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Beyond Access: Motivation and Digital Literacy in Sustainable Technology Use

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This article explores how motivation, background, digital literacy, and environmental awareness interact with sustainable digital practices in the United Arab Emirates (UAE). It advances third-level digital divide research and extends Resource and Appropriation Theory by analyzing how users adopt technology to reduce their ecological footprint. Survey data from the UAE show that motivation, along with digital skills and awareness, significantly influences behavior. Socioeconomic status also matters, with motivated, high-income individuals showing the highest engagement. Vocational training emerges as more relevant than university education for digital sustainability. While access and literacy are foundational, their environmental impact depends on human agency and structural factors. The findings offer policy insights for digital literacy and sustainability in non-Western contexts.

Keywords: digital inequality, environmental awareness, sustainable digital practices, motivation, third-level digital divide

This study examines the intersection of digital skills, digital habits, and environmental awareness, investigating how they contribute to environmentally conscious digital behaviors. It draws upon the third level of the digital divide (Ragnedda, 2017; van Deursen & Helsper, 2015), which examines individuals'

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ability to use digital technology for benefits, including environmental advantages, while minimizing negative impacts. The third level of the digital divide is associated with differences in the outcomes of digital technology use, primarily influenced by socioeconomic factors, such as education, income, and social status (van Deursen, van Dijk, & Helsper, 2014). Individuals with higher education and greater financial resources tend to gain more tangible benefits from digital technologies across multiple domains (van Deursen & Helsper, 2015). However, when exploring the third level of the digital divide, existing research has only considered environmental outcomes as a potential advantage of digital device use. Given the interplay between digital development and environmental impact, some scholars have suggested expanding the concept of digital inequalities to include environmental factors (Ruiu & Ragnedda, 2024). These approaches highlight that environmental outcomes from digital tools depend on users' digital literacy, motivation, and eco-conscious attitudes, often shaped by cultural and socioeconomic contexts (Ruiu, Ruiu, & Ragnedda, 2024). Even though these studies do not explicitly reference the third level of the digital divide, they suggest that digital inequalities manifest in uneven abilities to use digital technologies for environmental purposes, reinforcing disparities in environmental outcomes (Ruiu, Ruiu, Ragnedda, & Addeo, 2024). In this study, environmental outcomes refer to digitally mediated behaviors, such as reducing energy use, managing digital waste, using green apps (mobile applications designed to track, reduce, or educate users on environmental impact), and engaging in sustainability-focused digital practices.

Beyond traditional digital divide indicators, this study considers how motivation influences digital technology use for environmental purposes. User agency is highlighted as crucial to digital access, skill development, and participation (Calderón-Gómez & Kuric, 2022; Reisdorf & Groselj, 2017; van Dijk, 2005).

Theoretically, it expands third-level digital divide research by integrating digital skills and environmental motivation into analyses of digital outcomes and examining how digital expertise, social context, and environmental motivation interact to shape environmentally conscious digital practices (Ruiu, Ruiu, & Ragnedda, 2021).

Empirically, it focuses on the United Arab Emirates (UAE), characterized by 99% Internet penetration (Datareportal, 2024) and policies like the UAE Net Zero 2050 strategy (Ministry of Climate Change and Environment [MOCCAE], 2023), to examine how infrastructure-rich contexts shape third-level digital divide dynamics. Accordingly, this study explores how users perceive the role of environmentally motivated digital behaviors in fostering positive environmental outcomes while minimizing the negative effects of digital technology use, particularly among digitally skilled populations.

Previous studies (Ruiu et al., 2021; Ruiu, Ruiu, & Ragnedda, 2024) have only briefly examined similar topics within Western contexts. Research suggests that digitalization, accelerated by the COVID-19 pandemic, has influenced the relationship between individuals' digital practices and environmental awareness. However, these findings are limited to countries such as the United Kingdom and Italy, leaving a gap in understanding these dynamics in non-Western settings and on a global scale.

As digitalization grows, its environmental implications demand attention. Improving digital literacy raises questions about its role in fostering pro-environmental behaviors and informing sustainability policies.

The findings contribute to debates on ICTs and climate action, supporting the United Nations' Sustainable Development Goals (SDG 12: Responsible Consumption and Production and SDG 13: Climate Action).

By understanding how digital habits influence environmentally conscious behaviors, this study offers insights into how digital technologies can contribute to sustainability.

The study reviews literature on the third-level divide, details the methodology, measures, and analytical strategy, presents findings, discusses implications, and concludes with reflections and limitations.

Reframing the Digital Divide Through Environmental Lenses

While media and sociology research has addressed the digital divide and societal impacts of technology (Ragnedda, 2020), less attention has been paid to how digitalization interacts with individual pro-environmental actions. Some studies have focused on organizational capacity (Wang & Zhong, 2024; Zhang, Gao, & Li, 2023) or governance potential (Lim, 2010) for sustainability through digital transformation. Evidence is mixed on whether digital technologies help or harm the environment, with some arguing that information communication technologies (ICTs) increase efficiency and reduce emissions (Mol, 2008; Shen, Yang, & Zhang, 2023), while others point to digital pollution and carbon footprints (Malmodin & Lundén, 2018; Simpson, Dunlap, & Fullerton, 2019; Sparviero & Ragnedda, 2021). Furthermore, the debate extends to the application of technologies like artificial intelligence (AI), the Internet of Things (IoT), and machine learning (ML) as potentially advancing environmental protection (especially when deployed in smart cities, mobility optimization, or adaptive environmental policy; Rolnick, Kimbrell, & de Queiros, 2023). However, growing attention has been paid to how digital infrastructures, such as smart energy systems, low-carbon platforms, and algorithmic decision-making, might support ecological transition. Recent work has highlighted how ICTs can enable ecological transformation when embedded in supportive sociotechnical systems and regulatory frameworks (Hilty & Aebischer, 2015), contributing to data-driven resource optimization, smart energy systems, and low-carbon digital services. Therefore, the increasing digital-environmental convergence suggests that ICTs can act as enablers of environmental change, depending on policy design, sociotechnical arrangements, and user agency. These transformations, while still unevenly distributed, suggest a shift in environmental governance towards data-driven and sensor-enabled monitoring, automation, and resource optimization (Masterson, 2024).

On the other hand, less optimistic research identifies ICTs as contributors to environmental degradation through a "treadmill of information" effect (Simpson et al., 2019). This effect refers to how the continuous production and consumption of digital content requires increasing amounts of energy and resources, resulting in greater environmental impacts despite efforts to use technology sustainably. In this context, digital pollution, generated by Internet network operations and hardware production (Oo, Jonah, & Thin, 2023), is a growing concern. This problem is exemplified by the electricity consumption of AI systems and the manufacturing of digital devices, both of which increase the carbon footprint of digital technologies (Malmodin & Lundén, 2018; Sparviero & Ragnedda, 2021).

Despite contrasting interpretations, it could be argued that digital technologies are not inherently harmful; their environmental impact depends on individual use and context. When used for eco-friendly purposes (like tracking energy use, accessing sustainability information, or engaging in environmental advocacy), digital tools can foster positive outcomes. Yet, excessive or simultaneous use of multiple devices contributes to e-waste and energy. Therefore, this underscores the need to understand how individuals engage with digital technologies to enhance benefits and reduce harm, central to the third level of the digital divide, which focuses on effective, not just equitable, use. Digital and environmental studies tend to remain separate domains, with few works examining the links between digital skills and environmentally conscious behaviors (Ruiu & Ragnedda, 2024). While much research addresses the environmental impacts of traditional economic activities (Daoud et al., 2024; Helvaci & Helvaci, 2019), fewer studies examine how digital skills, consumption, work, learning, social networking, and environmental motivation intersect to shape eco-conscious digital uses. Although third-level digital divide research has explored economic, social, and educational outcomes, its environmental dimension remains underexplored. The digital divide refers to the unequal access, use, and outcomes of digital technologies. Its evolution includes access to digital technologies (first level; Van Dijk, 2006), types of use (second level; Attewell, 2001), and outcomes (third level; Ragnedda, 2017; van Deursen & Helsper, 2015), with recent scholarship highlighting the role of digital capital as a key resource influencing individuals' ability to benefit from digital engagement across all three levels (Ragnedda & Ruiu, 2020). Lack of digital skills, especially operational, communicative, and strategic, exacerbates exclusion and reflects broader social inequalities (Van Deursen & Helsper, 2015; Van Deursen, Helsper, Eynon, & Van Dijk, 2017). Furthermore, drawing on Van Dijk's (2005) resources and appropriation theory (RAT), motivation is central to understanding access, alongside ICT attributes, skill development, and usage practices (Haddon, 2007). Motivation itself is shaped by socioeconomic and cultural resource inequalities, such as employment, education, and household context, which influence access to technology. Finally, intentional skill acquisition is key to ensuring meaningful digital access and use (van Dijk, 2005). While this primarily relates to the second-level digital divide, combining skill appropriation with motivation for environmentally conscious digital use may help mitigate negative environmental impacts and transform Internet use into advantages (like informed decision-making, environmental awareness, resource optimization, and waste reduction). In the post-COVID context of digital acceleration and environmental urgency, the concept needs further exploration in relation to environmentally conscious digital behavior, sustainability awareness, and public engagement with environmental matters. Such further expansion is still rooted in social and economic inequalities influencing who benefits most, as evidenced by studies linking digital tools to improved environmental action and awareness through accessibility (Daoud et al., 2024; Liu & Zhang, 2024; Ruiu, Ruiu, & Ragnedda, 2024) and engagement drivers (Liu & Zhang, 2024; Skivko, Korneeva, & Korableva, 2021). This article focuses on the underexplored relationship between digital skills, behavior, and environmental outcomes across sociodemographic groups.

Hypotheses

Drawing on the motivational dimension of RAT (Van Dijk, 2005), this study considers how socioeconomic status, digital skills, and motivation shape environmentally oriented digital outcomes. Previous studies linked sociodemographic traits to differences in Internet uses and benefits in relation to age (Asrani, 2020), education (Asrani, 2020; Van Deursen & Van Dijk, 2019), socioeconomic status (Ragnedda, Addeo, & Ruiu, 2022), residence (Asrani, 2020; Song, Wang, & Bergmann, 2020), and gender (Asrani, 2020). Women also tend to report stronger pro-environmental attitudes (Xiao & Hong, 2017; Xiao & McCright, 2015; Zhao, Gong, Li, Zhang, & Sun, 2021), while socioeconomic status is often a contextual factor shaping pro-environmental behaviors (Matthies & Merten, 2022). RAT (Van Dijk, 2005) emphasizes motivation as key to digital engagement; however, motivation is moderated by resource availability. Economic conditions affect whether motivation translates into adoption and positive outcomes.

The first hypothesis posits that motivation to use technologies sustainably, driven by a sense of individual responsibility for acquiring relevant knowledge and skills, affects pro-environmental digital behaviors. Income acts as a moderator since economic conditions shape the strength of this relationship. Pro-environmental behaviors are defined as intentional actions aimed at reducing environmental harm (such as reducing waste and consumption; Kollmuss & Agyeman, 2002). Stern (2002) defines pro-environmental behaviors as impact-oriented (capable of positively impacting the environment) and intent-oriented (intentionally oriented to benefit the environment).

H1: *Users with a strong belief in their individual responsibility to develop digital skills and knowledge for sustainable practices are more likely to engage in environmentally friendly digital behaviors. The interaction between resource availability (income) and responsibility is expected to amplify this effect.*

In digital divide research, motivation, intentionality, and attitudes toward technology (Calderón-Gómez & Kuric, 2022; Ragnedda, Ruiu, & Addeo, 2020; Reisdorf & Groselj, 2017) are recognized as key predictors of access, use, and skill acquisition (Van Dijk, 2005). The European digital competence framework for citizens also includes environmental awareness as part of digital competence (Vuorikari, Kluzer, & Punie, 2022). The integration of green and digital skills has also become relevant for private businesses that provide sustainability skills courses (see, e.g., IBM, 2024). Drawing on this, we hypothesize that digital skills alone do not explain environmentally friendly technology use. Instead, it is the combination of digital skills, motivation to apply them toward environmental goals, and awareness of digital harms that predicts pro-environmental digital behaviors.

H2: *Users with higher levels of digital skills, environmental awareness of the digital impacts on the environment, and motivated by a belief in their individual responsibility to develop these skills for sustainable practices are more likely to engage in environmentally friendly digital behaviors.*

Methods

We conducted an online survey of adult Internet users in the UAE, a country with near-universal Internet access (Datareportal, 2024) and active digitalization efforts tied to its Net Zero 2050 strategy (MOCCAE, 2023). This context is well-suited to examining how digital use produces differing environmental outcomes, aligning with third-level digital divide concerns.

Compared to neighboring Gulf countries, the UAE presents a distinctive case due to its centralized governance model, long-standing digital transformation strategies, and state-led environmental agenda. Unlike more fragmented or resource-constrained contexts in the region, the UAE combines advanced digital infrastructure with targeted sustainability initiatives such as the UAE Net Zero 2050 and the Green Agenda 2030. Moreover, its population structure, characterized by a high share of expatriate residents, creates a digital ecosystem with potentially varying levels of digital engagement and environmental awareness. These features make the UAE a strategic context to investigate how digital access, skills, and motivation translate into pro-environmental behaviors.

We used a stratified sample of 1,016 respondents based on gender (Table 1), age (Table 2), geographic distribution (Table 3), and nationality (Table 4). Respondents were recruited, and data collected, via YouGov Dubai in February 2025. YouGov is an international online research and analytics company (https://corporate.yougov.com/about/). The survey took an average of 15 minutes to complete.

Table 1. Gender Distribution.

Total	Gender Sample		UAE Population (GMI, 2024)	
	Male	Female	Male	Female
1016	686 (67%)	330 (33%)	8.63 M (69%)	8.63M (31%)

Table 2. Age Distribution.

	Sample	Age group UAE (Federal Competitiveness and Statistics Center, 2024)
18-24	112 (11%)	865531 (11%)
25-34	325 (32%)	2589117.5 (32%)
35-44	335 (33%)	2642754 (33%)
45+	244 (25%)	2642754 (24%)
Total	1016 (100%)	7970586.5 (100%)

Table 3. Geographic Distribution.

	Sample	UAE Emirates (GMI, 2024)
Abu Dhabi	366 (36%)	3.8M (36%)
Dubai	366 (36%)	3.7M (36%)
Sharjah	173 (17%)	1.8M (17%)
Other Emirates	112 (11%)	1.2M (11%)
Tot	1016 (100%)	10.5M (100%)

Table 4. Nationality of Respondents.

Nationality	Sample	UAE Residents (GMI, 2024)
Emiratis	13%	11%
Arab Expats	26%	22%
Asian Expats	50%	49%
Western Expats	4%	7%
Others	7%	11%

The final sample closely mirrors population quotas. While typical limitations of online surveys apply, such as potential self-selection bias, absence of interviewer clarification, and motivation effects, these are mitigated in this context. With near-universal Internet access in the UAE, access-related bias is negligible. YouGov's active recruitment strategy enhances respondent diversity in interests and attitudes, reducing the risk of overrepresentation of highly motivated individuals. The alignment with population quotas further suggests broad coverage. Finally, the use of a previously validated questionnaire limits the risk of misinterpretation.

Measure

Digital Skills

This study includes technical, cognitive, and social-emotional skills, enabling device use, information evaluation, and online interaction, respectively (Ng, 2012) as components of digital expertise. In this context, digital expertise refers to skills that support pro-environmental technology use. Based on the DigComp framework (Vuorikari et al., 2022), we selected skill dimensions that both enhance digital engagement and potentially influence environmental outcomes. The framework includes macro-areas related to information and data literacy (to locate, retrieve, evaluate, and store digital data, information, and content); communication and collaboration (to interact, communicate, collaborate, and participate in society through digital technologies); digital content creation (to create and edit digital content); safety (to protect health, well-being, data, and devices and to be aware of the environmental impact of digital technologies and their use); and problem solving (to identify needs and problems, resolve them in digital environments, and stay current with digital evolution). Following this approach, skills were measured as self-reported efficiency, with respondents rating their agreement on a scale from 1 to 7 regarding their digital skills (see Appendix 1). A composite indicator based on the average score (see Appendix 1) was created, including skills related to searching for information, accessing up-to-date knowledge, identifying reliable sources (information and data literacy), creating meaningful content through appropriate channels, using advanced programs and software (digital content creation), using social media and digital collaboration tools, navigating government and public services channels, expressing opinions online (communication and collaboration), avoiding overuse of digital technologies (safety), learning and adopting new technologies, enhancing skills, and solving technical issues (problem solving). For the purposes of this study, the use of digital technologies to preserve and protect the environment was assessed as an outcome of the third level of the digital divide.

Environmental Awareness of Digital Impacts

Environmental concern, defined as a cognitive and emotional response to perceived environmental threats, is a key driver of sustainable behavior (Stern, Dietz, Abel, Guagnano, & Kalof, 1999). In this study, concern is framed around digital practices. Following Ruiu, Ruiu, and Ragnedda, (2024), we created a composite indicator by averaging responses to items assessing the perceived environmental impact of digital technologies (e.g., emissions, resource depletion, and energy demand; see Appendix 2). These items capture concern for the environmental costs of digital use and production, implications of emerging technologies, energy efficiency strategies, and available alternatives. Respondents rated their agreement on a 7-point Likert scale, capturing concern over both the costs and alternatives related to digital use and production.

Motivation to Adopt Digital Technologies for Environmental Purposes

Motivation was measured on a 7-point scale (1 = total disagreement, 7 = complete agreement) using the statement: "It is an individual's responsibility to actively seek knowledge and develop skills for sustainable digital practices to minimize their environmental impact." This item captures a sense of agency and frames sustainability as a moral obligation, reflecting motivation to act in an environmentally responsible manner. Although the statement reflects general personal responsibility, agreement is interpreted as evidence of internalized motivation to engage in sustainable digital practices. This interpretation aligns with literature linking perceived responsibility to pro-environmental motivation (De Dominicis, Schultz, & Bonaiuto, 2017; De Groot & Steg, 2010). This choice is supported by the tripartite framework of environmental attitudes (egoistic, altruistic, and biospheric). While egoistic (self-interest; De Dominicis et al., 2017; Lou, Li, & Ito, 2024) and altruistic (social concern) values (Schultz, & Zelezny, 1999) are context-dependent (Ryan & Spash, 2012), biospheric values (focused on nature's intrinsic worth) are the most consistent predictors of pro-environmental action (Milfont, Duckitt, & Cameron, 2006; Ryan & Spash, 2012). These values consider the moral or ethical importance of protecting nature, independent of anthropocentric concerns.

Environmentally Oriented Digital Behaviors

Environmentally oriented digital behaviors are defined as digital actions that prioritize environmental impact. Following Ruiu, Ruiu, and Ragnedda (2023), we constructed a composite indicator based on average scores across items (see Appendix 3), including green app use, environmental information-seeking, online activism, and awareness promotion; considerations of device recyclability and reparability; and digital strategies to reduce physical travel.

The indicator also covers limiting non-essential digital activities (e.g., gaming, streaming, crypto trading, excessive AI queries) and applying energy-saving settings (e.g., turning off devices, lowering video resolution). Respondents rated frequency on a 7-point scale (1 = never, 7 = always).

Analysis Strategy

H1 was tested through a multiple linear regression, with the dependent variable representing environmentally conscious digital behaviors. The first model included sociodemographic predictors, such as gender (dummy: man/woman), age (scale), educational level (dummy: elementary, secondary, vocational, undergraduate, and postgraduate studies), employment situation (dummy: working/not working), and annual income (dummy: up to 5,000 AED, 5,001–10,000 AED, 10,001–20,000 AED, 20,001–40.000 AED, and 40.000+AED), employment status (dummy: employed/unemployed), and nationality (dummy: Emiratis, other Arabs, Asians, Westerners, and other nationalities). The difference between urban and rural areas could not be accounted for, as 88% of the UAE population lives in an urban context (Datareportal, 2025). Moreover, the sample includes only users who have access to the digital realm and are mainly located in urban contexts.

In the second model, we introduced an additional variable related to motivation to adopt digital technologies for environmental purposes. The second model also introduces the interaction term between centered motivation and income (motivation*income) to account for the potential moderating effect of resources available, as suggested by the RAT. Model 1 (only demographic and socioeconomic predictors) explained around 5% of the variance in digital environmental behavior. Model 2 (adding the motivational variable and the interactive term motivation*income) explains 25% of the variance.

H2 was tested through a linear regression in which the dependent variable was still represented by eco-conscious digital behavior, and in addition to the sociodemographic variables that showed significance in the first two models, we inserted the interactive terms motivation*income (over 40,000 monthly), digital skills, and awareness of the environmental impacts of digital technologies (digital-environmental awareness) as predictors of digital behaviors that are environmentally friendly. This choice was supported by the literature that has shown that both digital skills and environmental concerns tend to be predictors of environmentally friendly digital behaviors (Ruiu, Ruiu, & Ragnedda, 2024).

We assessed the standard assumptions of linear regression. Tolerance and variance inflation factor (VIF) values (reported in Tables 5 and 7) confirmed the absence of multicollinearity among predictors (tolerance>.7, VIF< 2.5 across all variables). These values fall within accepted thresholds, suggesting no redundancy or strong correlation among the independent variables.

Results

Gender was found to be insignificant in both models, as was employment status. The effect of employment status was likely absorbed by the income effect. In terms of nationality, Emiratis (in both models; see Table 5) and Arabs (in model 2) showed a significantly higher likelihood of engaging in digital environmental behaviors compared to Asians. By contrast, Westerners were less likely to engage in these behaviors compared to Asians.

Regarding education, the undergraduate degree was used as a reference category, showing that individuals with vocational training are more engaged in digital environmental behaviors compared to those with an undergraduate level of study when they are motivated by the belief that it is an individual responsibility to learn how to use digital technologies sustainably.

Age was significant in the first model but not significant in Model 2 (M1 $B = .008$; $p < .05$; M2 $B = .006$; $p > .05$), suggesting that older individuals may be slightly more likely to engage in sustainable digital behaviors, and this effect might be attenuated by motivation to act sustainably. Higher income levels were associated with more environmentally friendly digital behaviors (see Model 1). Individuals with higher income levels scored significantly higher in our measure of environmentally friendly behaviors than those earning less than 5,000 AED. However, in Model 2, income lost its significance, suggesting that its effect could be mediated by other factors, particularly the interaction between motivation and income. This is further supported by the results from ANOVA, which was used to analyze whether income groups significantly influence digital environmental behavior (see Table 6). Even though the results indicated a significant effect of income on digital environmental behavior, the eta-squared suggested that only 4.2% of the variance in digital environmental behavior was explained by income. Moreover, the within-group variance was larger than the between-group variance, suggesting that individuals within the same income group tend to show different digital environmental behaviors. The random-effect omega-squared (.010) suggests that the influence of income groups is weaker when considering the variation across groups.

This supports the idea that income alone might not be a strong determinant of digital environmental engagement. Instead, the interaction term motivation*income above 40,000 AED ($B = .278$, $p < .001$) suggests that keeping fixed the level of motivation, an increase in income determines a further increase in our dependent variable. This means, for instance, that an individual with an average level of motivation will score .278 higher in our indicator of conscious behavior than an individual with the same level of motivation but belonging to the reference category of income.

In Model 2, motivation was significant, with a strong positive effect ($B =. 308$, $p < .001$). This suggests that individuals who are motivated by the belief that they are personally responsible for acquiring the necessary skills to implement sustainable digital practices are significantly more likely to engage in these behaviors. The presence of motivation also increases the explanatory power of the model, further supporting its role as a predictor in understanding sustainable digital behaviors. The analysis suggests that the effect of motivation on sustainable digital behavior is more evident among individuals with higher income (above 40,000 AED). This suggests that motivation may be more influential for wealthier individuals, possibly due to access to resources that enable the adoption of sustainable digital practices. Vocational education also has a significant positive contribution compared to undergraduate levels of education ($B = .214$, $p < .05$)

Table 5. Multiple Linear Regression Exploring Digital Behavior That are Conscious of the Environment.

Predictor	B	SE	p	Tolerance	VIF
Model 1					
(Constant)	4.163	.203	.000		
Gender	-.070	.075	.346	.919	1.088
Emiratis	.283	.110	.010	.860	1.163
Arabs	.122	.082	.140	.862	1.160
Westerners	-.155	.132	.240	.912	1.097
Other Nationalities	-.499	.184	.007	.915	1.093
Elementary Education	.252	.268	.346	.971	1.030
Secondary Education	-.034	.096	.725	.864	1.158
Vocational Education	.213	.119	.075	.941	1.063
Professional+PhD Education	.142	.144	.325	.915	1.093
Age	.008	.003	.012	.924	1.082
Employment	-.173	.100	.082	.846	1.182
AED 5001-10000	.173	.100	.084	.770	1.298
AED 10001-20000	.141	.098	.151	.776	1.289
AED 20001-40000	.212	.103	.040	.763	1.311
>40001+	.419	.128	.001	.743	1.346
Model 2					
(Constant)	2.629	.261	.000		
Gender	-.070	.067	.298	.912	1.096
Emiratis	.325	.099	.001	.859	1.165
Arabs	.153	.074	.040	.862	1.160
Westerners	-.191	.118	.106	.903	1.107
Other Nationalities	-.347	.164	.035	.907	1.103
Elementary Education	.172	.240	.474	.963	1.038
Secondary Education	-.019	.088	.830	.853	1.172
Vocational Education	.214	.108	.048	.928	1.078
Professional+PhD Education	.085	.130	.516	.888	1.126
Age	.006	.003	.060	.910	1.099
Employment	-.168	.090	.062	.848	1.180
AED 5001-10000	.127	.090	.158	.759	1.317
AED 10001-20000	.156	.089	.081	.756	1.323
AED 20001-40000	.052	.095	.580	.729	1.372
>40001+AED	.171	.117	.146	.707	1.414
Motivation*Income 5001-10000 AED	-.074	.064	.249	.663	1.507
Motivation*Income 10001-20000 AED	-.001	.002	.816	.723	1.384
Motivation*Income 20001-40000 AED	.061	.072	.403	.706	1.416
Motivation*Income >40000+AED	.278	.085	.001	.741	1.349
Motivation	.308	.036	.000	.402	2.488

References for categorical variables: female for gender, Asian group for nationality, undergraduate degree for education, and the category < 5000 AED for incomes.
Model 1: R^2 .048, Sig. < .001 Durbin-Watson 1.942; Model 2: R^2 .250, Sig. <. 001 Durbin-Watson 1.942

Table 6. Effect of Income Within and Between Groups.

	Value	95% Confidence Interval
Fixed Effects (M±SE)	4.514 ± 0.033	[4.4488, 4.5791]
Random Effects (SE)	0.104	[4.2245, 4.8034]
Between-Component Variance	0.048	—
Between Groups SS (df)	37.809 (4)	—
Within Groups SS (df)	859.385 (881)	—
Total SS (df)	897.194 (885)	—
F	9.690	P <. 001
Eta-squared	0.042	[0.017, 0.067]
Epsilon-squared	0.038	[0.013, 0.063]
Omega-squared (Fixed-effect)	0.038	[0.013, 0.063]
Omega-squared (Random-effect)	0.010	[0.003, 0.017]

SS = Sum of Squares; df = degrees of freedom; SE = Standard Error. Eta-squared and epsilon-squared are based on the fixed-effect model.

Hypothesis 2 was investigated by adding digital skills and awareness of the environmental impacts of digital technologies (digital environmental awareness) to the model (see Table 7). We maintained the sociodemographic variables that showed significance and the interaction term between motivation and higher levels of income that showed the highest contribution in the precedent model. In this case, the model showed an improvement in the variance explained to 48.6%. Digital skills (B = 0.248, p < .001), digital environmental awareness (B = .391, p < .001), and motivation*income (> 40000 AED) (B = .212, p < .001) are the strongest predictors of digital behaviors respectful of the environment. Age (B = 0.012, p < .001) has a small significant effect, supporting that older individuals score slightly higher. Similarly, Westerners (B = –.356, p < .05) and other nationalities (B = –.287, p < .005) continue to show less engagement with these behaviors, whereas Emirates show more engagement compared to the Asian group. Finally, vocational studies significantly predict eco-conscious digital behaviors compared to undergraduate levels of education. Therefore, motivation and digital environmental awareness are the strongest predictors. Higher incomes combined with motivation contribute to explaining the adoption of sustainable digital behaviors.

Table 7. Linear Regression Investigating Digital Skills, Digital Awareness, and Motivation as Predictors of Eco-Conscious Digital Behaviors.

Predictor	B	SE	p	Tolerance	VIF
(Constant)	.766	.173	.000		
Age	.012	.003	.000	.914	1.094
Emiratis	.311	.080	.000	.889	1.125
Arabs	.099	.063	.116	.863	1.159
Other nationalities	−.287	.099	.004	.915	1.093
Westerners	−.356	.138	.010	.951	1.051
Elementary Education	.135	.204	.508	.980	1.021
Secondary Education	.104	.071	.143	.903	1.107
Vocational Education	.225	.091	.013	.942	1.061
Professional+PhD Education	.018	.110	.872	.934	1.071
Digital Skills	.248	.027	.000	.625	1.599
Motivation*income>40000	.212	.065	.001	.876	1.142
Digital Environmental Awareness	.391	.032	.000	.630	1.587

References: Asian group for nationality and undergraduate degree category for education
R^2 .486, Sig. < .001, Durbin-Watson: 1.957

Discussion

The results confirm that digital skills, environmental awareness, and motivation significantly predict pro-environmental digital behaviors (H2). Motivation, understood as a sense of duty to acquire digital skills for environmental action, is the strongest predictor, supporting H1 and aligning with psychological models of environmental behavior (Stern, 2000). Motivation interacts significantly with higher income levels (> 40,000 AED), suggesting that individuals who have both financial resources and intrinsic motivation are the most engaged in sustainable digital practices. This aligns with RAT, which identifies motivation, alongside the availability of resources, as a key determinant of meaningful digital engagement (van Dijk, 2021). Moreover, it supports the third-level digital divide perspective, which focuses on translating digital access into meaningful outcomes (Van Deursen & Helsper, 2018). Studies on environmental ethics similarly highlight the importance of personal beliefs and willingness in shaping responsible digital behavior (Akhtar, Sultana, Masud, Jafrin, & Al-Mamun, 2021), with evidence from Saudi Arabia showing that responsibility outweighs religious beliefs in driving green consumption (Klabi & Binzafrah, 2023). RAT further emphasizes how digital engagement involves integrating technology into daily practices to achieve meaningful outcomes. This is particularly relevant to digital environmental literacy, which requires not only motivation but also the strategic application of digital tools to advance sustainability goals (Hilty & Aebischer, 2015).

Age and income also play a role, though inconsistently. While some studies find younger urban users to be more environmentally active (Chen et al., 2011), others report stronger concern and intention among older individuals (Park & Chang, 2024; Shen & Saijo, 2007). Similarly, research on the third-level digital divide suggests that age does not directly determine digital benefits. Its impact is mediated by skills, interests, and motivation (Van Deursen et al., 2017). In sub-Saharan Africa, age predicted the second-level divide but not the third (Ogbo, Brown, Gant, & Sicker, 2021). These findings reinforce that skills and motivation are key to bridging age-related gaps in digital sustainability. When motivation is considered, age effects diminish, indicating that individuals of any age can engage in sustainable digital behaviors if they are sufficiently skilled and motivated.

Moreover, motivated high-income individuals are more likely to engage in pro-environmental digital behaviors, while lower-income individuals may face barriers despite similar motivation. This aligns with RAT, which suggests that access to digital resources alone does not guarantee meaningful engagement. Instead, appropriation and integration into daily life determine actual outcomes (van Dijk, 2021). In the UAE, policies like the Net Zero 2050 strategy enhance this dynamic by promoting smart homes and renewable technologies, often accessible only to wealthier households. Thus, while motivation is essential, its impact is mediated by resource availability shaped by economic and policy contexts.

Our findings on nationality support the idea that cultural values shape ecological concerns (Xiao & Dunlap, 2007). Emiratis consistently showed higher engagement in pro-environmental digital behaviors, likely reflecting national sustainability policies and cultural narratives of environmental stewardship. Arabs showed weaker, inconsistent effects, while Westerners and other nationalities displayed negative coefficients, possibly due to differing cultural framings of sustainability responsibility (Poortinga, Whitmarsh, Steg, Böhm, & Fisher, 2019). The UAE's policy context, including the Net Zero 2050 strategy and smart city initiatives, promotes the use of digital technologies for environmental goals. This may explain the stronger engagement among motivated, digitally skilled individuals and why vocational education, aligned with practical skills, correlates more with sustainable digital behavior than higher education.

An unexpected finding is the stronger link between vocational education and pro-environmental digital behavior, contrasting with patterns in Europe and North America, where academic education more often predicts environmental concern (Franzen & Vogl, 2013; Gifford & Nilsson, 2014). Education has traditionally been linked to pro-environmental behaviors (Aklin, Bayer, Harish, & Urpelainen, 2013; Chankrajang & Muttarak, 2017) and reducing digital inequalities (Nishijima, Ivanauskas, & Sarti, 2017). However, recent studies have challenged this assumption, showing little evidence that higher education significantly increases pro-environmental behaviors (Kountouris & Remoundou, 2023). Instead, education's effect appears to be mediated by knowledge, concern, and willingness (Suárez-Perales, Valero-Gil, Leyva-de la Hiz, Rivera-Torres, & Garcés-Ayerbe, 2021). In the UAE, Al-Naqbi and Alshannag (2018) found that university students showed high environmental awareness but only moderate pro-environmental behaviors. This suggests a gap between knowledge and action, influenced by multiple factors such as economic policies, formal and informal education, and personal attitudes (Takshe et al., 2023).

Our findings show a positive association between vocational education and sustainable digital behaviors, while advanced academic degrees have no significant effect. This might reflect the UAE Green Agenda 2015–2030 (UAE, 2016), which prioritizes vocational training for green jobs and environmental sustainability as one of its five key pillars. The practical focus of vocational education may better prepare individuals to apply digital skills in environmentally conscious ways (Karatas & Gürbüz, 2016), supporting RAT's view that meaningful engagement depends on the strategic use of skills rather than formal education alone.

Theoretically, this article contributes to third-level digital divide research by showing that motivation and contextual alignment (not access or skills alone) determine whether digital practices produce socially or environmentally beneficial outcomes.

These findings point to new comparative implications. In contexts like the UAE, where infrastructure is strong but stratification remains, motivation and policy design become central levers for closing third-level divides. The findings have relevant policy implications, particularly within the UAE's strategic alignment with sustainability and digital transformation. As the country aims to achieve net-zero emissions and invests in green jobs, our study suggests that enhancing environmental outcomes through digital technology use should not rely solely on infrastructure. It also requires targeted efforts to reduce motivational and skill-based gaps that limit individual engagement with eco-conscious digital practices. This includes integrating environmental awareness and digital literacy into education, supporting inclusive access to green apps and services, and designing policies that consider the unequal distribution of digital capital. In this sense, digital sustainability becomes not only a technological challenge but also a social and political one, requiring coordinated action across governance, labor, and education sectors.

Conclusions

This study highlights an association between digital skills, environmental awareness, and motivation in using digital technologies pro-environmentally. Being motivated by a sense of personal responsibility to acquire digital skills for environmental action is the strongest predictor of sustainable digital engagement. However, its impact is contingent on the availability of financial and certain educational resources.

By integrating perspectives from digital divide research and socioenvironmental studies, this study emphasizes the need for policies and interventions that expand the conceptualization of digital divides to include environmental aspects. When considering the interaction between motivation and income, we found that higher-income digital users were better able to translate motivation into environmentally sustainable action.

Digital literacy programs should not only focus on providing technical skills but also cultivate intrinsic motivation and consciousness of the environmental impacts of digital technologies. Vocational education may be more effective than formal higher education in promoting digital sustainability practices, aligning with UAE policy priorities on green jobs and skills development.

This study has several limitations. The cross-sectional design does not allow for establishing causal relationships between digital expertise and environmental behaviors. Longitudinal studies would better track how digital skills and motivation evolve. Moreover, while this study accounts for key socioeconomic variables, it does not fully capture institutional- or policy-level factors that may influence digital environmental engagement. Future studies could further investigate how regulatory frameworks impact individuals' ability to integrate digital tools into sustainable practices. Finally, the study focuses on self-reported behaviors, which may be subject to social desirability bias. In any case, anonymity and the absence of face-to-face interviews should reduce this source of distortion.

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Appendix

Appendix 1. Digital Expertise.

Item	Skill area
I can search for information online using various search engines and databases (e.g., Google, academic databases)	Searching for information
I can troubleshoot common software and hardware issues (e.g., fixing software errors, resolving connectivity problems)	Problem solving
I can use advanced digital tools (e.g., data analysis software, programming languages, project management tools)	Using advanced programs and software
I can create meaningful content using digital platforms (e.g., video editing, graphic design, blogging)	Creating meaningful content through appropriate channels
I can use social media platforms for communication and networking (e.g., posting content, engaging with others, and promoting initiatives).	Using social media and digital collaboration tools
I can use digital collaboration tools (e.g., Slack, Zoom, Google Workspace) for effective teamwork	Communication and collaboration
I am confident in learning and adopting new technologies or software applications.	Learning and adopting new technologies
I can enhance my skills/knowledge through online learning resources (e.g., web-based courses and educational videos)	Enhancing skills
I can access diverse and up-to-date information to make informed decisions	Accessing up-to-date knowledge
I can identify and avoid false or misleading information	Information and data literacy
I know how to avoid overusing digital devices to maintain a balanced approach to technology use.	Avoiding overuse of digital technologies (safety)
I am able to contact the government and use related public services through digital tools (e.g., e-government platforms, online forms)	Navigating government and public services channels

Cronbach's α= .922, M= 4.87, SD= 1.18

Appendix 2. Environmental Awareness of Digital Impacts.

Scale Item	Macro Area
I recognize that using digital technologies contributes to global pollution (e.g., due to the energy used that causes carbon emissions).	Overall impact
I know that Producing technologies can be harmful to the environment (e.g., due to mineral extraction)	Overall impact
I am familiar with alternatives to traditional digital devices, such as refurbished or energy-efficient products	Awareness of alternatives
Digital waste should be disposed of at specialized centers to mitigate the environmental impact	Awareness of alternatives
The Internet of Things has the potential to optimize the management of digital devices, thereby minimizing energy waste	Energy Management and Optimization
Certain online activities (e.g., video/music streaming, cloud backups, online storage, online gaming, cryptocurrency mining) can have adverse environmental effects due to their energy consumption.	Energy Management and Optimization
I am aware that the use of AI systems (e.g., virtual assistants, large-scale computations) can have an environmental impact due to energy consumption.	Energy Management and Optimization
The processes involved in machine learning and training Artificial Intelligence (teaching computer programs or systems to perform tasks by providing them with data and instructions) can have environmental impacts due to their energy consumption	Impact of Emerging Technologies
Mining cryptocurrencies (the process of validation and recording of transactions on a digital currency network, e.g., bitcoin) is environmentally impactful due to energy requirements	Impact of Emerging Technologies

Cronbach's α=.892 M= 5.06, SD= 1.03

Appendix 3. Environmentally Oriented Digital Behaviors.

Scale Item	Macro Area
I use digital technologies for environmental purposes (e.g., search for information, sign environmental petitions online, share information about environmental issues)	Environmental-related activities
I use green apps (e.g., energy-saving apps, and zero-waste lifestyle apps) to track my impact on the environment.	Environmental-related activities
I use my digital technologies (e.g., mobile phones and computers) till they properly function	Digital Device Longevity and Sustainable Usage
I repair my digital technologies instead of changing them	Digital Device Longevity and Sustainable Usage
I bring my old digital devices to the specific recycling centers	Digital Device Longevity and Sustainable Usage
I prefer to meet friends online rather than face to face (e.g., to limit my physical movements and reduce my impact on the environment)	Digital Interaction and Remote Work for Environmental Impact
I prefer working from home, when given the option, to reduce my commuting and its environmental impact.	Digital Interaction and Remote Work for Environmental Impact
I use digital collaboration tools (e.g., Slack, Zoom, Google Workspace) to reduce unnecessary physical travel and minimize my environmental impact.	Digital Interaction and Remote Work for Environmental Impact
I order online only if I need multiple items	Sustainable Consumer Behavior
I read product reviews because I want to avoid returning the items if they do not correspond to what I expect	Sustainable Consumer Behavior
I choose energy-efficient settings (e.g., turning off devices when not in use, reducing video resolution) to minimize environmental impact.	Energy-Efficient Digital Practices
I avoid purchasing cryptocurrencies because they harm the environment (digital or virtual currencies used for financial transactions)	Limiting Digital Activities for Environmental Impact
I limit the number of requests I make to AI systems to reduce energy consumption and environmental impact	Limiting Digital Activities for Environmental Impact
I try to limit my social media activities online (e.g., messaging on FB, watching YouTube videos, posting on social media) because they hurt the environment	Limiting Digital Activities for Environmental Impact
I avoid online gaming to reduce my impact on the environment	Limiting Digital Activities for Environmental Impact
I try to limit the amount of data I store online to reduce energy consumption	Limiting Digital Activities for Environmental Impact

Cronbach's α=.896, M= 4.47, SD=.99