Awareness and Practices on Smartphone Battery Drainage: A Cross-Sectional Study in Dodoma City Higher Education Institutions, Tanzania

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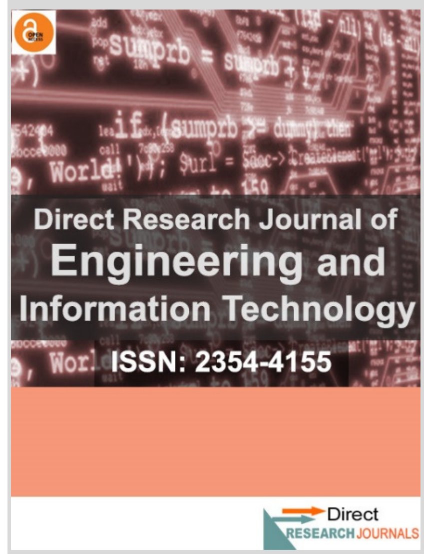
ABSTRACT

Smartphone battery drainage remains a remarkable challenge that negatively affects device performance and users' daily activities. The challenge is more severe mainly to students who rely heavily on mobile devices for academic and social purposes. This study examined the level of awareness and practices related to smartphone battery drainage among students in higher education institutions (HEIs) in Dodoma City, Tanzania. A cross-sectional study design was employed, using a structured self-administered questionnaire distributed to 384 students selected through systematic sampling. Of these, 381 completed questionnaires were valid and included in the analysis. Data were analyzed using descriptive statistics and multiple linear regression analysis to determine the relationship between students' awareness, charging behaviors, usage patterns, and experiences of smartphone battery drainage. The findings revealed a moderate level of awareness regarding the causes of battery drainage and battery-saving practices among students. However, inappropriate behaviors such as prolonged use of background applications, excessive screen brightness, and irregular charging patterns were prevalent and significantly associated with increased battery drainage. The multiple regression results further indicated that awareness level was a statistically significant predictor of effective battery drainage management practices (p < 0.05). These findings underscore the need for targeted awareness and educational programs within HEIs to promote optimal smartphone usage and charging practices, thereby enhancing battery longevity and improving overall device efficiency among students.

Keywords: *Smartphone battery drainage, user awareness, charging practices, higher education institutions, Dodoma city, Tanzania*



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INTRODUCTION

The rapid advancement of mobile technology has transformed smartphones into essential tools for communication, learning, and social interaction, particularly within higher education institutions (HEIs) (Lazaro & Duart. , 2023). Students increasingly rely on smartphones for academic activities such as accessing online learning platforms, conducting research, communicating with lecturers and peers, and managing daily schedules (Aina, 2025). In Tanzania, the shift from feature phones to smartphones has been driven by improved internet accessibility, affordability of devices, and expansion of mobile network coverage (Muya et al., 2023).

According to the quarterly report of the Tanzania Communications Regulatory Authority (TCRA, 2025), smartphone penetration in Tanzania increased from 36.75% to approximately 39.53%, corresponding to 26.9 million active smartphone devices users by September 2025. Similarly, during the same period, internet subscriptions expanded to 56.3 million, equivalent to an internet penetration rate of 82.6%. These data reflect that there is accelerated digital adoption, driven by large spread of mobile broadband infrastructure and increased affordability of internet-enabled devices (TCRA, 2025).

This growth has enhanced digital inclusion in HEIs although, there are also new challenges arising related to device performance such as smartphone battery drainage, shared charging sockets, theft risks, struggle to afford for data bundle, and charging devices during lectures (Mhina & Lashayo, 2023; Mawgoud, Taha, & Khalifa, 2019). Of all, regular mobile battery drainage limits effective smartphone use, disrupts academic activities, and increases dependence on charging facilities, which may be inadequate or unreliable in some institutional settings. The evidence show that, smartphone battery drainage is influenced by multiple factors, including users' awareness, charging behaviors, application usage patterns, screen brightness settings, and network connectivity (Olasina & Kheswa, 2021).

Despite technological improvements in battery design, improper usage practices such as overcharging, running multiple background applications, and excessive use of mobile data continue to accelerate battery depletion. Understanding users' awareness and practices is therefore crucial for promoting efficient smartphone usage and prolonging battery lifespan.

Several studies have examined smartphone usage behaviors among students; however, limited empirical evidence exists on awareness and practices related specifically to battery drainage within Tanzanian HEIs. Moreover, inconsistencies in institutional infrastructure and access to charging facilities may further compound the problem. This study addresses this gap by assessing awareness levels and battery-related practices among students in selected HEIs in Dodoma City. These institutions include Saint John's University of Tanzania, Local Government Training Institute, College of Business Education and the University of Dodoma. By focusing on battery drainage rather than general smartphone features, this study provides context-specific insights that can inform awareness programs, institutional policies, and user education strategies aimed at improving smartphone efficiency and supporting uninterrupted academic engagement in HEIs. The rapid increase in smartphone usage among students in HEIs has brought significant benefits including communication, collaborative learning, social interaction, networking, entertainment and the like (Mwalukasa, 2023). However, smartphone battery drainage has emerged as a persistent challenge that affects students' academic efficiency and daily routines. The evidence shows that many students rely heavily on smartphones for a wide range of services, with academic activities being the primary functions supported by these devices (Mwalukasa, 2022b). Despite the availability of technical recommendations for battery optimization, many students often lack adequate awareness of best practices or fail to apply them consistently, and thus, highlighting gaps in effective practices that may extend to areas such as battery management. In the context of Dodoma City, this challenge is compounded by socio-cultural and environmental factors, such as limited access to reliable electricity in student residences, the practice of sharing charging sockets in hostels and libraries, and concerns over phone theft when devices are left unattended while charging in public spaces. These conditions may encourage risky charging behaviors or discourage timely charging, thereby worsening battery drainage problems. Moreover, existing studies on smartphone battery performance tend to emphasize technical aspects such as hardware efficiency and software optimization, with limited attention to users' awareness, behaviors, and contextual realities, particularly within Tanzanian HEIs. As a result, there is insufficient empirical evidence linking students' knowledge and practices to battery drainage experiences in this socio-cultural setting. Therefore, the problem addressed in this study is the lack of systematic understanding of students' awareness and practices regarding smartphone battery drainage within the specific socio-cultural context of HEIs in Dodoma City. This study contributes to the existing body of knowledge by informing targeted student groups in academic institutions about awareness programs and practical interventions aimed at improving smartphone battery management and supporting effective digital engagement. To achieve the study objectives, the researchers seek to address the following research questions.

RQ1: What is the level of awareness among students in higher education institutions in Tanzania regarding the factors that contribute to smartphone battery drainage?

RQ2: To what extent do students in higher education institutions in Tanzania understand strategies and practices for reducing smartphone battery drainage?

LITERATURE REVIEW

This section reviews relevant theory and empirical literature on smartphone battery drainage and management practices for optimization. It focuses on concepts, models and previous studies that explain user awareness, battery consumption behavior, and management practices among HEIs students, with particular emphasis on evidence from Tanzania and comparable contexts. The main objective is to bridge the gap between awareness and management practices among students that contributes to early device replacement and e-waste challenges within university students' environments (Raudha & Msolla, 2021).

Theoretical Literature Review

The study of smartphone battery awareness and user practices can be effectively guided by Social Cognitive Theory (SCT), developed by Bandura in 1986 (Bandura, 1986). SCT posits that human behaviour is influenced by a dynamic and reciprocal interaction among cognition (personal factors), behaviour, and environment. In the context of smartphone battery management, cognition encompasses knowledge and beliefs about battery health and charging practices; behaviour includes daily practices such as charging frequency, screen brightness adjustment, and app usage; and environment refers to both physical and social factors, including access to electricity, availability of charging facilities, peer influence, and institutional norms.

Previous research applied SCT to technology adoption and health-related behaviour, demonstrating that individuals are more likely to adopt practices when they possess both self-efficacy and outcome expectations, and when their environment supports the desired behaviour (Schwarzer & Hamilton, 2020; Zhang & Zhang, 2022). For smartphone battery conservation, self-efficacy may reflect the confidence of users in managing battery life effectively, while outcome expectations involve beliefs that correct charging practices prolong battery lifespan and reduce device inconvenience.

Despite the relevance of SCT, prior studies in the Dodoma context and similar African settings have not operationalized SCT constructs into survey instruments. Many surveys capture knowledge and practices but do not explicitly link responses to cognition, behaviour, or environmental influences. To address this gap, the current study designed questionnaire items reflecting SCT constructs. For example, items assessing knowledge of battery principles correspond to cognition, reported charging and usage behaviours reflect constructs, and questions on electricity access or peer guidance relate to environmental factors. Operationalizing SCT in this way ensures that both data collection and analysis are theoretically grounded.

Furthermore, SCT provides a framework for interpreting study results. For instance, correlations between knowledge and reported practices can be viewed through the lens of cognitive-behavioral interaction, while environmental constraints such as unreliable electricity can explain discrepancies between awareness and actual behaviour. By explicitly linking SCT constructs to questionnaire items and the analytical framework, the study aligns empirical findings with a well-established theoretical model, enhancing both explanatory power and practical relevance (Sekhon, Cartwright, & Francis, 2022).

Empirical Literature Review

This sub-section reviews numerous studies on the level of awareness of mobile battery drainage and mobile energy-saving practices among students for both in a global context and within Sub-Saharan Africa.

Level of Awareness of Mobile Phone Battery Drainage Causes among Students in Higher Education Institutions

There is a numerous body of literature on awareness of mobile or smartphone battery consumption worldwide. The following paragraphs highlight well-known and recent studies, although many of them have certain limitations.
A study by Rahman, Rahman, and Rashid (2017) in Asia reveals that 46% of respondents indicated were not aware of the causes behind abrupt mobile battery drainage**,** while the remaining 48% confirmed some level of awareness about the factors contributing to excessive mobile battery drainage. This finding gives significant study gap in knowledge among the majority of university students concerning mobile battery usage and energy efficiency. The lack of awareness among more than half of the students' population call urgent intervention for education provision to enhance students' understanding of energy-draining contributing factors such as excessive switching on numerous applications, screen brightness, and other internet related connectivity settings. A study by Chen et al. (2023) in China universities reveal that students explained of being aware of the main causes for mobile phones power drainage but still they recommended to be addictive to the services offered through their mobile phones and thus, it was difficult for them to optimize the power through shutting down their devices. Similarly, a study by Santhi and Rajesh (2020) in India shows that many students (58.58%) are aware of the importance of switching off mobile probably as a way to conserve battery or prevent misuse and believed that their academic performance can improve without mobile phone. This implies that to some extent a number of students' belief that turning off phone helps academic performance, although in other side it related to energy conservation for extra mobile phones survival. In Europe region a recent study conducted in Hungary show that, 57% of students were found not to be aware of the factors contributing to mobile battery drainage. These majority percent students were relatively conscious about protecting the phone physically (Mai & Tick., 2021).

In Portugal, a study by Horta et al. (2016), highlights that the university students within the country are increasingly aware of the negative impacts of smartphone overuse, including issues like battery drainage due to excessive usage. However, the study does not provide the adopted strategies among the students do minimize the mobile power drainage through excessive use. In sub-Saharan Africa, there are body of literature which highlight the level of university students' awareness regarding the mobile battery consumption causes. For example, a study by Aina,(2025) in Nigeria a reveal that the majority of students mainly in higher education institutions were aware of factors that contribute to mobile energy drainage-highlighting mobile brightness, watching YouTube videos, playing recorded music and playing games to be the main source of battery drainage. Similarly, the researcher identified that only a small actively engaged in trying to minimize these services in order to optimize their battery charge. Similarly, a study by Makoza (2025) in South Africa reveals that some students in higher education institutions complained about high screen brightness, constant screen-on time, and battery drain, which caused their mobile phones to lose power quickly. This situation informs the audience that at least some students are aware, through experience, that high screen brightness and keeping the screen on at full brightness cause battery drain

Thus, this study does not provide specific statistics on students' awareness on mobile battery drainage causes, instead it offers valuable insights into how awareness campaigns can influence smartphone usage behaviors, potentially leading to reduced battery consumption. The empirical review revealed that there is significant gap in existing research, as no studies were found that specifically address the level of awareness regarding mobile battery consumption causes among students in higher education levels in Tanzania. Despite of increasing reliance on mobile devices for academic and social activities, there appears to be a lack of scholarly attention on how well students understand the factors contributing to battery drain. This gap highlights the need for targeted research to explore students' awareness levels and to inform strategies for promoting more efficient mobile device usage within this demographic.

Higher Education Students' Understanding of Strategies to Reduce Mobile Phone Battery Drainage

Understanding the potential strategies to reduce battery drainage among the users is essential for ensuring uninterrupted access to digital resources. There is a significant body of evidence worldwide demonstrating students' awareness and understanding of strategies to reduce mobile phone battery drainage. The following studies provide empirical support for these findings. A study by Wu, Wang, and Wolter (2023) show that among the possible technical means or strategies to be adopted among higher education students to optimize the power in smartphones is reducing screen brightness, disabling background apps, and having cloud offloading executions. There are numerous approaches which can be adopted among the students of higher education worldwide, though these approaches might differ in accord with the location and settings environments. A study by Awad, Hegazy, and El-Horbaty (2024) highlight the general approaches to minimize mobile battery drainage in higher education students worldwide should adopt a combination of technical and behavioral strategies that optimize power. Key approaches include reducing screen brightness, using power-saving modes, disabling background app refresh, turning off location services when not needed, and limiting push notifications. Similarly, the students should close unused applications, use Wi-Fi instead of mobile data when available, and enable battery optimization settings built into modern operating systems. Awareness and consistent application of these strategies not only extend battery life but also promote more intentional and efficient device use. The alike energy-saving practices could be adopted by Tanzanian students to optimize battery usage, but further exploration is needed to understand whether these strategies are well-known and commonly implemented in Tanzanian higher education institutions. Understanding the approaches adopted among students of higher education in Tanzania would be an important area of investigation. If optimized battery management allows students to stay connected and use their devices more efficiently, it may enhance their academic productivity.

MATERIALS AND METHODS

Study Design and Setting

This study employed a cross-sectional survey design, which is appropriate for assessing awareness and practices related to smartphone battery usage (Setia, 2016). Data were collected from multiple higher education institutions (HEIs) in Dodoma City, Tanzania, to capture diverse perspectives among students and staff.

Population and Sampling

The target population included all students and staff enrolled or employed at selected HEIs during the study period. A proportionate stratified sampling technique was used to ensure representation across the two strata: students and staff. Within each stratum, participants were randomly selected proportionally to the stratum size (Kumar, 2018). For example, if students accounted for 80% of the total population, they received 80% of the sample, while staff received 20%.

Sample Size Determination

The sample size was determined using the formula for proportions in a finite population (Cochran, 1977):

$$n = \frac{Z^2 . p(1-p)}{d^2} \quad (1)$$

Where:

Z = 1.96 for 95% confidence,
p = expected proportion of participants with adequate battery awareness (0.5 used to maximize sample size),
d= margin of error (0.05).

The finite population correction ensures accuracy given the actual population size. A 10% adjustment was made to account for non-response, resulting in a final sample (Israel, 2013)

$$n = \frac{(1.96)^2 .05\ (0.5)}{(0.05)^2} = 384.16 \quad (2)$$

Using Cochran's (1977) formula with a 95% confidence level, a margin of error of 5%, and an assumed population proportion of 0.5, the required sample size is 384 respondents. This sample size is widely accepted in social science research when the population is large or unknown.

Data Collection

A structured self-administered questionnaire was developed guided by the SCT–covering cognition (knowledge of battery principles), behaviour (charging and usage practices), and environment (electricity access, peer influence)

Instrument validation was conducted via expert review and a pilot test with 30 participants from a non-sampled HEI. Internal consistency reliability was assessed using Cronbach's alpha**,** yielding α = 0.78**,** indicating acceptable reliability (Backhaus , Erichson, Gensler, Weiber, & Weiber, 2018)

Data Collection Procedure

Data were collected between May, 2025and July, 2025. Research assistants were trained in ethical conduct and survey administration. Participants provided written informed consent in accordance with the ethical principles outlined in the Declaration of Helsinki 2013. Participants were of assured of confidentiality and participation was voluntary, and respondents could withdraw at any time without consequence (World Medical Association, 2013)**.** The survey method was used to collect data from a sample of 384 students (Table 1). To measure their attitudes, a Five-point Likert scale was employed, ranging from (*1=strongly disagree to 5=strongly agree).* This scale was chosen because it is easy to understand and use for both respondents and survey administrators (Joshi, Kale, Chandel, & Pal, 2015). All distributed questionnaires were returned back; however, only 381 were deemed valid and suitable for analysis.

Data Analysis

Data were analyzed using R-Studio statistical software (version 2024.12.1) (Posit, 2025). Descriptive statistics, including frequencies, percentages, means, and standard deviations, were employed to summarize participants' socio-demographic characteristics and smartphone battery management practices. The relationships between Social Cognitive Theory (SCT) constructs and battery-preserving behaviours were assessed using chi-square tests for bivariate analysis and multivariable logistic regression models to identify significant predictors while controlling for potential confounders. Statistical significance was determined at a 5% level (p < 0.05).

Table 1: Sample size distribution.

Education level	Institutions	Number of respondents
Certificate	College of Business Education	60
	Local Government Training Institute	90
Diploma	College of Business Education	68
	Local Government Training Institute	60
Bachelor degree	University of Dodoma	63
	St John's University of Tanzania	40
Total		384

Ethical Considerations

The ethical approval for this study was obtained from the Dodoma Regional Administrative Secretary (RAS). All research procedures were conducted in accordance with established ethical guidelines, including obtaining written informed consent from participants, ensuring confidentiality of responses, and informing participants of their right to withdraw from the study at any time.

RESULTS AND DISCUSSION

The results in this section are structured and discussed in accordance with RQ1 and RQ2 and described accordingly highlighting key themes and insights that emerged from the analysis.

What is The Level of Awareness among Students in HEIs in Tanzania Regarding the Factors that Contribute to Mobile Phone Battery Drainage? (RQ1)

The level of awareness among students in higher education institutions in Tanzania regarding factors that contribute to phone battery drainage. The results show that out of the total 381 students (Figures 1 and 2)**,** the largest proportion of 145 students (38%), selected the "Neutral" category. This indicates that many students are somewhat aware of the factors that affect battery life, but they are neither fully confident nor strongly convinced about the impact of these factors. In comparison, students who "Agree" or "Strongly Agree" represent 188 students (49%), showing that almost half of the respondents

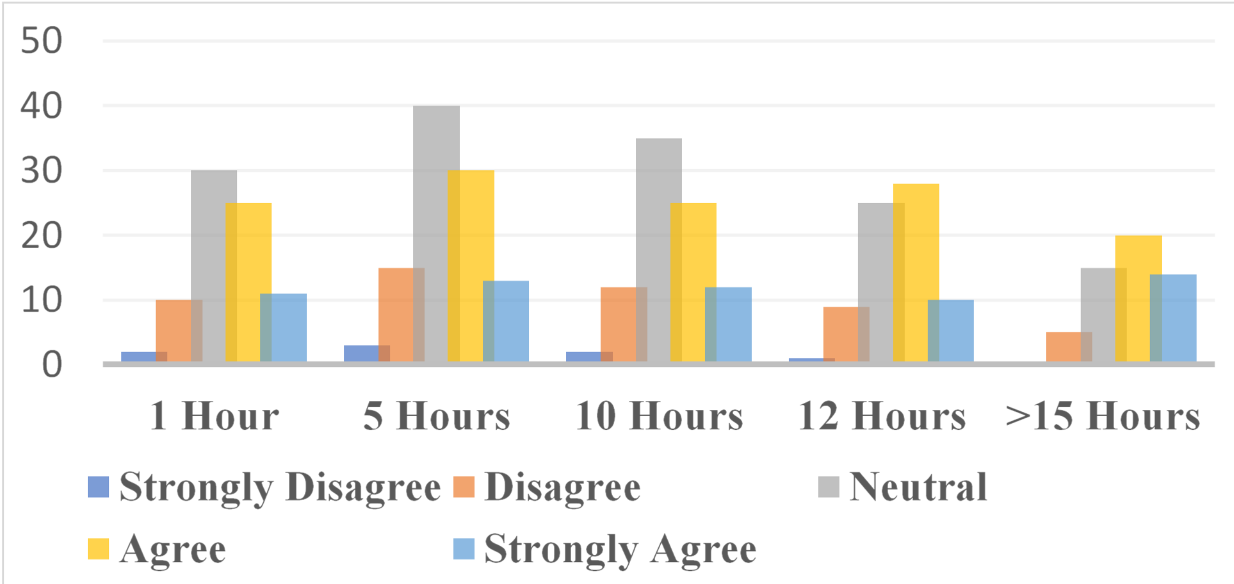

Figure 1: The frequency of phone battery charging among students in higher education institutions

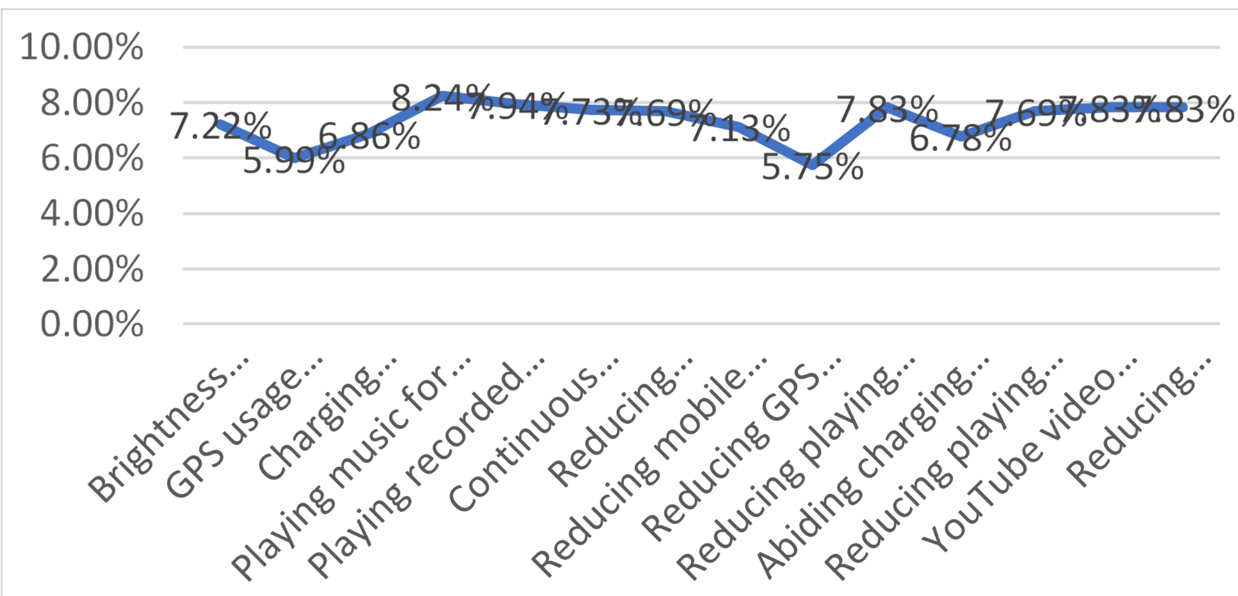

Figure 2: Student perceptions of battery drainage in higher education institutions in Tanzania**.**

recognize that certain behaviors, applications, and usage patterns can lead to battery depletion. Only a small portion of the sample, 59 students (15%)**,** "Disagree" or "Strongly Disagree," indicating limited unawareness among the population. The distribution of awareness across charging frequency further highlights this pattern. Students who charge their phones very frequently (every 1–5 hours) are predominantly "Neutral" or "Agree," suggesting that direct experience with battery drainage increases practical awareness, though most remain moderately informed. Students who charge less frequently (10–12 hours) also show a similar pattern, with responses clustered around "Neutral" and "Agree." Interestingly, even students who rarely charge their phones (>15 hours) exhibit awareness, as responses are spread across "Neutral," "Agree," and "Strongly Agree," indicating that awareness is consistent regardless of usage patterns. The findings suggest that students in higher education institutions in Tanzania have a moderate understanding of the factors contributing to phone battery drainage. While many recognize that

Table 2: Descriptive statistics showing the level of awareness on factors contributing to phone battery drainage.

Factor	N	Minimum	Maximum	Mean	Std. Deviation
Brightness causes battery drainage	381	1	5	3.41	1.199
GPS usage causes battery drainage	381	1	5	2.83	1.173
Charging behaviours cause battery drainage	381	1	5	3.24	1.235
Playing music for a long time	381	1	5	3.89	1.140
Playing recorded videos	381	2	5	3.75	0.996
Continuous usage of WhatsApp, Instagram, and Facebook	381	2	5	3.65	0.996
Reducing playing YouTube videos optimizes battery	381	1	5	3.63	1.143
Reducing mobile brightness optimizes battery	381	1	5	3.37	1.152
Reducing GPS usage optimizes battery	381	1	5	2.72	1.223
Reducing playing music for a long time optimizes battery	381	1	5	3.70	1.133
Abiding by charging behaviours optimizes battery	381	1	5	3.20	1.133
Reducing playing recorded videos optimizes battery	381	2	5	3.63	1.122
Valid N (listwise)	381				

Table 3: Residuals for awareness of factors contributing to phone battery drainage

Min	1Q	Median	3Q	Max
-5.1682	-1.2672	0.0888	1.1655	4.7821

smartphone usage and certain behaviors affect battery life, their awareness is not strong or uniform enough to place the majority in the “Strongly Agree” category.

This moderate level of awareness highlights the need for educational interventions and information campaigns to improve knowledge and promote effective battery management practices among students. The results in (Table 2) show the descriptive statistics of the study provide insight into students’ awareness of battery drainage and the behaviors they adopt to optimize battery life. A total of 381 respondents participated, offering a comprehensive overview of their perceptions and practices. Regarding the perceived causes of battery drainage, students generally recognize that high screen brightness significantly contributes to battery consumption, as indicated by a mean score of 3.41 and a standard deviation of 1.199.

GPS usage, on the other hand, is perceived as a less critical factor, with a mean score of 2.83, suggesting that some students either use location-based services infrequently or underestimate their impact on battery life. Improper charging behaviors are moderately acknowledged as a cause of battery drain (*mean* = 3.24), although the variation in responses indicates that awareness is not uniform across the student population. The analysis also highlights behavioral patterns that may drain battery. Prolonged media usage, such as playing music for a long time (*mean* = 3.89) or watching recorded videos (mean = 3.75), is widely recognized by students as a significant contributor to battery depletion. Continuous use of social media platforms, including WhatsApp, Instagram, and Facebook, is similarly acknowledged (*mean* = 3.65), reflecting the high reliance on these applications in students’ daily routines. The relatively low standard deviations in these measures suggest a consistent perception among most respondents. In terms of battery optimization practices, students show moderate engagement in behaviors aimed at conserving battery life. Reducing the playback of YouTube videos (*mean* = 3.63) and lowering mobile brightness (*mean* = 3.37) are common strategies, though there is noticeable variation in implementation. Reducing GPS usage for battery optimization is less frequently practiced (mean = 2.72), indicating either a lack of awareness or dependence on location-based services. Adhering to proper charging habits receives moderate attention (*mean* = 3.20), while efforts to limit media playback, such as reducing music or video consumption (*mean* = 3.70 and 3.63, respectively), are somewhat practiced but not consistently across the student body. The findings reveal a moderate level of awareness among students regarding both the causes of battery drainage and the strategies for optimization. While most students understand the impact of media usage on battery life, practices such as limiting GPS use and maintaining proper charging habits are less consistently applied. The variation in responses highlights the need for targeted educational interventions to promote more consistent and effective battery management behaviors among students. Table 3 presents the residuals from the regression analysis examining students’ awareness of factors contributing to phone battery drainage. Residuals represent the difference between the observed awareness scores and the values predicted by the regression model. Analyzing residuals helps assess how well the model fits the data and whether the predictors (gender, age, and daily phone usage) adequately explain variations in awareness.

The minimum residual (-5.1682) and maximum residual (4.7821) indicate that some students’ observed awareness scores deviate considerably from the predicted values.

This suggests that while the model captures general trends, individual differences such as personal experience with mobile devices, exposure to information about battery usage, or other unmeasured factors also influence awareness.

The first quartile (1Q = -1.2672), median (0.0888), and third quartile (3Q = 1.1655) show that the majority of residuals are relatively close to zero, meaning most students' awareness scores are fairly well predicted by the model. The median being near zero indicates that the model does not systematically over predict or under predict awareness scores. The residuals demonstrate that the regression model provides a moderate fit for the data. Most predictions are reasonably accurate, but the wide range between the minimum and maximum residuals highlights that there are other factors influencing students' awareness beyond gender, age, and daily phone usage. This suggests opportunities for future research to include additional predictors such as smartphone experience, peer influence, or educational campaigns to improve model accuracy. Table 4 presents the Variance Inflation Factor (VIF) values for the predictors in the regression model examining students' awareness of factors contributing to phone battery drainage. In this model, the VIF values are: Gender: 1.000335, Age**:** 1.000362 and Daily use: 1. 000029.All VIF values are very close to 1, which indicates no multicollinearity among the predictors.

Table 4: Multicollinearity Test (VIF) assesses if predictors are correlated.

Predictor	VIF
Gender	1.000335
Age	1.000362
Daily use	1.000029

Table 5: Regression results to present the estimates from the linear regression model.

Predictor	Estimate	Std. Error	t-value	p-value
(Intercept)	6.417	0.574	11.175	<0.001 ***
Gender Female	-0.108	0.189	0.569	0.047
Age	0.041	0.022	1.915	0.036
Daily use	0.170	0.097	1.747	0.041

This means that gender, age, and daily phone usage are essentially independent of each other in this sample. Consequently, the regression coefficients can be interpreted reliably, and the model is unlikely to suffer from bias due to correlated predictors. The VIF results confirm that the chosen predictors gender, age, and daily phone usage can independently contribute to explaining variations in students' awareness of battery-draining factors without interference from multicollinearity. The regression results in (Table 5) examine the relationship between gender, age, and daily phone usage and students' awareness of factors contributing to phone battery drainage. The dependent variable, awareness Score, provides a quantitative measure of how knowledgeable students are about behaviors and factors that reduce battery life. The intercept is 6.417 ($p < 0.001$), which indicates the baseline awareness score when all other variables are zero. This value falls within a moderate level of awareness (assuming a scale where low = 0–3, moderate = 4–7, and high = 8–10). This suggests that, on average, students possess a moderate understanding of factors that cause battery drainage.

Gender has a negative coefficient ($\beta = -0.108$) with a p-value of 0.047, which is statistically significant at the 5% level. This indicates that female students tend to have slightly lower awareness scores compared to male students. Although the effect is small, gender appears to have a measurable impact on awareness, keeping most students within the moderate awareness category. Age has a positive coefficient ($\beta = 0.041$) with a marginally significant p-value of 0.036. This shows that older students tend to have slightly higher awareness scores. The finding may reflect that older students have more experience with mobile devices or have developed better strategies to manage battery usage over time.

Daily phone usage also shows a positive relationship with awareness ($\beta = 0.170$, $p = 0.041$), indicating that students who use their phones more frequently each day tend to be slightly more aware of battery-draining factors. This could be because heavy users are more familiar with the impact of their behaviors on battery life and therefore pay more attention to energy-saving practices. These results suggest that the level of awareness among students is generally moderate, with small variations influenced by gender, age, and daily usage patterns. Female students have slightly lower awareness, while older and more frequent phone users show marginally higher awareness. However, the predicted scores do not reach the high awareness range (8–10), indicating potential for targeted educational interventions to improve understanding and practices regarding battery drainage.

To What Extent do Students in HEIs in Tanzania Understand the Strategies for Reducing the Rate of Mobile Phone Battery Drainage? (RQ2)

The major contribution of this study is building a comprehensive, longitudinal, and ingrained data set collected from the daily users of smartphone which is crucial for imparting knowledge to users on how to handle their charging and usage behaviors to reduce the high usage of institutional resources including electricity bills. Understanding the usefulness of mobile battery optimization practices can lead to improved academic performance, because students can benefit from the knowledge gained through attending online classes, accessing study materials, having collaborative learning, and participating in academic essential activities without interruptions caused by battery drain. To fill this gap this study seeks to answer the following research questions. From (Figure 2) above, it is evident that playing music for a long time (8.24%) is perceived as the most significant contributor to battery drainage. Closely following are YouTube video usage (7.83%) and playing recorded videos (7.94%), indicating that activities involving prolonged media playback are the most demanding on battery life. Similarly, the continuous use of social media applications such as WhatsApp, Instagram, and Facebook also shows a considerable influence (7.73%), reflecting the growing impact of social media consumption on mobile device energy consumption.

Factors related to device settings and usage habits, such as brightness adjustment (7.22%) and charging behaviors (6.86%), are perceived as moderately influential. This suggests that while students recognize the technical aspects of battery management, behavioral factors such as media consumption have a stronger effect on battery drainage. On the other hand, GPS usage (5.99%) and reducing GPS usage to optimize battery (5.75%) are considered less impactful compared to other activities, indicating that location-based services are not the primary concern for battery depletion among students. The (Figure 2), highlights that student perceptions of battery drainage are dominated by high-consumption activities, especially multimedia and social media use, while technical management strategies play a supporting but important role. Understanding these perceptions is critical for developing awareness campaigns and practical interventions aimed at improving battery longevity and encouraging efficient phone usage among higher education students.

The Model Summary in (Table 6) indicates that the correlation coefficient (R) was 0.224, reflecting a weak positive relationship between the predictors (battery-saving strategies) and students' understanding. The R Square value of 0.050 shows that the model explains only 5 percent of the variance in students' understanding, while the Adjusted R Square of 0.017, after accounting for the number of predictors, confirms the limited explanatory power of the model. The standard error of the estimate (1.27967) suggests considerable variability in students' understanding that is not captured by the predictors. These findings imply that while the identified strategies such as reducing continuous social media usage, adjusting brightness, and adopting proper charging behaviors do influence students' understanding, their contribution is minimal, and most of the variation is attributable to other factors.

Table 6: Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.224	0.050	0.017	1.27967

The ANOVA results further clarify the overall significance of the model. The regression sum of squares (31.806) compared to the residual sum of squares (600.987) shows that the majority of the variation in understanding remains unexplained. However, the F-value of 1.494 with a significance level of 0.00117 indicates that the model as a whole is statistically significant (Table 7). This means that, although the predictors explain only a small proportion of the variance, they still contribute meaningfully to students' understanding of battery-saving practices.

Table 7: ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	31.806	13	2.447	1.494	0.00117
Residua	600.987	367	1.638		
Total	632.793	380			

Taken together, these results suggest that students in higher education institutions possess some awareness of strategies for reducing phone battery drainage, but their level of understanding is relatively limited. The statistical significance of the model shows that the strategies under study are important, yet the weak explanatory power highlights the role of other unmeasured influences, such as personal experience, peer advice, or informal digital literacy, in shaping students' knowledge of battery optimization.

Table 8 shows several usage-related variables show meaningful relationships with battery performance. Continuous usage of social media applications (WhatsApp, Instagram, and Facebook) has a negative and statistically significant effect on battery performance (B = −0.103, p = 0.0265). This implies that prolonged use of these applications increases battery drainage. Playing recorded videos has a positive and statistically significant relationship with battery performance (B = 0.097, p = 0.0410). This suggests that controlled or moderate playback of recorded videos may be associated with better battery efficiency compared to unrestricted usage.

YouTube video usage (B = 0.078, p = 0.0481) also shows a statistically significant effect, indicating that video streaming contributes to changes in battery performance, although the relatively small standardized coefficient (Beta = 0.059) suggests a weak effect. GPS usage, playing music, and general charging behaviors display either negative or positive relationships, but their effects are not statistically significant at the 5% level, implying limited independent influence on battery performance. Battery optimization practices demonstrate stronger and more consistent effects on battery performance. Reducing mobile screen brightness has a positive and statistically significant effect (B = 0.114, p = 0.0184), confirming that lowering screen brightness improves battery efficiency.
Abiding by proper charging behaviors is the strongest predictor in the model and is highly significant (B = −0.179, p = 0.0024). The negative coefficient indicates that adherence to correct charging practices substantially reduces battery drainage and enhances battery longevity. Reducing the playing of recorded videos also has a

Table 8: Regression Coefficients.

Predictor Variable	Unstandardized Coefficient (B)	Std. Error	Standardized Coefficient (Beta)	t-value	p-value
Constant	2.762	0.354	–	7.811	**< 0.001**
YouTube video	0.078	0.110	0.059	0.706	**0.04810**
GPS usage	−0.038	0.092	−0.034	-0.415	0.06790
Charging behaviours	0.170	0.093	0.163	1.832	0.06800
Playing music	−0.059	0.104	−0.052	−0.562	0.05740
Playing recorded videos	0.097	0.118	0.075	0.825	**0.04100**
Continuous usage of WhatsApp, Instagram & Facebook	−0.103	0.092	−0.079	−1.116	**0.02650**
Reducing playing YouTube videos optimizes battery	0.032	0.080	0.028	0.399	0.06900
Reducing mobile brightness optimizes battery	0.114	0.086	0.102	1.330	**0.01840**
Reducing GPS usage optimizes battery	−0.106	0.077	−0.101	−1.389	**0.01660**
Reducing playing music for long time optimizes battery	−0.121	0.087	−0.106	−1.386	**0.01660**
Abiding charging behaviours optimizes battery	−0.179	0.079	−0.157	−2.260	**0.00240**
Reducing playing recorded videos optimizes battery	0.100	0.096	0.087	1.045	**0.02970**
Reducing continuous usage of WhatsApp, Instagram & Facebook	−0.019	0.116	−0.014	−0.160	0.08730

positive and statistically significant effect on battery performance (B = 0.100, p = 0.0297), suggesting that limiting video playback helps conserve battery power.
Reducing GPS usage (B = −0.106, p = 0.0166) and reducing long-duration music playback (B = −0.121, p = 0.0166) show statistically significant but negative coefficients. This indicates that even when these activities are reduced, they may still consume considerable battery power, possibly due to background processes or hardware demands. Reducing continuous usage of social media applications and reducing YouTube video playback show no statistically significant effects, suggesting that partial reduction alone may not yield substantial improvements in battery performance.

Conclusions

This study has provided valuable understandings into student awareness and practices regarding mobile battery drainage and optimization strategies within Tanzanian higher education institutions. The findings highlight that while many students recognize the importance of managing their mobile battery usage, there remains a gap in their understanding of effective optimization techniques and sustainable battery practices. This indicates a need for increased awareness campaigns, digital literacy programs, and institutional initiatives to promote responsible mobile usage. Despite the limitations encountered, the study contributes to the growing body of knowledge on mobile technology use in educational contexts and offers a foundation for further research. Future studies could expand the scope by including more institutions, integrating experimental assessments, and examining the impact of emerging mobile technologies on students' battery management behaviors.

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