Latent class analysis in PLS-SEM: A review and recommendations for future applications. *Journal of Business Research, 138*, 398–407. https://doi.org/10.1016/j.jbusres.2021.08.051

Sarstedt, M., Ringle, C. M., Cheah, J.-H., Ting, H., Moisescu, O. I., & Radomir, L. (2020). Structural model robustness checks in PLS-SEM. *Tourism Economics, 26*(4), 531–554. https://doi.org/10.1177/1354816618823921

Schwartz, S. H. (1977). Normative influences on altruism. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol. 10, pp. 221–279). Academic Press. https://doi.org/10.1016/S0065-2601(08)60358-5

Steg, L., Bolderdijk, J. W., Keizer, K., & Perlaviciute, G. (2014). An integrated framework for encouraging pro-environmental behaviour: The role of values, situational factors and goals. *Journal of Environmental Psychology, 38*, 104–115. https://doi.org/10.1016/j.jenvp.2014.01.002

Stern, P. C., Dietz, T., Abel, T., Guagnano, G. A., & Kalof, L. (1999). A value-belief-norm theory of support for social movements: The case of environmentalism. *Human Ecology Review, 6*(2), 81–97.

Suryawanshi, K., & Narkhede, S. (2015). Green ICT for sustainable development: A higher education perspective. *Procedia Computer Science, 70*, 701–707. https://doi.org/10.1016/j.procs.2015.10.107

Tariq, M. S., & Khalid, A. (2023). Placing Green IT awareness and practices among universities' librarians: A NAT perspective. *The Journal of Academic Librarianship, 49*(5), Article 102770. https://doi.org/10.1016/j.acalib.2023.102770

Tushi, B., Sedera, D., & Recker, J. (2014). Green IT segment analysis: An academic literature review. In *Proceedings of the 20th Americas Conference on Information Systems* (pp. 1–15). Association for Information Systems. https://aisel.aisnet.org/amcis2014/

United Republic of Tanzania. (2022). Vital statistics on higher education in Tanzania 2022. Tanzania Commission for Universities. https://www.tcu.go.tz/sites/default/files/VitalStats%202022.pdf

United Republic of Tanzania. (2023). Higher education statistics. Tanzania Commission for Universities. https://www.tcu.go.tz/publications/higher-education-statistics

Velte, T., Velte, A., & Elsenpeter, R. C. (2008). Green IT: Reduce your information system's environmental impact while adding to the bottom line. McGraw-Hill.

Venkatesh, V., Thong, J. Y. L., & Xu, X. (2012). Consumer acceptance and use of ICT: Extending the unified theory of acceptance and use of technology. *MIS Quarterly, 36*(1), 157–178. https://doi.org/10.2307/41410412

Zhang, H., Yang, Y., & Zhou, H. (2023). Understanding pro-environmental behaviors in emerging economies: The role of personal responsibility and environmental values. *Sustainable Development, 31*(2), 1023–1038. https://doi.org/10.1002/sd.2405

Zharova, A., & Lee, H.-E. (2022). Understanding user perception and intention to use smart homes for energy efficiency: A survey [Preprint]. arXiv. https://doi.org/10.48550/arXiv.2212.05019

Zhu, J. J., Jiang, J., Yang, M., & Ren, Z. J. (2023). ChatGPT and environmental research. *Environmental Science & Technology, 57*(46), 17667–17670. https://doi.org/10.1021/acs.est.3c01818