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Empowered through digital social media: exploring university students' perceptions and engagement with sustainability practices

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Abstract. This study examines how social media enables Tanzanian university students to adopt sustainable practices. Using social cognitive theory and an explanatory sequential mixed-methods design, we address two research questions: (1) What are students' perceived social media empowerment factors and their engagement with sustainability practices? (2) How do these empowerment factors contribute to sustainability engagement? Descriptive analysis ($n = 510$) revealed that social media serve as powerful tools for resource access (mean score = 4.31, 94.12% positive), self-expression and control (mean score = 4.09, 88.82%), and participation in virtual sustainability discussions (mean score = 4.05, 83.33%). Structural equation modelling showed that self-expression and control were the strongest predictors of sustainability-related collaboration ($\beta = 0.797$), community outreach ($\beta = 0.817$), and behavioural change ($\beta = 0.827$, $p<.0001$). Access to resources and support demonstrated moderate positive effects on all outcomes ($\beta = 0.482$–0.537, $p < .0001$), while participation and engagement showed smaller but significant influences ($\beta = 0.122$–0.136, $p \leq .003$), underscoring their supplementary roles. Qualitative focus groups ($n = 12$) highlighted peer validation as key to translating engagement into action, although information credibility and motivation gaps persist. The findings extend social cognitive theory by showing that digital feedback amplifies self-efficacy in resource-constrained contexts. Implications include integrating social media into Tanzania's digital education strategy and global Sustainable Development Goals frameworks, with emphasis on digital literacy and peer-supported action. This study bridges gaps in Tanzanian research, offering actionable insights for instructors and policymakers in the Global South.

Keywords: digital tools, digital empowerment, social media, university students, sustainability practices

1. Introduction

1.1. Background to the study

The integration of modern technologies, particularly Web 2.0 tools, has been widely recognised as a catalyst for transformation in education and training worldwide. Digital learning frameworks such as the UNESCO ICT Competency Framework for Teachers [69] and the European Digital Education Action Plan 2021–2027 [23] underscore the potential of digital tools in fostering global knowledge sharing. Tanzania's National Digital Education Strategy 2024–2030 [68] similarly emphasises the role of digital tools in expanding access to high-quality teaching and learning. Despite these ambitions, persistent barriers at the local level – particularly insufficient digital infrastructure and inadequate digital literacy among users, including teachers – continue to challenge the realisation of these frameworks' goals [68, 69].

Scholars globally recognise digital tools, including social media, as enablers of immersive, learner-centred environments that foster interactivity, collaboration, and the co-creation of knowledge [1, 42,

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46, 66, 70]. The rapid advancement of artificial intelligence further strengthens this potential, offering new possibilities for personalised learning and deeper integration of technology into education [36, 44]. In sustainability education, digital tools including social media have emerged as empowerment platforms, increasing awareness of sustainability challenges and encouraging active engagement in sustainability initiatives [5, 32]. As the development of 21st-century skills remains a key priority within the global educational agenda, leveraging modern technologies to advance transformative sustainability learning has become increasingly critical.

Social media platforms such as WhatsApp, Facebook, and YouTube are increasingly replacing traditional media by enabling decentralised, user-generated, and real-time information dissemination [1, 76]. They are fundamentally transforming how information is created, shared, and consumed in the digital era [28]. In this study, social media are viewed as digital empowerment tools that enhance users' knowledge sharing, virtual dialogue, resource access, self-expression, control, engagement, and participation in sustainability issues. These empowerment factors are seen as critical motivators for sustainability practices; virtual participation in sustainability dialogues, for example, can foster shared values and pro-environmental behaviours [28, 42, 46]. They also influence actions such as adopting eco-friendly products and engaging in community initiatives [32, 50]. Social media thus provide a valuable avenue for advancing sustainability awareness and responses, holding significant potential for supporting the achievement of the UN Sustainable Development Goals at the grassroots level.

Social media use in education fosters interactivity, engagement, collaboration, and knowledge sharing [39]. Multiple studies show that social media has a positive impact on peer collaboration and can empower youth engagement with sustainability practices [5, 20]. However, exposure to sustainability content does not always translate into real-world action; some users remain passive advocates without tangible behavioural change [32, 55]. Barriers such as low digital literacy and poor facilitative conditions also limit effective engagement [53].

While social media offer educational benefits [3, 76], concerns persist regarding excessive usage and negative impacts on learning outcomes [2, 13, 78]. Despite these potential drawbacks, social media remain crucial tools for enhancing digital learning and sustainability advocacy when used responsibly, supported by clear guidelines, capacity-building initiatives, and enabling environments [39].

1.2. Research problem, rationale and purposes

While studies in Western and broader global contexts have provided valuable insights into digital empowerment and sustainability practices [5, 32, 42, 46, 63], this connection remains underexplored in Tanzania. Existing Tanzanian research has primarily focused on the usability of digital media for enhancing learning experiences [27, 45, 48] and the acceptance of mobile technologies in teaching and learning [40, 47]. These studies emphasise information literacy and general technology use rather than the empowering potential of digital media for advancing sustainability practices.

While some studies address the localisation of sustainable development initiatives [34, 41], they concentrate on policy frameworks without examining how digital media could enhance grassroots sustainability actions. This gap, especially regarding Tanzania's specific social, technological, and educational dynamics, limits the development of targeted policies and interventions aimed at improving sustainability engagement through digital platforms.

Understanding social media empowerment factors and their influence on sustainability practices is inherently contextual, shaped by local technological infrastructures, educational outreach on sustainability, and patterns of digital adoption [28]. In Tanzania, growing internet and mobile penetration rates influence how students engage with digital platforms, while national efforts in sustainability education shape students' perceptions and actions. Examining the interplay between social media empowerment and students' sustainability engagement within this evolving digital landscape remains an important and timely area of inquiry.

This study examined the impact of perceived social media empowerment factors on university

students' engagement with sustainability practices in Tanzania. Using a mixed-methods approach to inform digital education and sustainability policies, the study focused on three key empowerment dimensions: self-expression and control (SEC), participation and engagement (PE), and access to resources and support (ARS). The study was guided by two questions: (1) What are university students' perceived social media empowerment factors and their engagement with sustainability practices? (2) How do perceived social media empowerment factors contribute to students' engagement with sustainability practices?

2. Literature review

2.1. Social cognitive theory as a theoretical perspective

This study was grounded in Social Cognitive Theory (SCT), developed by Bandura [8]. SCT is a widely recognised framework for understanding behavioural change and information-seeking behaviour, particularly in social media contexts [67, 77]. The theory focuses on personal agency, modelling, self-efficacy, and outcome expectations as key determinants of behavioural change.

SCT emphasises dynamic mutual determinism between three factors: social context (environment), cognitive reasoning (personal interaction), and individual behaviour [67]. The theory views learning as a social-centred process where individuals learn through interactions within social settings [77]. Personal agency is central to SCT, highlighting individuals' freedom to make choices and their ability to regulate actions based on self-belief and motivation [61, 62]. In the context of this study, social media users who feel empowered by their engagement with sustainability practices are more likely to believe in their ability to take action. This sense of agency can translate into self-regulation linked to pro-sustainability behaviours.

Self-efficacy, modelling (observational learning), behavioural capability, and reinforcement are key elements of the theory. Self-efficacy refers to belief in one's ability to succeed in a specific context [71]. In this study, university students' success in engaging with sustainability practices can be enhanced by social media, which enables them to express their personal sustainability values – for instance, by posting about sustainable consumption. Positive reinforcement, such as likes, shares, and peer acknowledgement, can strengthen users' belief in their ability to engage in sustainability practices. As users feel capable, they are more likely to engage in pro-sustainability actions.

Modelling (observational learning) suggests that individuals can change their behaviour by observing others [77]. Social media platforms facilitate modelling by allowing users to observe sustainability practices promoted by peers, influencers, or content creators. This exposure can enhance intentions to adopt sustainable practices.

Regarding behavioural capability and reinforcement: behavioural capability refers to the ability to perform certain behaviours [61]. Through social media, users can access knowledge and tools such as life skills and environmental protection tutorials on YouTube. Engagement with sustainability-related content (comments, shares, likes) provides reinforcement, fostering a sense of shared commitment to future sustainability actions.

This study applied SCT to understand how social media empowerment factors – access to resources and support involving information sharing, self-expression and control, and participation and engagement – enhance students' engagement with sustainability practices. Information sharing aligns with modelling, SEC correlates with self-efficacy, and PE is linked to reinforcement. The mutual relationship between these factors is crucial for shaping students' engagement with sustainability. This study extends SCT by demonstrating how digital platforms amplify self-efficacy through instant peer feedback, distinct from the theory's traditional settings. In Tanzania's resource-constrained context, this extension offers particular relevance.

2.2. The concept of social media

Literature on social media has evolved rapidly, mirroring advancements in digital technology. Since 2000, the concept has been presented interchangeably with terms such as computer-supported networks [72], virtual communities [59], and social networking sites [9, 51]. Initially, social media were viewed primarily as tools for connecting people with shared interests. Over time, they have transformed into platforms for co-creation and sharing of user-generated content [1].

The central role of social media, as reflected across these varied concepts, lies in their ability to offer virtual space for creating and sharing information, as well as connecting, collaborating, and organising users to achieve specific goals. Social media facilitates faster interaction, networking, and access to resources, promoting engagement between individuals [1].

According to the Digital World 2025 Report, approximately 63.9% of the world's population are active social media users, spending an average of 2.21 hours daily primarily for information gathering and staying in touch with family and friends [38]. In Tanzania, social media usage has increased remarkably, with approximately 5.65 million users – an increase of 1.9 million (48.7%) from 2023 to 2024 [37]. This growth not only enhances social interconnectedness but also provides an innovative platform to address global challenges, including sustainability issues.

2.3. Social media as an empowerment tool

The concept of empowerment can be viewed from multiple perspectives, including personal, community, organisational, and outcome-based dimensions [43, 64]. In this study, empowerment is discussed at an individual level and as an outcome of engagement within social media environments. Social media empowerment is understood as a process through which individuals actively engage with social media platforms, harnessing their full potential for self-expression, participation in public dialogues, and access to resources and support [60, 64, 65]. Beyond mere access to digital platforms, empowerment involves active engagement and self-expression within virtual communities.

Research has shown a positive correlation between active social media use and both intrapersonal and interactional empowerment. Li [43] found that as social media users engage with various content and participate in online chats, they develop a stronger sense of self. Chun and Lee [14] found that individuals are more likely to express themselves on social media when they feel supported by others. Chun and Lee [15] noted that feedback and public opinion shape individuals' readiness to voice their views.

Empowerment through social media use has significant implications for addressing social issues, including sustainability practices. The democratising power of social media allows individuals to create, share, and apply knowledge to address sustainability challenges, promoting pro-environmental actions and community engagement in sustainability initiatives. Social media-enhanced interaction empowerment fosters collaboration and collective action, crucial for addressing sustainability challenges [28, 32, 50]. Positive feedback and free exchange of ideas on social media encourage self-expression and participation in public dialogues such as those on sustainability issues [14, 43]. Studies have shown that factors such as digital literacy, social norms, and users' attitudes influence knowledge sharing and rapport on social media [7]. However, the extent to which this empowerment translates into actual sustainability practices remains an area for further exploration.

Despite the positive aspects of social media, drawbacks exist for knowledge exchange amongst university students. Some students and academics dismiss social media as a legitimate empowerment tool for knowledge sharing [57], while others are hesitant to engage with it [30]. Excessive social media use can lead to negative psychological and social consequences such as virtual addiction, interpersonal alienation, and burnout [73, 75]. To mitigate these negative effects, scholars recommend strategies such as mindfulness and digital detoxification, as well as institutional guidelines promoting digital wellness [6, 73].

2.4. University students' engagement with sustainability practices

University students play a crucial role in advancing the sustainable development agenda by promoting sustainable practices. To achieve this, universities must integrate sustainability issues into academic programmes and provide specific strategies to engage students effectively [4]. Universities should promote sustainability competencies by embedding them into general frameworks or specific pedagogical activities [17, 58]. A study by Alsharif and Ofori-Darko [4] in Saudi Arabia revealed that integration of sustainability content into degree programmes was positively associated with students' orientation towards environmental sustainability. Cleverdon et al. [17] found that engaging students with sustainability content not only raises awareness but also increases intent to engage in sustainability actions such as recycling.

Despite growing emphasis on students' engagement with sustainability [4, 17, 34, 41], much existing literature focuses primarily on sustainability consciousness rather than tangible sustainability practices. Sustainability consciousness refers to internal aspects such as knowledge, attitudes, and behavioural intentions [26, 54], while sustainability practices involve external actions including behavioural change, collaboration, and community engagement. Although these concepts are interrelated, research examining actual behaviours and actions that promote sustainability practices among university students remains limited.

2.5. Social media use and sustainability practices

Recent studies highlight the role of social media in promoting sustainability awareness and practices, although a significant gap remains between awareness and actual behavioural change. A systematic review by Ghermandi et al. [28] on the role of social media in environmental and sustainability research revealed its potential in shaping and sharing sustainability knowledge, particularly regarding human-environment interactions. Scherman, Valenzuela and Rivera [63] found a positive correlation between social media use and youth engagement in environmental activism. Hodson et al. [32] highlighted that image and video-based content are more engaging than text in disseminating sustainability information among Canadian students.

However, the effectiveness of social media in translating awareness into actual sustainability practices remains underexplored. Hamid et al. [31] emphasised the role of social media in fostering participation in environmental sustainability discussions within higher education, but noted a lack of studies focusing on how such awareness can be converted into actionable practices. Pabian and Pabian [55] found that social media use among young people in Poland contributed minimally to sustainability knowledge management, with nearly half of the respondents never encountering sustainability content on social media.

Chung et al. [16] examined differences between traditional and digital media in disseminating environmental information. The findings revealed that while social media are key tools for sharing sustainability information, many users remain passive consumers, rarely engaging or interacting with content. This signifies a disconnection between social media's potential as a transformative tool for sustainability and actual use in driving behavioural change and fostering active participation in sustainability practices.

3. Research methodology

3.1. Research approach and design

This study employed a mixed-methods research approach to investigate undergraduate students' perspectives on social media empowerment and their engagement with sustainability practices. Underpinned by pragmatic epistemology, the approach bridged quantitative (realistic) and qualitative (relativist) philosophical perspectives [29]. The mixed methods approach provided a comprehensive understanding of both general views and individual experiences. In this study, the approach allowed for both numerical outcomes, as depicted by the mean scores of perceived empowerment, and

subjective experiences, as depicted by participants' interpretations of empowerment in sustainability engagement.

Adopting an explanatory sequential design, the study consisted of two phases. The first phase, which dominated the study, focused on collecting and analysing quantitative data; the qualitative phase aimed to explain the quantitative findings [22]. The design was suitable for testing relationships between social media empowerment factors and sustainability practices, then explaining emerging patterns. During data collection, qualitative protocols were informed by quantitative results. At the interpretation and discussion stages, both numerical and narrative findings were presented together, ensuring the seamless integration of both data types.

3.2. Population and sample of the study

This study employed a quantitative-driven mixed-methods approach with a population of undergraduate students at one of Tanzania's largest public universities. Purposive sampling targeted ($n = 816$) "Lifelong Learning for Sustainable Development" course enrollees in the 2023/2024 academic year. This cohort was chosen for its relevance to sustainability content, as they were presumed to have greater insights regarding the subject matter [21]. For the quantitative phase, sample size was determined a priori using G*Power software version 3.1.9.7 [24] for SEM analysis. Assuming a medium effect size ($f^2 = 0.15$), $\alpha = 0.05$, power = 0.80, and three predictors, the minimum required sample was approximately 84 for regression, adjusted to 300-500 for SEM [35]. The achieved $n = 510$ (62.5% response rate from 816) exceeded this threshold, ensuring adequate power.

For the qualitative phase, 12 participants were selected from the quantitative cohort using maximum variation sampling to achieve diversity, comprising 50% male and 50% female participants of varied ages. This approach aimed to capture diverse perspectives by considering factors such as gender and age [56]. Individuals with leadership roles, such as social media group administrators and class representatives, were invited to participate voluntarily in reflective focus group discussions. The purpose was to gather varied, rich data on students' engagement with sustainability practices and social media empowerment. Demographic characteristics of respondents are presented in table 1.

3.3. Ethical considerations

All study participants were confirmed to be 18 years of age or older via university enrollment records, ensuring that no minors were included, thereby negating the need for parental consent. Researchers obtained informed consent, and the study objectives, withdrawal rights, and confidentiality measures were clearly communicated to prospective respondents. Confidentiality was maintained throughout by assigning passwords to data set files, and findings were reported anonymously.

3.4. Quantitative data collection methods and procedures

Quantitative data were collected using a self-developed, closed-ended questionnaire adapted from prior studies [16, 42, 43, 46, 60]. The questionnaire comprised 45 items across three sections: demographics (six items), perceived social media empowerment (21 items across three subscales: self-expression and control ($n = 6$ items), access to resources and support ($n = 7$ items), and participation and engagement ($n = 8$ items)), and engagement with sustainability practices (18 items across three subscales: behavioural change ($n = 6$ items), community outreach ($n = 6$ items), and collaboration ($n = 6$ items)). Items assessing empowerment were rated on a 5-point Likert-type scale (1 = strongly disagree to 5 = strongly agree), whereas engagement items were rated on a 5-point frequency scale (1 = never to 5 = always).

An online cross-sectional survey was administered via Google Forms and distributed to approximately 816 university students enrolled in a "Lifelong Learning for Sustainable Development" course through a WhatsApp group, yielding 510 valid responses (62.5% response rate). Prior to distributing the survey, the researcher met with prospective respondents to explain the study's purpose and

Table 1
Demographic characteristics of the respondents.

Phase I: Quantitative study			
Gender		**Total**	
Demographics	**Frequency**	**Percent**	
Male	257	50.39	
Female	253	49.61	
Age range in years			
15-20	6	1.18	510
21-25	376	73.73	
26-30	54	10.59	
31+	74	14.51	
Phase II: Qualitative study			
Gender			
Male	6	50	
Female	6	50	
Age range in years			
**15-20	1	8.3	
21-25	7	58.4	12 (recruited from phase one cohort)
26-30	3	25	
31+	1	8.3	

Note: **The '15-20' category reflects self-reported ages; enrolment records verified that all participants were 18 years of age or older.

address their questions, thereby enhancing rapport and participation. The survey remained open for 14 days during weeks 11 and 12 of the second semester in the academic year 2023/2024.

Quantitative analyses were conducted using SPSS Version 25 and AMOS Version 25. Descriptive statistics (means, standard deviations, and frequency distributions) summarised responses. Multivariate analyses included confirmatory factor analysis (CFA) to assess construct validity and reliability, and structural equation modelling (SEM) to examine relationships among variables [11]. Model fit indices, path coefficients, and R-squared values were reported [52]. Reliability was confirmed via Cronbach's α (0.82-0.85) and CR (0.813-0.861). Multiple regression analysis was performed further to evaluate the predictive strength of the independent variables.

3.5. Qualitative data collection methods and procedures

To deepen understanding of quantitative results, a qualitative follow-up study was conducted. It focused on explaining relationships observed in the data, particularly the strong effects of self-expression and control ($\beta = 0.827$, $p < .0001$) and access to resources and support ($\beta = 0.537$, $p < .0001$) on sustainability practices – specifically behavioural change and community outreach, respectively. The study also aimed to clarify the weak effect of participatory engagement ($\beta = 0.122$, $p = 0.0001$) on collaboration among university students.

Two focus group discussions (FGDs) were conducted, each with six participants from the original study cohort. The FGDs were semi-structured, allowing in-depth discussion of quantitative findings. Discussions focused on why the SEC and ARS had a strong influence on sustainability practices, and why PE had a weaker effect. The groups were diverse in terms of gender and age, and the discussions lasted approximately 2 hours. Ethical considerations, including voluntary participation (respondents could withdraw at any point) and confidentiality, were ensured. The collected data were used exclusively for academic purposes, in compliance with the ethical principles outlined by Cohen, Manion and Morrison [19].

Data from FGDs were analysed using thematic analysis, following a deductive approach [10], where predetermined themes from the quantitative results were explored. Themes were compared across two FGDs and linked back to quantitative findings, providing explanatory insights into patterns observed in statistical analysis. This method facilitated interactive discussion, produced rich qualitative data within a short period, and validated quantitative findings. Data saturation was achieved after two sessions, as no additional information emerged, with an inter-rater agreement of 92%.

4. Results

4.1. Findings based on descriptive analysis

Descriptive statistics were used to answer the first research question, examining university students' perceptions of social media empowerment factors and their engagement with sustainability practices. Table 2 presents overall scores of all variables.

Table 2
Descriptive statistics of study variables ($n = 510$).

Variables	Strongly disagree, *N* (%)	Disagree, *N* (%)	Neutral, *N* (%)	Agree, *N* (%)	Strongly agree, *N* (%)	Mean±SD
Social media empowerment factors						
Self-expression and control	1 (0.20)	2 (0.39)	54 (10.59)	344 (67.45)	109 (21.37)	4.09±0.59
Access to resources and support	3 (0.59)	3 (0.59)	24 (4.71)	283 (55.49)	197 (38.63)	4.31±0.64
Participation and engagement	2 (0.39)	1 (0.20)	82 (16.08)	311 (60.98)	114 (22.35)	4.05±0.65
Engaging with sustainability practices						
Behaviour change	2 (0.39)	1 (0.20)	82 (16.08)	311 (60.98)	114 (22.35)	3.95±0.77
Community outreach	8 (1.57)	46 (9.02)	160 (31.37)	176 (34.51)	120 (23.53)	3.69±0.98
Collaboration	6 (1.18)	22 (4.31)	164 (32.16)	196 (38.43)	122 (23.92)	3.80±0.89

As shown in table 2, university students perceived social media as a valuable empowerment tool, particularly for accessing resources and support (mean score = 4.31, 94.12% positive responses). Social media were also viewed as effective for self-expression and control over virtual interactions (mean score = 4.09, 88.82% positive responses), fostering engagement in sustainability-related activities. Students reported that social media enabled active participation in virtual discussions (mean score = 4.05, 83.33% positive responses), which could support university sustainability initiatives. Regarding engagement with sustainability practices, students had a positive view of behavioural change (mean score = 3.95, 83.33% positive responses), collaboration (mean score = 3.80, 62.35% positive responses), and community outreach (mean score = 3.69, 58.04% positive responses). However, approximately one-third of respondents expressed neutrality regarding collaboration (31.16%) and community outreach (31.37%), suggesting opportunities to enhance active engagement in these areas.

4.2. Quantitative study findings

4.2.1. Confirmatory factor analysis

To ascertain whether data fitted the hypothesised measurement model, confirmatory factor analysis (CFA) was conducted [11]. Table 3 presents CFA results including factor loading, CR, AVE, and MSV, complemented by Cronbach's α.

As shown in table 3, the measurement model comprises three latent constructs: self-expression and control, access to resources and support, and participation and engagement. Factor loadings for self-expression and control ranged from 0.74 to 0.80, for access to resources and support from 0.71

Table 3
Confirmatory factor analysis results.

Latent construct	Indicator	Factor loading	CR	AVE	MSV	Cronbach's α
Self-expression and control	SEC1	0.74	0.861	0.559	0.206	0.614
	SEC2	0.75				
	SEC3	0.81				
	SEC4	0.77				
	SEC5	0.7				
	SEC6	0.8				
Access to resources and support	ARS1	0.72	0.813	0.684	0.206	0.844
	ARS2	0.75				
	ARS3	0.72				
	ARS4	0.71				
	ARS5	0.78				
	ARS6	0.8				
	ARS7	0.78				
Participation and engagement	PE1	0.81	0.838	0.0693	0.161	0.835
	PE2	0.75				
	PE3	0.76				
	PE4	0.8				
	PE5	0.76				
	PE6	0.72				
	PE7	0.71				
	PE8	0.72				

to 0.80, and for participation and engagement from 0.71 to 0.81. The item "I frequently engage in discussions on social media" (0.81) had the highest contribution. Average variance extracted (AVE) for all constructs ranged from 0.559 to 0.693, confirming adequate convergent validity (AVE > 0.50). Composite reliability (CR) for all constructs exceeded 0.70, indicating strong internal consistency.

Maximum shared variance (MSV) values (0.161–0.206) were lower than AVE for each construct, confirming discriminant validity [74]. Cronbach's α values ranging from 0.614 to 0.853 across latent constructs indicate acceptable to excellent reliability. The lower Cronbach's α for self-expression and control ($\alpha = 0.614$) indicates questionable internal consistency, but the higher CR (0.813) suggests that factor loadings strengthen reliability, indicating that some items are more representative. These results confirm the measurement model's robustness, validating constructs for further SEM analysis. Harman's single-factor test assessed common method bias; the first factor explained 38% of the variance, which is below 50%, suggesting minimal bias, supported by CFA's discriminant validity (MSV $<$ AVE, table 3).

4.2.2. SEM fit statistics

The proposed model demonstrated acceptable overall fit based on various fit indices, as shown in table 4.

As depicted in table 4, the χ^2/df ratio (4.310) falls below the recommended threshold of 5, indicating a reasonable fit. The root mean square error of approximation (RMSEA) value of 0.019 suggests excellent fit (RMSEA < 0.05), and the PCLOSE value of 0.071 indicates acceptable model fit. Absolute fit indices such as the goodness of fit index (GFI $= 0.961$) and adjusted goodness of fit index (AGFI $= 0.970$) exceed recommended thresholds of 0.90 and 0.80, respectively, demonstrating strong model fit [74]. The root mean residual (RMR) value of 0.000 indicates a perfect fit with minimal residuals.

For incremental fit indices, the comparative fit index (CFI $= 0.920$) and Tucker-Lewis index (TLI

Table 4
SEM fit statistics.

Fit statistic			Incremental Fit Indices		
Indices	**Recommended**	**Obtained**	**Indices**	**Recommended**	**Obtained**
χ^2	–	801.827	NFI		0.38
df	–	186	CFI	>0.90	0.92
χ^2/df	<5	4.31	TLI	>0.95	0.97
RMSEA	<0.05	0.019	IFI	>0.95	0.903
PCLOSE	>0.05	0.071			
GFI	>0.90	0.961			
AGFI	>0.80	0.97			
RMR	<0.05	0			

= 0.970) demonstrate acceptable to excellent fit, while the incremental fit index (IFI = 0.903) is slightly below ideal but within an acceptable range. However, the normed fit index (NFI) value of 0.380 is lower than recommended, indicating poor fit and suggesting the model does not significantly improve over the null model. Overall, the model exhibits a good fit, with strong evidence from most fit indices, confirming its validity for further analysis.

4.2.3. Pearson's correlations

Pearson correlation analysis assessed relationships among six domains, as depicted in table 5. Coefficients range from 0.09136 to 0.68926, with corresponding *p*-values (<0.0001 to 0.0392) indicating statistical significance at the 0.05 level.

Table 5
Pearson's correlation coefficients.

	SEC	**ARS**	**PE**	**BC**	**CO**	**Col**
SEC	1	0.54628 <.0001	0.5164 <.0001	0.21091 <.0001	0.17656 <.0001	0.19009 <.0001
ARS	0.54628 <.0001	1	0.54485 <.0001	0.19473 <.0001	0.09136 0.0392	0.12703 0.0041
PE	0.5164 <.0001	0.54485 <.0001	1	0.21234 <.0001	0.19465 <.0001	0.22522 <.0001
BC	0.21091 <.0001	0.19473 <.0001	0.21234 <.0001	1	0.5769 <.0001	0.53669 <.0001
CO	0.17656 <.0001	0.09136 0.0392	0.19465 <.0001	0.5769 <.0001	1	0.68926 <.0001
Col	0.19009 <.0001	0.12703 0.0041	0.22522 <.0001	0.53669 <.0001	0.68926 <.0001	1

Key: SEC = self-expression and control, ARS = access to resources and support, PE = participation and engagement, BC = behavioural change, CO = community outreach, Col = collaboration

The strongest correlation was observed between community outreach (CO) and collaboration (Col) ($r = 0.689$, $p < .0001$), indicating that university students engaging in community outreach activities are highly likely to utilise social media as a collaborative tool. This suggests a synergistic relationship where outreach efforts enhance collaborative opportunities facilitated by digital platforms. The robust correlations between behavioural change (BC) and both community outreach ($r = 0.577$, $p < .0001$) and collaboration ($r = 0.537$, $p < .0001$) highlight that sustainable practices empowered through social media are closely tied to community engagement and teamwork. This may reflect

behavioural change acting as a moderator, bridging personal sustainability actions with collective efforts supported by social media use.

A moderate correlation exists between self-expression and control and access to resources and services ($r = 0.546$, $p < .0001$) as well as SEC and participation empowerment ($r = 0.516$, $p < .0001$), suggesting that students who express themselves via social media also recognise its potential to improve access to resources and foster participation in sustainability initiatives. However, causality remains ambiguous, as the digital divide – unequal access to social media – may influence self-expression and control, complicating these relationships. A strong positive correlation between ARS and PE ($r = 0.545$, $p < .0001$) underscores that enhanced access to resources through social media boosts participation in sustainability practices, reinforcing the role of digital tools in empowerment.

Correlation analysis revealed weak but statistically significant relationships between SEC and BC, CO, and collaboration (r ≈ 0.18–0.21, $p < .0001$). These modest findings indicate a limited but notable link, possibly reflecting contextual or digital barriers (for instance, lower student access to digital tools) that warrant further investigation.

4.2.4. Structural model of the study

The structural equation model assessed relationships between three independent constructs – self-expression and control, access to resources and support, and participation and engagement – and dependent constructs – collaboration, community outreach, and behaviour change. Independent constructs reflect social media empowerment, whereas dependent variables reflect the engagement of university students with sustainability practices. Every domain in the independent construct was associated with each domain in the outcome construct, as illustrated in figure 1.

Structural model analysis examined the hypothesised relationships between exogenous and endogenous variables, as presented in table 6.

Table 6
The parameter estimates of the structural model.

Exogenous		Endogenous	Estimate	S.E.	CR	*p*-value	R^2
SEC	→	Collaboration	0.797	0.511	6.841	<.0001	0.895
	→	Community outreach	0.817	0.472	6.82	<.0001	
	→	Behavioural change	0.827	0.294	6.16	<.0001	
ARS	→	Collaboration	0.496	0.138	9.645	<.0001	0.974
	→	Community outreach	0.537	0.128	10.106	<.0001	
	→	Behavioural change	0.482	0.084	7.669	<.0001	
PE	→	Collaboration	0.122	0.086	3.231	0.001	0.933
	→	Community outreach	0.136	0.073	3.82	<.0001	
	→	Behavioural change	0.125	0.048	2.951	0.003	

Key: SEC = self-expression and control, ARS = access to resources and support, PE = participation and engagement

The model's strong fit, as evidenced by high R-squared values (0.895–0.974) and significant critical ratios (CR = 2.951–10.106), aligns with SCT's framework of personal agency and environmental influences [8]. However, high R-squared values could also stem from unmodeled factors, such as digital literacy, internet access, or socio-demographic factors, which can inflate associations.

SEM demonstrated an uneven predictor hierarchy. Self-expression and control emerged as the dominant predictor across all endogenous variables, with standardised betas ranging from 0.797 to 0.827 (all $p < .0001$), indicating large effect sizes that exceed Cohen's [18] threshold of 0.35 for "large" effects. Its strongest positive effect on behavioural change ($\beta = 0.827$) indicates that greater engagement in self-expression through social media can significantly drive sustainability-related behavioural transformations. A one-standard-deviation increase in self-expression and control could

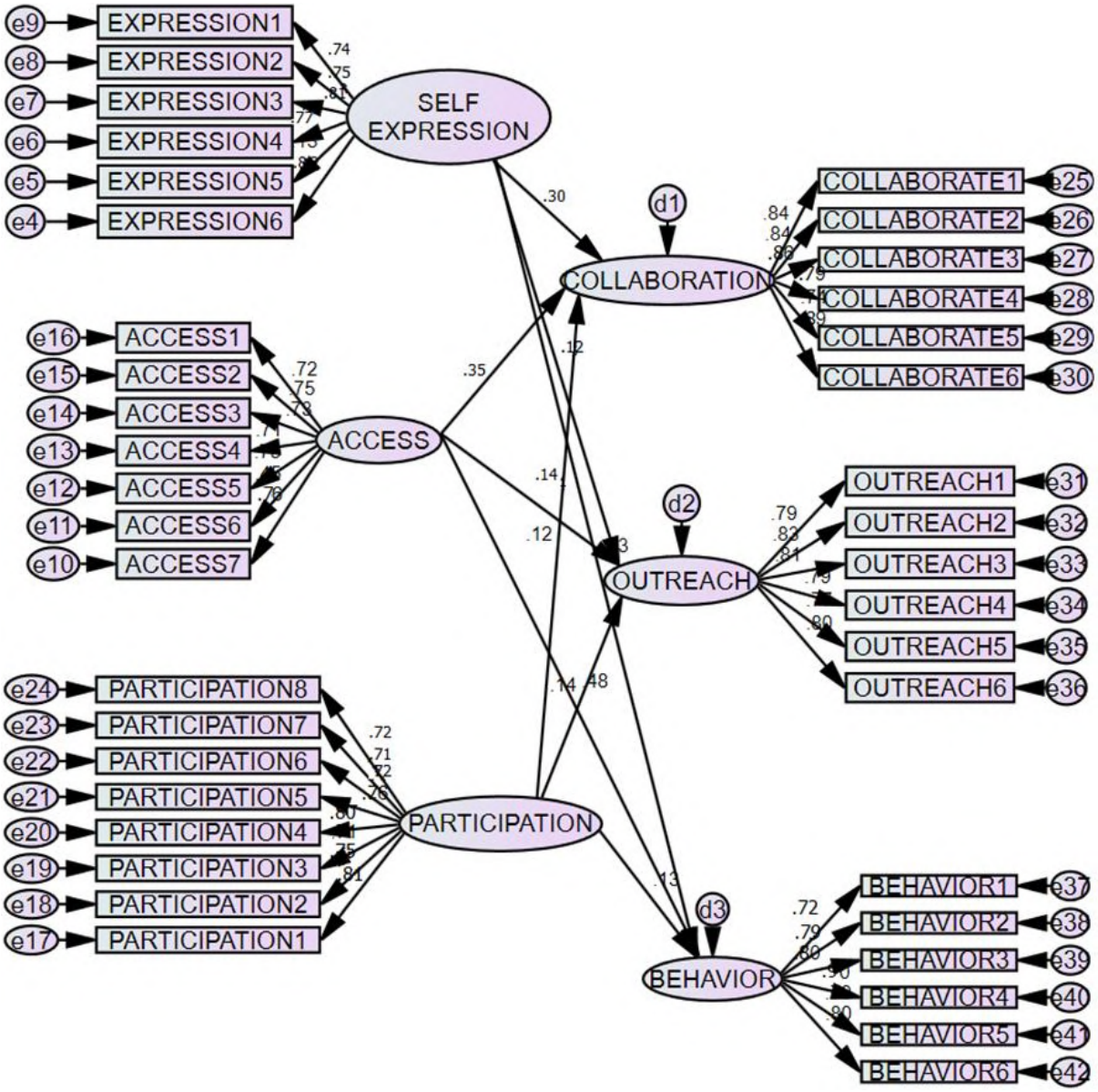

Figure 1: Structural model on the relationship between social media empowerment and engagement with sustainability practices.

boost behavioural change by 82.7% of a standard deviation – magnitude comparable to high-impact interventions in sustainability education [46]. SEC also strongly influences community outreach ($\beta = 0.817$, $p < .0001$) and collaboration ($\beta = 0.797$, $p < .0001$).

Access to resources and support, with moderate betas (0.482–0.537), yielded medium effects ($f^2 \approx 0.10$–0.12) with substantial positive effects on community outreach ($\beta = 0.537$), followed by collaboration ($\beta = 0.496$) and behavioural change ($\beta = 0.482$). These findings support the notion that access to resources facilitates practical engagement. However, the stronger path to community outreach over behavioural change suggests resources may catalyse collective rather than solitary actions in resource-scarce settings like Tanzania.

Participation and engagement yielded weaker but significant paths ($\beta = 0.122$–0.136, $p \leq .003$), suggesting a supplementary role in reinforcing engagement with sustainability practices among university students. These findings suggest that PE may be a less salient driver in the Tanzanian context, possibly due to barriers such as low digital literacy or passive online participation. This raises the question of whether cultural factors – such as collectivist norms in Tanzania that favour

self-expression over virtual participation – moderate these paths.

The uniformly weak effects of PE ($\beta = 0.122$–0.136, $p \leq .003$) contrast with SCT's core tenet of reinforcement through social engagement, where participatory behaviours are expected to shape pro-environmental actions strongly [8]. This limited role of PE is unexpected in a digital context where platforms like WhatsApp ostensibly facilitate dialogue and collective efficacy.

4.3. Qualitative study findings

The following findings, organised by theme, summarise core insights from FGDs, as depicted in table 7.

Table 7
Thematic analysis of FGDs findings.

Theme and subthemes	Qualitative explanation (FGDs quotes)	Interpretation
Self-expression and behavioural change 1. Affirmative loops (instant feedback cycles; 4 mentions). 2. Threshold dependency (critical mass needed; 3 mentions).	"Interactive social media, especially WhatsApp groups, is a valuable tool for sharing views and receiving instant feedback that can motivate real sustainability actions" (FGD 1, Participant 4). "When we express our feelings openly online and receive confirmation from others, it acts as a lever for us to engage in sustainability practices" (FGD 2, Participant 2).	Expressing views drives actions via SCT-aligned self-efficacy reinforcement, but non-linearly: "loops" initiate intent while "thresholds" sustain it, dependent on peer reciprocity. High salience (58% of FGD 1 utterances) among the 21-25 age group suggests cultural amplification in collectivist digital spaces, which explains the SEC's quantitative dominance.
Access to resources and collaborations 1. Informational abundance (easy access; 3 mentions). 2. Credibility gaps (accuracy/validation barriers; 2 mentions, 1 deviant case)	"Digital tools facilitate easier access to resources and information. However, validating the accuracy of this information remains a major challenge" (FGD 2, Participant 2). "Access alone does not automatically lead to collaboration unless people are also motivated to act" (FGD 2, Participant 5).	Resources enable collaboration per SCT's modelling but are moderated by motivational and epistemic barriers; "gaps" (e.g., rural bandwidth issues) create enabling constraints, qualifying ARS's moderate SEM effects and highlighting unmodeled literacy needs.
Participation and community outreach 1. Amplification (reaching audiences; 3 mentions). 2. Empathic revelation (highlighting needs; 2 mentions).	"Social media, particularly WhatsApp, is an effective tool to reach a broader audience and mobilise them for social action" (FGD 1, Participant 5). "Online sustainability dialogues help reveal the needs of disadvantaged groups and can encourage support for them" (FGD 1, Participant 3).	Active participation on social media promotes community outreach and fosters social sustainability by highlighting the needs of disadvantaged groups.
Participation and behavioural change 1. Implementation inertia (translation challenges; 1 direct quote, 2 implied)	"Although participation in online discussions about sustainability is clear, many of us face challenges in translating this into real-world practices" (FGD 1, Participant 5).	PE raises awareness but stalls at action due to inertia (e.g., habit gaps), a SCT reinforcement shortfall; low frequency signals passive engagement dominance, elucidating PE's modest quantitative effects ($\beta = 0.125$).

5. Discussion

This study examined how university students in Tanzania perceive social media as a factor in empowerment and their engagement with sustainability practices. The discussion is organised by research question.

5.1. Perceived social media empowerment factors and engagement with sustainability practices

This study examined university students' perceptions of social media empowerment and their engagement with sustainability practices in Tanzania. Findings reveal that students largely viewed social media as a valuable tool for accessing resources, corroborating previous research [5, 16, 28, 46] that emphasises the platform's role in facilitating information exchange and virtual participation. These results contrast with findings of Pabian and Pabian [55], who reported limited contributions of social media to knowledge sharing among youths.

In terms of sustainability practices, university students exhibited stronger engagement through behavioural change, collaboration, and community outreach. These results align with earlier studies such as Cleverdon et al. [17] and Alsharif and Ofori-Darko [4], which identified positive associations between the integration of sustainability content into academic programmes and students' orientation toward sustainable practices.

Despite overall positive perceptions of social media empowerment, particularly in fostering self-expression, resource accessibility, and engagement, the slight decline in agreement levels concerning tangible sustainability actions signifies a gap between perceived empowerment and actual behavioural change. Addressing this gap requires targeted interventions that not only promote digital empowerment but also actively cultivate translation of empowerment into sustained, action-oriented practices.

5.2. The impact of social media empowerment factors on engagement with sustainability practices

SEM results revealed the impact of social media empowerment factors on engagement with sustainability practices. Self-expression through social media had the strongest positive impact on university students' engagement with sustainability practices: behavioural change ($\beta = 0.827$, $p < .0001$), community outreach ($\beta = 0.817$, $p < .0001$), and collaboration ($\beta = 0.797$, $p < .0001$). This suggests that increased engagement in online self-expression significantly promotes students' sustainability-related behaviours and collaborations. The findings challenge SCT's emphasis on observational learning, as SEC outperformed ARS, possibly due to digital adoption patterns in Tanzania [37], offering a novel digital lens on SCT. In Tanzania's resource-constrained context, SEC's dominance might further suggest cultural norms valuing individual agency outperform modelling, refining SCT's triadic reciprocity.

Qualitative findings reinforce this relationship. Participants highlighted that expressing views on interactive social media platforms, particularly WhatsApp groups, motivated tangible actions toward sustainability. FGD quotes suggest that peer support and social feedback play crucial roles in converting online self-expression into real-world behavioural change, aligning strongly with quantitative findings.

Access to resources and support through social media also showed statistically significant positive effects on collaboration ($\beta = 0.496$, $p < .0001$), community outreach ($\beta = 0.537$, $p < .0001$), and behavioural change ($\beta = 0.482$, $p < .0001$). Although the effects were slightly weaker than those of SEC, ARS emerged as a meaningful driver of university students' engagement in sustainability initiatives. Qualitative evidence provided additional nuance: participants recognised that digital tools facilitate easier access to resources and sustainability-related information.

However, participants raised concerns about the accuracy of the information and the motivation needed to act upon it. FGD quotes suggest that while access to resources is a prerequisite for collaboration and behavioural change, intrinsic motivation and critical evaluation are essential for meaningful engagement, clarifying the moderate but significant influence of ARS found in SEM results.

Participation empowerment demonstrated statistically significant but comparatively weaker effects on collaboration ($\beta = 0.122$, $p = 0.001$), community outreach ($\beta = 0.136$, $p < .0001$), and behavioural change ($\beta = 0.125$, $p = 0.003$). Although PE showed the least predictive strength among

the three independent variables, its influence remained relevant. Qualitative data helped explain this limited impact: participants acknowledged that participation in online sustainability dialogues could reach broader audiences and encourage community outreach, but they also indicated that active participation did not always translate into real-world behaviour change. FGD quotes highlight a critical gap: while social media discussions enhance awareness and advocacy, they may not lead to actionable change among university students without additional support mechanisms or real-life reinforcement strategies.

The integration of SEM and FGDs via joint display (table 8) demonstrates convergence (such as self-expression and control quantitative strength explained by qualitative loops) and divergence (such as ARS barriers qualifying paths), generating meta-inferences that refine SCT for digital sustainability. For instance, the modest effects of participation and engagement are contextualised as inertia-driven, bridging the 'why' of SEM patterns.

Table 8
Mixed-methods joint display – integrating SEM results with qualitative themes.

Quantitative result (SEM, table 6)	Qualitative theme / sub-theme (table 7)	Integration type and meta-inference
SEC → Behavioural change ($\beta = 0.827$, large effect, $R^2 = 0.933$)	Self-expression and control: affirmative loops (4 quotes); threshold dependency (3 mentions).	Convergence: qualitative "loops" (e.g., WhatsApp feedback) explain SEC's dominance, amplifying SCT self-efficacy. Digital interventions should target interactive validation to sustain actions.
ARS → Community outreach ($\beta = 0.537$, medium effect, $R^2 = 0.974$)	Access to resources and support: credibility gaps (2 quotes, 1 deviant case).	Divergence: FGD barriers (e.g., accuracy challenges) qualify ARS's effects, implying paths moderated by literacy. Future models should include covariates for robustness.
PE → Behavioural change ($\beta = 0.125$, small effect, $R^2 = 0.933$)	Participation and engagement: implementation inertia (1 quote, 2 implied).	Complementarity: "inertia" elucidates PE's weakness as a translation gap, not an error. This refines SCT by highlighting the limits of passive digital reinforcement, guiding hybrid online-offline strategies.
Overall model ($R^2 = 0.895$–0.974)	Cross-theme patterns: peer validation (7 mentions across themes).	Expansion: emergent relational motif (e.g., confirmation in SEC/PE) suggests untested mediation (validation → outcomes). Supports longitudinal testing for causality in Tanzanian contexts.

The integration of SEM and FGD results suggests that self-expression on social media is a particularly powerful driver of sustainability engagement among university students, supported by peer validation and community feedback. These findings are consistent with previous studies, such as those by Chun and Lee [15] and Li [43]. Chun and Lee [15] noted that feedback and public opinion significantly shape individuals' willingness to express their views through social media. The role of social media as an empowerment tool aligns with self-efficacy as stipulated in social learning theory. Interactions on social media can enhance users' belief in their ability to express personal sustainability values, such as posting about sustainable consumption.

The findings also highlight the importance of access to digital resources. According to social learning theory, modelling through observational learning – facilitated by social media platforms – enables users to observe sustainability practices promoted by their peers. However, the credibility of information and user motivation require attention. Bryl and Supino [12] highlighted potential dangers of relying on social media information for sustainability research and practice, emphasising the importance of critically evaluating sustainability-related content. Despite such drawbacks, social media's role in digital learning remains valuable when used appropriately. Appropriate use requires clear guidelines for responsible engagement and educational interventions aimed at building digital literacy and critical evaluation skills [39].

While participation in online discussions raises awareness and fosters outreach among university

students, translating this into tangible behavioural change remains complex and partially realised. Previous studies report similar challenges in moving from sustainability dialogues on social media to actionable practices [31, 55]. Confetto et al. [20] and Ghermandi et al. [28] note that students can translate exposure to sustainability into engagement with practical activities. However, Hodson et al. [32] and Pabian and Pabian [55] caution that online resource exposure often remains superficial, resulting in online advocacy without substantial practical implications. Actualising sustainability practices promoted through social media requires a transformation of mindset and behaviour – essential for bridging the gap between virtual communication and real-world sustainability action.

6. Limitations, recommendations, and conclusion

6.1. Limitations and suggestions for further studies

This study provides insights into social media empowerment and sustainability engagement among Tanzanian university students; however, several limitations warrant acknowledgement.

First, the cross-sectional mixed-methods design collected both quantitative survey data and qualitative focus group discussions at a single point in time, capturing only a snapshot of students' perceptions and behaviours. This design precludes establishing causality or examining changes over time [21, 25]. While SEM revealed strong predictive effects of self-expression and control on behavioural change, temporal precedence could not be confirmed – whether social media empowerment drives sustainable actions or vice versa remains unclear. Future research should adopt longitudinal mixed-methods designs, such as panel surveys tracking social media engagement and sustainability behaviours across multiple semesters, complemented by real-time qualitative diaries or social media analytics. Such approaches would illuminate dynamic processes and strengthen causal inference [33].

Second, the explanatory sequential design, though effective for triangulation, limited the depth of qualitative integration because focus group discussions were conducted after quantitative analysis rather than concurrently [21]. A convergent mixed-methods design, which collects quantitative and qualitative data simultaneously, could strengthen integration and provide richer contextual insights.

Third, purposive sampling from a single sustainability course restricts generalisability. Stratified random sampling across multiple universities would enhance representativeness and capture the diverse experiences of students.

Fourth, reliance on self-reported measures introduces potential response bias. Incorporating objective indicators, such as app usage logs or digital trace data, would enhance validity across diverse cultural contexts.

Fifth, although SEM results demonstrate the empowering role of social media in sustainability practices, the uneven strength of path coefficients warrants cautious interpretation. Future studies should apply advanced SEM techniques, including multi-group analysis to test cultural moderators and longitudinal extensions to examine temporal dynamics [49].

6.2. Recommendations

To strengthen student sustainability engagement, educational institutions and policymakers should consider several strategies:

1. *Integrate digital literacy into curricula* to enhance students' ability to evaluate information credibility and counter misinformation.
2. *Promote peer-supported learning via social media platforms* to foster collaboration and collective action, capitalising on the strong effects of self-expression and peer feedback documented in this study.
3. *Link online participation with real-world projects* to ensure that digital engagement directly contributes to community-based sustainability initiatives, addressing the translation gap between virtual participation and tangible action.

4. *Enhance motivation through recognition and incentives*, providing institutional support that reinforces sustainability behaviours initiated online.
5. *Reinforce national policy frameworks* to create enabling environments for student-led sustainability practices, aligning with Tanzania's National Digital Education Strategy 2024–2030.

6.3. Conclusion

This study investigated the impact of social media empowerment factors on Tanzanian university students' engagement with sustainability practices. Self-expression through social media emerged as the strongest driver of sustainability-related collaboration, community outreach, and behavioural change. Access to resources and support also influenced engagement, though concerns about information credibility and motivation emerged as barriers. Participation and engagement exerted weaker yet significant effects across outcomes. These findings suggest that while digital platforms enhance sustainability engagement, translating online participation into tangible environmental actions remains a persistent challenge.

The findings address gaps in Tanzanian digital education research and contribute to global discourse on the United Nations Sustainable Development Goals, particularly SDG 4.7 (education for sustainable development) and SDG 13 (climate action). Unlike Western studies where participation often dominates sustainability engagement [32], this research highlights the distinct value of self-expression and control in Global South contexts. To harness this potential, policymakers and educators should integrate social media training into UNESCO's ICT competency frameworks and develop context-specific mobile applications that enable real-time sustainability tracking and peer collaboration.

The study extends social cognitive theory by demonstrating how digital feedback amplifies self-efficacy in resource-constrained contexts – a mechanism less prominent in traditional SCT applications. By bridging digital empowerment with concrete environmental actions, universities can cultivate proactive advocates and accelerate grassroots progress toward a sustainable future.

Data availability statement

Available upon request.

Declaration on Generative AI

During the preparation of this work, the authors utilised ChatGPT to enhance their writing style. After using this service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

References

[1] Aichner, T., Grünfelder, M., Maurer, O. and Jegeni, D., 2021. Twenty-Five Years of Social Media: A Review of Social Media Applications and Definitions from 1994 to 2019. *Cyberpsychology, Behavior, and Social Networking*, 24(4), pp.215–222. Available from: https://doi.org/10.1089/cyber.2020.0134.

[2] Al-Yafi, K., El-Masri, M. and Tsai, R., 2018. The effects of using social network sites on academic performance: the case of Qatar. *Journal of Enterprise Information Management*, 31(3), pp.446–462. Available from: https://doi.org/10.1108/JEIM-08-2017-0118.

[3] Alshalawi, A.S., 2022. The Influence of Social Media Networks on Learning Performance and Students' Perceptions of Their Use in Education: A Literature Review. *Contemporary Educational Technology*, 14(4), p.ep378. Available from: https://doi.org/10.30935/cedtech/12164.

[4] Alsharif, M.A. and Ofori-Darko, J., 2024. Exploring the relationship between university students' programme of study and orientation to environmental sustainability: the case of Al Baha

University. *Journal of Umm Al-Qura University for Engineering and Architecture*, 15(3), pp.211–230. Available from: https://doi.org/10.1007/s43995-024-00052-6.

[5] Ansari, J.A.N. and Khan, N.A., 2020. Exploring the role of social media in collaborative learning the new domain of learning. *Smart Learning Environments*, 7(1), p.9. Available from: https://doi.org/10.1186/s40561-020-00118-7.

[6] Ansari, S., Iqbal, N., Azeem, A. and Danyal, K., 2024. Improving Well-Being Through Digital Detoxification Among Social Media Users: A Systematic Review and Meta-Analysis. *Cyberpsychology, Behavior, and Social Networking*, 27(11), pp.753–770. Available from: https://doi.org/10.1089/cyber.2023.0742.

[7] Arif, M., Qaisar, N. and Kanwal, S., 2022. Factors affecting students' knowledge sharing over social media and individual creativity: An empirical investigation in Pakistan. *The International Journal of Management Education*, 20(1), p.100598. Available from: https://doi.org/10.1016/j.ijme.2021.100598.

[8] Bandura, A., 1986. From Thought to Action: Mechanisms of Personal Agency. *New Zealand Journal of Psychology*, 15(1), pp.1–17. Available from: https://www.psychology.org.nz/journal-archive/NZJP-Vol151-1986-1-Bandura.pdf.

[9] boyd, d.m. and Ellison, N.B., 2007. Social Network Sites: Definition, History, and Scholarship. *Journal of Computer-Mediated Communication*, 13(1), pp.210–230. Available from: https://doi.org/10.1111/j.1083-6101.2007.00393.x.

[10] Braun, V. and Clarke, V., 2006. Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), pp.77–101. Available from: https://doi.org/10.1191/1478088706qp063oa.

[11] Brown, T.A., 2015. *Confirmatory Factor Analysis for Applied Research*, Methodology in the Social Sciences. 2nd ed. New York and London: The Guilford Press. Available from: https://tinyurl.com/4rekhc6v.

[12] Bryl, L. and Supino, E., 2022. Sustainability Disclosure in Social Media – Substitutionary or Complementary to Traditional Reporting? *Journal of Intercultural Management*, 14(3), p.41–62. Available from: https://doi.org/10.2478/joim-2022-0011.

[13] Cao, X., Wu, Y., Cheng, B. and Ali, A., 2024. An investigation of the social media overload and academic performance. *Education and Information Technologies*, 29(8), pp.10303–10328. Available from: https://doi.org/10.1007/s10639-023-12213-6.

[14] Chun, J.W. and Lee, M.J., 2017. When does individuals' willingness to speak out increase on social media? Perceived social support and perceived power/control. *Computers in Human Behavior*, 74, pp.120–129. Available from: https://doi.org/10.1016/j.chb.2017.04.010.

[15] Chun, J.W. and Lee, M.J., 2022. Understanding empowerment process of willingness to speak out on social media: Amplifying effect of supportive communication. *Telematics and Informatics*, 66, p.101735. Available from: https://doi.org/10.1016/j.tele.2021.101735.

[16] Chung, C.H., Chiu, D.K.W., Ho, K.K.W. and Au, C.H., 2020. Applying social media to environmental education: is it more impactful than traditional media? *Information Discovery and Delivery*, 48(4), pp.255–266. Available from: https://doi.org/10.1108/IDD-04-2020-0047.

[17] Cleverdon, L., Pole, S., Weston, R., Banga, S. and Tudor, T., 2017. The Engagement of Students in Higher Education Institutions with the Concepts of Sustainability: A Case Study of the University of Northampton, in England. *Resources*, 6(1), p.3. Available from: https://doi.org/10.3390/resources6010003.

[18] Cohen, J., 1988. *Statistical Power Analysis for the Behavioral Sciences*. 2nd ed. New York: Routledge. Available from: https://doi.org/10.4324/9780203771587.

[19] Cohen, L., Manion, L. and Morrison, K., 2018. *Research Methods in Education*. 8th ed. London and New York: Routledge. Available from: https://tinyurl.com/3ax4b2v4.

[20] Confetto, M.G., Covucci, C., Addeo, F. and Normando, M., 2023. Sustainability advocacy antecedents: how social media content influences sustainable behaviours among Generation Z. *Journal of Consumer Marketing*, 40(6), pp.758–774. Available from: https://doi.org/10.1108/JCM-11-2021-5038.

[21] Creswell, J.W. and Plano Clark, V.L., 2018. *Designing and Conducting Mixed Methods Research*. 3rd

ed. SAGE Publications, Inc. Available from: https://bayanbox.ir/view/236051966444369258/9781483344379-Designing-and-Conducting-Mixed-Methods-Research-3e.pdf.

[22] Creswell, J.W. and Plano Clark, V.L., 2023. Revisiting mixed methods research designs twenty years later. In: C.N. Poth, ed. *The Sage Handbook of Mixed Methods Research Design*. SAGE Publications, Inc., pp.623–635. Available from: https://doi.org/10.4135/9781529682663.n6.

[23] European Commission, Directorate-General for Education, Youth, Sport and Culture, 2020. *Digital Education Action Plan 2021-2027: Resetting education and training for the digital age*. (COM(2020) 624 final). Publications Office of the European Union. Available from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0624.

[24] Faul, F., Erdfelder, E., Buchner, A. and Lang, A.G., 2009. Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods*, 41(4), pp.1149–1160. Available from: https://doi.org/10.3758/BRM.41.4.1149.

[25] Fetters, M.D., Curry, L.A. and Creswell, J.W., 2013. Achieving Integration in Mixed Methods Designs—Principles and Practices. *Health Services Research*, 48(6pt2), pp.2134–2156. Available from: https://doi.org/10.1111/1475-6773.12117.

[26] Gericke, N., Boeve-de Pauw, J., Berglund, T. and Olsson, D., 2019. The Sustainability Consciousness Questionnaire: The theoretical development and empirical validation of an evaluation instrument for stakeholders working with sustainable development. *Sustainable Development*, 27(1), pp.35–49. Available from: https://doi.org/10.1002/sd.1859.

[27] Ghasia, M.A. and Rutatola, E.P., 2021. Contextualizing Micro-learning Deployment: An evaluation report of platforms for the higher education institutions in Tanzania. *International Journal of Education and Development using Information and Communication Technology (IJEDICT)*, 17(1), pp.65–81. Available from: https://files.eric.ed.gov/fulltext/EJ1285500.pdf.

[28] Ghermandi, A., Langemeyer, J., Van Berkel, D., Calcagni, F., Depietri, Y., Egarter Vigl, L., Fox, N., Havinga, I., Jäger, H., Kaiser, N., Karasov, O., McPhearson, T., Podschun, S., Ruiz-Frau, A., Sinclair, M., Venohr, M. and Wood, S.A., 2023. Social media data for environmental sustainability: A critical review of opportunities, threats, and ethical use. *One Earth*, 6(3), pp.236–250. Available from: https://doi.org/10.1016/j.oneear.2023.02.008.

[29] Gillespie, A., Glăveanu, V. and de Saint Laurent, C., 2024. *Pragmatism and Methodology: Doing Research That Matters with Mixed Methods*. Cambridge: Cambridge University Press. Available from: https://doi.org/10.1017/9781009031066.

[30] Goswami, A.K. and Agrawal, R.K., 2019. Explicating the influence of shared goals and hope on knowledge sharing and knowledge creation in an emerging economic context. *Journal of Knowledge Management*, 24(2), pp.172–195. Available from: https://doi.org/10.1108/JKM-09-2018-0561.

[31] Hamid, S., Ijab, M.T., Sulaiman, H., Md. Anwar, R. and Norman, A.A., 2017. Social media for environmental sustainability awareness in higher education. *International Journal of Sustainability in Higher Education*, 18(4), pp.474–491. Available from: https://doi.org/10.1108/IJSHE-01-2015-0010.

[32] Hodson, J., Dale, A., Jost, F. and Clifton-Ross, J., 2020. Sustainability issue communication and student social media engagement: Recommendations for climate communicators. *Journal of Digital & Social Media Marketing*, 8(3), pp.277–290. Available from: https://doi.org/10.69554/lihr6053.

[33] Ivankova, N.V., Creswell, J.W. and Stick, S.L., 2006. Using Mixed-Methods Sequential Explanatory Design: From Theory to Practice. *Field Methods*, 18(1), pp.3–20. Available from: https://doi.org/10.1177/1525822X05282260.

[34] Jönsson, K. and Bexell, M., 2021. Localizing the Sustainable Development Goals: The case of Tanzania. *Development Policy Review*, 39(2), pp.181–196. Available from: https://doi.org/10.1111/dpr.12497.

[35] Kang, H., 2021. Sample size determination and power analysis using the G*Power software. *Journal of Educational Evaluation for Health Professions*, 18, p.17. Available from: https://doi.org/10.3352/jeehp.2021.18.17.

[36] Kaushik, A., Yadav, S., Browne, A., Lillis, D., Williams, D., Mc Donnell, J., Grant, P., Kernan, S.C., Sharma, S. and Arora, M., 2025. Exploring the Impact of Generative Artificial Intelligence in Education: A Thematic Analysis. 2501.10134, Available from: https://doi.org/10.48550/arXiv.2501.10134.

[37] Kemp, S., 2024. Digital 2024: Tanzania. Available from: https://datareportal.com/reports/digital-2024-tanzania.

[38] Kemp, S., 2025. Digital 2025: Global Overview Report. Available from: https://datareportal.com/reports/digital-2025-global-overview-report.

[39] Lampropoulos, G., Siakas, K., Makkonen, P. and Siakas, E., 2021. A 10-year Longitudinal Study of Social Media Use in Education. *International Journal of Technology in Education*, 4(3), p.373–398. Available from: https://doi.org/10.46328/ijte.123.

[40] Landa, E., Zhu, C. and Sesabo, J., 2021. Readiness for integration of innovative teaching and learning technologies: An analysis of meso-micro variables in Tanzanian higher education. *International Journal of Educational Research Open*, 2, p.100098. Available from: https://doi.org/10.1016/j.ijedro.2021.100098.

[41] Lauwo, S.G., Azure, J.D.C. and Hopper, T., 2022. Accountability and governance in implementing the Sustainable Development Goals in a developing country context: evidence from Tanzania. *Accounting, Auditing & Accountability Journal*, 35(6), pp.1431–1461. Available from: https://doi.org/10.1108/AAAJ-10-2019-4220.

[42] Li, P. and Noor, S.M., 2020. A study on the influence of social media on college students' pro-environmental behavior. *Eurasian Journal of Educational Research*, 102, pp.108–132. Available from: https://ejer.com.tr/article-view/?id=1096.

[43] Li, Z., 2016. Psychological empowerment on social media: Who are the empowered users? *Public Relations Review*, 42(1), pp.49–59. Available from: https://doi.org/10.1016/j.pubrev.2015.09.001.

[44] Maity, S. and Deroy, A., 2024. Generative AI and Its Impact on Personalized Intelligent Tutoring Systems. 2410.10650, Available from: https://doi.org/10.48550/arXiv.2410.10650.

[45] Masele, J.J. and 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), pp.91–122. Available from: https://doi.org/10.1080/10495142.2022.2133060.

[46] Meng, Y., Chung, D. and Zhang, A., 2023. The effect of social media environmental information exposure on the intention to participate in pro-environmental behavior. *PLOS ONE*, 18(11), p.e0294577. Available from: https://doi.org/10.1371/journal.pone.0294577.

[47] Mtebe, J. and Gallagher, M., 2022. Continued usage intentions of digital technologies post-pandemic through the Expectation-Confirmation Model: the case of a Tanzanian university. *International Journal of Education and Development using Information and Communication Technology (IJEDICT)*, 18(1), pp.125–145. Available from: http://ijedict.dec.uwi.edu/include/getdoc.php?id=9454&article=3041&mode=pdf.

[48] Mungwabi, H., 2023. Assessment on Usage of the Library Website Resources by Students in the Information Studies Programme at the University of Dar es Salaam. *Tanzania Journal of Engineering and Technology*, 42(2), pp.224–237. Available from: https://web.archive.org/web/20251222060638/https://tjet.udsm.ac.tz/index.php/tjet/article/download/917/723.

[49] Narayanan, K. and Moon, C., 2022. A multigroup SEM analysis of the antecedents and moderating influence of culture on workplace deviance behavior. *Cross Cultural & Strategic Management*, 30(2), pp.169–196. Available from: https://doi.org/10.1108/CCSM-06-2021-0103.

[50] Nazish, M., Khan, M.N. and Khan, Z., 2024. Environmental sustainability in the digital age: unraveling the effect of social media on green purchase intention. *Young Consumers: Insight and Ideas for Responsible Marketers*, 25(6), pp.1015–1035. Available from: https://doi.org/10.1108/YC-01-2024-1965.

[51] O'Murchu, I., Breslin, J.G. and Decker, S., 2004. Online Social and Business Networking Communities. In: Y. Ding, D. Fensel, R. Lara, H. Lausen, M. Stollberg and S. Han, eds.

Proceedings of the ECAI 2004 Workshop on Application of Semantic Web Technologies to Web Communities, Valencia, Spain, August 23-27, 2004. CEUR-WS.org, *CEUR Workshop Proceedings*, vol. 107. Available from: https://ceur-ws.org/Vol-107/paper2.pdf.

[52] Onyutha, C., 2020. From R-squared to coefficient of model accuracy for assessing "goodness-of-fits". Available from: https://doi.org/10.5194/gmd-2020-51.

[53] Oughton, E.J., Comini, N., Foster, V. and Hall, J.W., 2022. Policy choices can help keep 4G and 5G universal broadband affordable. *Technological Forecasting and Social Change*, 176, p.121409. Available from: https://doi.org/10.1016/j.techfore.2021.121409.

[54] Ovais, D., 2023. Students' sustainability consciousness with the three dimensions of sustainability: Does the locus of control play a role? *Regional Sustainability*, 4(1), pp.13–27. Available from: https://doi.org/10.1016/j.regsus.2023.02.002.

[55] Pabian, A. and Pabian, B., 2023. Role of Social Media in Managing Knowledge of the Young Generation in the Sustainability Area. *Sustainability*, 15(7), p.6008. Available from: https://doi.org/10.3390/su15076008.

[56] Perez, N., 2024. *n*-Sizes, Attributes, and A Priori Sampling: A Qualitative Sampling Model for Large, Heterogeneous Populations. *American Journal of Qualitative Research*, 8(3), pp.193–207. Available from: https://doi.org/10.29333/ajqr/14895.

[57] Pirkkalainen, H. and Pawlowski, J.M., 2014. Global social knowledge management – Understanding barriers for global workers utilizing social software. *Computers in Human Behavior*, 30, pp.637–647. Available from: https://doi.org/10.1016/j.chb.2013.07.041.

[58] Rahardjanto, A. and Husamah, H., 2024. Efforts by Universities to Promote Sustainability Competence Over The Last Few Decades : A Systematic Literature Review. *Jurnal Kependidikan: Jurnal Hasil Penelitian dan Kajian Kepustakaan di Bidang Pendidikan, Pengajaran, dan Pembelajaran*, 10(2), p.605–617. Available from: https://doi.org/10.33394/jk.v10i2.11407.

[59] Ridings, C.M., Gefen, D. and Arinze, B., 2002. Some antecedents and effects of trust in virtual communities. *The Journal of Strategic Information Systems*, 11(3), pp.271–295. Available from: https://doi.org/10.1016/S0963-8687(02)00021-5.

[60] Sadiku, M.N.O., Chukwu, U.C., Ajayi-Majebi, A. and Musa, S.M., 2022. Digital Empowerment: An Introduction. *International Journal of Trend in Scientific Research and Development (IJTSRD)*, 6(4), pp.554–559. Available from: https://www.ijtsrd.com/papers/ijtsrd50141.pdf.

[61] Saka, N.T., 2025. Social Learning Theory. In: L.Y. Fındık, ed. *Exploring Adult Education Through Learning Theory*. Hershey, PA: IGI Global Scientific Publishing, chap. 6, pp.135–162. Available from: https://doi.org/10.4018/979-8-3693-5812-2.ch006.

[62] Saripanidis, I., Travlos, A.K., Antonopoulou, P., Strigas, A. and Ourda, D., 2025. Exploring Moderators of the Relationship Between Self-Efficacy and Bullying Involvement: A Social Cognitive Theory Perspective. *Journal of Interpersonal Violence*, p.08862605251324965. Available from: https://doi.org/10.1177/08862605251324965.

[63] Scherman, A., Valenzuela, S. and Rivera, S., 2022. Youth environmental activism in the age of social media: the case of Chile (2009-2019). *Journal of Youth Studies*, 25(6), pp.751–770. Available from: https://doi.org/10.1080/13676261.2021.2010691.

[64] Schneider, A., von Krogh, G. and Jäger, P., 2013. "What's coming next?" Epistemic curiosity and lurking behavior in online communities. *Computers in Human Behavior*, 29(1), pp.293–303. Including Special Section Youth, Internet, and Wellbeing. Available from: https://doi.org/10.1016/j.chb.2012.09.008.

[65] Shridhar, S.N. and Thippesh, K., 2023. Empowering students in the digital age: Assessing of digital empowerment level of students in higher education. *International Journal of Advanced Academic Studies*, 5(8), pp.41–44. Available from: https://doi.org/10.33545/27068919.2023.v5.i8a.1031.

[66] Sviridova, E., Yastrebova, E., Bakirova, G. and Rebrina, F., 2023. Immersive technologies as an innovative tool to increase academic success and motivation in higher education. *Frontiers in Education*, 8, p.1192760. Available from: https://doi.org/10.3389/feduc.2023.1192760.

[67] Tang, W., 2023. Conducting in-Depth Research on Influencing Mechanisms for Improving Social

Media Services Using Cognition Theory. *Journal of Social Service Research*, 49(5), pp.511–529. Available from: https://doi.org/10.1080/01488376.2023.2234424.

[68] The United Republic of Tanzania. Ministry of Education, Science and Technology, 2024. Draft national digital education strategy 2024/25 – 2029/30. Available from: https://www.moe.go.tz/sites/default/files/Draft_National_Digital_Education_Strategy2024-2030-2.pdf.

[69] UNESCO, 2018. *UNESCO ICT Competency Framework for Teachers*. Paris: United Nations Educational, Scientific and Cultural Organization. Available from: https://unesdoc.unesco.org/ark:/48223/pf0000265721.

[70] Wang, D. and Huang, X., 2025. Transforming education through artificial intelligence and immersive technologies: enhancing learning experiences. *Interactive Learning Environments*, 33(7), pp.4546–4565. Available from: https://doi.org/10.1080/10494820.2025.2465451.

[71] Wang, X. and Zhou, M., 2025. The Relationships Among Emotions, Self-Efficacy, and Engagement in Virtual Reality-Assisted Foreign Language Learning: A Social Cognitive Theory-Based Study. *Perceptual and Motor Skills*, 132(1), pp.218–236. Available from: https://doi.org/10.1177/00315125241297188.

[72] Wellman, B., 2001. Computer Networks As Social Networks. *Science*, 293(5537), pp.2031–2034. Available from: https://doi.org/10.1126/science.1065547.

[73] Wenkai, S., Xiaohong, W., Huiwen, X., Huishi, L., Liao, S. and Fei, H., 2023. The role of interpersonal alienation in the relationship between social media addiction and learning burnout among Chinese secondary school students. *Children's Health Care*, 52(2), pp.196–219. Available from: https://doi.org/10.1080/02739615.2022.2068552.

[74] West, S.G., Taylor, A.B., and Wu, W., 2012. Model Fit and Model Selection in Structural equation Modeling. In: R.H. Hoyle, ed. *Handbook of Structural Equation Modeling*. New York and London: The Guilford Press, chap. 13, pp.209–231. Available from: https://www.researchgate.net/publication/361861039.

[75] Wu, Q., Gu, L., Zhang, M. and Liu, H., 2024. Understanding Dual Effects of Social Network Services on Digital Well-Being and Sustainability: A Case Study of Xiaohongshu (RED). *Sustainability*, 16(15), p.6709. Available from: https://doi.org/10.3390/su16156709.

[76] Xu, T., Gao, Q., Ge, X. and Lu, J., 2024. The relationship between social media and professional learning from the perspective of pre-service teachers: A survey. *Education and Information Technologies*, 29(2), pp.2067–2092. Available from: https://doi.org/10.1007/s10639-023-11861-y.

[77] Zhang, X., Chen, B., Li, G. and Dong, Y., 2022. Exploring the health information seeking behavior of social media users under the background of COVID-19 pandemic: An empirical study based on social cognitive theory. *Frontiers in Psychology*, 13, p.1045914. Available from: https://doi.org/10.3389/fpsyg.2022.1045914.

[78] Zhao, L., 2023. Social Media Addiction and Its Impact on College Students' Academic Performance: The Mediating Role of Stress. *The Asia-Pacific Education Researcher*, 32(1), pp.81–90. Available from: https://doi.org/10.1007/s40299-021-00635-0.