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Original Article

Smartphone Use, Learning, and Student Well-Being in Higher Education: Evidence from Bangladesh

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Abstract: This study examined smartphone use and its implications for teaching, learning, and academic engagement among 353 university students aged 18–25 years in Rangpur, Bangladesh. A cross-sectional mixed-methods design combined a 29-item questionnaire (Cronbach's α = .837) with interviews involving 10 students and 10 faculty and administrative staff members. Multiple linear regression identified communication dependency (β = .163, p = .002) and perceived academic impact (β = .141, p = .009) as significant predictors of smartphone-use frequency, explaining 10.0% of its variance. Findings indicated that extensive social media use coexisted with academic distraction, sleep disturbances, compulsive checking, and perceived isolation. Interviews also revealed the absence of institutional smartphone-use policies. These findings highlight smartphones' dual role as learning resources and potential sources of academic disruption, underscoring the need for institutional guidelines and educational strategies that promote responsible use and support effective teaching, learning, and student well-being in higher education across diverse learning environments.

Keywords: Generation Z; smartphone use; perceived academic impact; self-regulation; digital well-being; Bangladesh.

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INTRODUCTION

Generation Z has grown up in a digital environment in which communication, learning, entertainment, and social participation are increasingly mediated by smartphones (Palfrey & Gasser, 2008; Prensky, 2001; Rathore & Sonawat, 2015). In Bangladesh, mobile technology has expanded substantially since the 1990s, with smartphones becoming an important channel for internet access, financial services, and everyday transactions (Rahaman, 2017). Beyond these practical functions, smartphones facilitate peer communication, identity development, and digital skills acquisition among young

people (Campbell, 2005). Within educational settings, smartphone use has been associated with differences in academic engagement (Paterna *et al.*, 2024; Aghosh Zahra *et al.*, 2026), sleep patterns (Leow *et al.*, 2023), checking behaviours, and technology-related anxiety, including nomophobia (Girela-Serrano *et al.*, 2024; Grant *et al.*, 2019). These findings highlight the importance of understanding smartphone use in relation to students' educational experiences and well-being (Marangunić & Granić, 2015).

In Bangladesh, smartphones have facilitated e-learning and access to educational resources (Hasan *et al.*, 2021; Shokal *et al.*, 2024). At the same time, studies have reported associations between intensive or less purposeful smartphone use and outcomes related to academic performance, psychological well-being, and face-to-face relationships (Arefin *et al.*, 2017; Hosen *et al.*, 2021; Sarker *et al.*, 2026). Taken together, this literature suggests that smartphones can serve both educational and social functions while being associated with challenges relevant to students' learning experiences. However, findings from self-reported, cross-sectional studies should be interpreted in terms of associations rather than causal relationships. Further research is therefore needed to examine smartphone-use patterns and their relationships with academic, social, psychological, and self-regulatory outcomes in specific higher education contexts (Aghosh Zahra et al., 2026).

Three gaps in the literature on smartphone use among university students in Bangladesh warrant further investigation. First, a structured search of Scopus, Google Scholar, and BanglaJOL for empirical studies published between 2015 and 2025, using combinations of the terms *smartphone/mobile phone*, *student*, and *Bangladesh*, identified ten studies, seven of which were conducted in Dhaka and its surrounding metropolitan area. This distribution suggests that empirical evidence from other divisional cities, including Rangpur, remains limited. Second, previous studies have tended to examine specific aspects of smartphone use, including problematic use (Hosen *et al.*, 2021), access to e-learning (Hasan *et al.*, 2021), and academic performance (Arefin *et al.*, 2017). Although these studies provide useful insights into individual outcome domains, academic, social, psychological, and self-regulatory dimensions have not consistently been examined together within a single sample using a common instrument. Third, more context-specific evidence is needed to understand how students' everyday smartphone-use patterns relate to usage frequency and how students, faculty members, and university administrators perceive and manage smartphone use in higher education settings outside the capital.

Rangpur provides an important setting for extending research on smartphone use beyond the metropolitan context of Dhaka. Research on digital learning in Bangladesh has identified disparities in students' access to technological resources, internet connectivity, and online learning opportunities (Hasan *et al.*, 2021; Kabir *et al.*, 2021). Badiuzzaman *et al.* (2021) further demonstrated that internet costs and inadequate network infrastructure can constrain students' participation in online learning, even when digital devices are available. Similarly, Saha *et al.* (2021) documented challenges associated with the digital divide and its psychological implications among undergraduate students in Dhaka. These findings highlight the importance of considering socioeconomic circumstances, connectivity, and educational environments when examining students' experiences of technology-supported learning. However, evidence from metropolitan settings cannot

automatically be assumed to represent students in other regions. Examining smartphone use in Rangpur can therefore extend the geographical scope of existing research and contribute to a more diverse understanding of students' digital learning experiences. Such evidence may also inform context-sensitive approaches to digital well-being and responsible technology use in higher education (Siemens, 2005; Oktay & Dasdag, 2006).

Against this background, the study examines smartphone use among 353 Generation Z students aged 18–25 in Rangpur, Bangladesh, using a cross-sectional mixed-methods design. Building on previous research (Arefin *et al.*, 2017; Badiuzzaman *et al.*, 2021; Saha *et al.*, 2021), it investigates five dimensions: usage behaviours, academic use and impact, social and behavioural outcomes, psychological and health outcomes, and self-regulation and awareness. Survey findings are complemented by interviews with ten students and ten faculty and administrative staff members (Creswell & Plano Clark, 2018; Hoque, 2018). The study describes smartphone-use patterns, identifies factors associated with usage frequency through multiple linear regression, examines differences across demographic and educational subgroups, and uses qualitative insights to contextualise the findings within teaching and learning practices.

Given its cross-sectional design and reliance on self-reported measures, this study examines statistical associations rather than causal relationships, consistent with reviews highlighting the need for rigorous measurement and longitudinal research (Candussi *et al.*, 2023; Islambouli *et al.*, 2025; Paterna *et al.*, 2024). It makes three contributions: extending evidence on smartphone use beyond Dhaka to the underrepresented context of Rangpur; examining five related dimensions within a single analytical framework; and connecting quantitative findings with institutional practices, including classroom smartphone policies and students' self-regulation. By integrating survey data with perspectives from students, faculty, and administrative staff, the study provides context-specific evidence to inform institutional guidelines and educational strategies for responsible smartphone use, digital well-being, and effective learning in higher education.

THEORETICAL SUPPORT

This study draws on complementary theoretical perspectives to examine smartphone use among Generation Z university students. The Technology Acceptance Model (TAM) provides a foundation for understanding technology use, while self-regulation offers a perspective on students' awareness of digital risks and their capacity to manage smartphone use (Hasan *et al.*, 2021; Hodge & Gebler-Wolfe, 2022). Social constructivism complements these perspectives by recognising that smartphone-mediated communication may support social interaction and learning. Together, these perspectives guide the interpretation of smartphone-use patterns and their academic, behavioural, and psychological dimensions without assuming causal relationships.

Self-regulation as the linking mechanism

There is a construct linking the two outcome domains: self-regulation. Aware of digital risk does not necessarily lead to behavioural change (Billieux *et al.*, 2007; Goswami & Singh, 2015), and there is evidence of deficits of behavioural and cognitive self-control

in problematic use (Fabio *et al.*, 2022). The path-analytical evidence presented by the Chinese students in the university shows that problematic smartphone use is related to academic procrastination and academic anxiety, and that self-regulation is a partial mediating factor (Yang *et al.*, 2019; Rathod & Agal, 2023). This asymmetry in awareness and action is a testable expectation for this sample: students will perceive less control when they report recognizing harm, and when they report harm to their academic performance (Raja & Nagasubramani, 2018; Paudel, 2025), they will report lower use.

Technology Acceptance Model (Davis, 1989)

TAM assumes that perceived usefulness and perceived ease of use affects behavioural intention which, in turn, affects actual system use (Davis, 1989; Venkatesh & Davis, 2000). The model has been validated through meta-analysis (King & He, 2006; Scherer, Siddiq, & Tondeur, 2019) and used in higher education in Bangladesh (Hasan *et al.*, 2021; Milon & Iqbal, 2017). In the context of now, there are 2 adaptations needed. First, TAM was developed to explain the voluntary adoption of an unfamiliar technology, but in this population smartphone use is habitual and near universal; under these circumstance, habit and dependency lead to use beyond intention (Venkatesh & Davis, 2000). Communication dependency is therefore included as a construct separate from perceived usefulness, instead of on TAM alone, but based instead on the habit extension in UTAUT2. Second, in the present study, behavioral intention has not been directly assessed and the model is therefore reduced to a direct link between perceptual constructs and reported smartphone use frequency.

Social constructivism (Vygotsky, 1978) as an interpretive lens

Vygotsky (1978) conceptualised learning as a mediated process in which more capable others provide support within the learner's zone of proximal development, a perspective further developed through the concept of scaffolding (Wood *et al.*, 1976). In this study, students' communication through messaging platforms and peer study groups may facilitate assignment clarification, information sharing, and informal learning (Greenhow & Robelia, 2009; Hrastinski, 2009). Thus, high communication dependency does not necessarily indicate distraction; it may also reflect communication that supports learning. However, this interpretation remains tentative because the study measured self-reported communication dependency rather than the content, purpose, or instructional quality of communication. Accordingly, communication dependency is treated as a dimension of smartphone use, not as evidence of social media-based learning. Future research should directly examine the content and purpose of students' digital communication to distinguish learning-related interactions from non-instructional use.

Together, these theoretical perspectives guide the examination of smartphone-use frequency and the interpretation of students' academic, social, psychological, and self-regulatory experiences without implying causal relationships. Table 1 summarizes the theoretical constructs, their corresponding indicators, and their roles in the analysis, distinguishing directly measured variables from interpretive perspectives.

Table 1. The correspondence between the theoretical constructs and the variables tested explicitly

Theoretical construct	Source	Measured indicator(s) in this study	Role in analysis	Theoretical construct
Perceived usefulness	TAM (Davis, 1989)	Academic use of mobile technology; use of mobile apps for learning	Predictor	Perceived usefulness
Perceived ease of use (proxy)	TAM (Davis, 1989)	Perceived ease of access to study materials	Predictor	Perceived ease of use (proxy)
Habit / dependency	UTAUT2 (Venkatesh & Davis, 2000)	Communication dependency; daily social media use	Predictor	Habit / dependency
Perceived consequences of use	Extension to TAM	Perceived academic impact of phone use	Predictor	Perceived consequences of use
Behavioural intention	TAM (Davis, 1989)	Not measured	(delimitation)	Behavioural intention
Actual use	TAM (Davis, 1989)	Self-reported frequency of smartphone use	Dependent variable	Actual use
Social mediation / scaffolding	Vygotsky (1978); Wood *et al.* (1976)	Not directly measured	Interpretive lens only	Social mediation / scaffolding
Behavioural, psychological and self-regulatory outcomes	—	Clusters C, D and E	Described, not modelled as outcomes of use	Behavioural, psychological and self-regulatory outcomes

To guide the investigation, this study draws on the Technology Acceptance Model (TAM; Davis, 1989) and the Unified Theory of Acceptance and Use of Technology (UTAUT2; (Venkatesh & Davis, 2000). These theoretical perspectives provide a foundation for organizing the study variables and examining smartphone-use behaviours in relation to students' academic, social, psychological, and self-regulatory experiences. The resulting conceptual framework is presented in Figure 1.

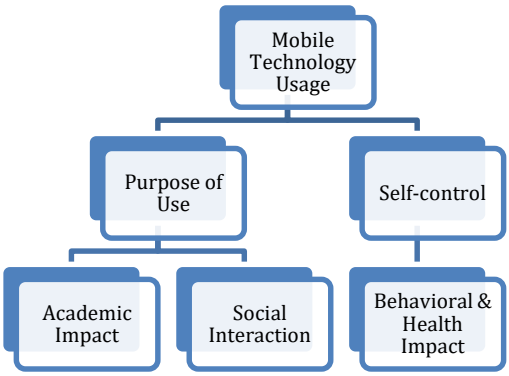

Figure 1. Conceptual framework of smartphone use among generation z students
Note. Developed by the authors based on the Technology Acceptance Model (Davis, 1989), UTAUT2 (Venkatesh & Davis, 2000), and the study's measured dimensions

Figure 1 illustrates the conceptual framework developed by the authors, drawing on the Technology Acceptance Model (TAM) proposed by Davis (1989) and the Unified Theory of Acceptance and Use of Technology (UTAUT2) developed by Venkatesh and Davis (2000). The framework provides a theoretical basis for examining smartphone use

among Generation Z students by considering five dimensions: usage behaviours, academic use and impact, social and behavioural outcomes, psychological and health outcomes, and self-regulation and awareness. These dimensions guide the analysis of smartphone-use patterns and their associations with usage frequency, while also informing the interpretation of students' experiences of academic distraction, communication dependency, and self-regulation. The framework is intended to organise the study's variables and guide interpretation of the findings rather than establish causal relationships, consistent with the study's cross-sectional design and methodological limitations.

METHOD

This study employed an explanatory sequential mixed methods design with quantitative priority (QUAN → qual; Creswell & Plano Clark, 2018), combining a cross-sectional survey conducted in April–May 2025 with qualitative interviews in June–August 2025 to contextualize findings on smartphone-use patterns, subgroup differences, and associations with self-reported smartphone-use frequency. Data were collected from 353 of 400 students approached at purposively selected public universities, private universities, and affiliated colleges in Rangpur, Bangladesh, using stratified sampling across three institutional strata. Although Generation Z was defined as those born in 1997–2012 (Dimock, 2019), eligibility was restricted to smartphone-owning, consenting students aged 18–25 in 2025 (birth years 2000–2007). Affiliated colleges were included as part of Bangladesh's tertiary education system under the National University. Education level was examined as a grouping variable, and sensitivity analysis excluding 44 affiliated-college students yielded substantively unchanged regression coefficients. Given the purposive institutional selection and non-probability participant recruitment, potential volunteer-selection bias was acknowledged, no weighting was applied, and statistical representativeness was not claimed.

The questionnaire comprised 24 five-point Likert items (1 = strongly disagree to 5 = strongly agree), four demographic items, and one open-ended question. The items were adapted from four established instruments. Seven additional items were developed to reflect smartphone-use experiences in the Bangladeshi higher-education context. Table 2 summarizes the item sources, thematic clusters, and adaptations. A bilingual social scientist translated the questionnaire, and an independent translator back-translated it. Translation discrepancies were resolved by the research team. Two experienced social-science academics reviewed the items for relevance, clarity, and representativeness. A pilot study involving 30 students assessed comprehension, clarity, and completion time, resulting in the rewording of four ambiguous items. The final questionnaire incorporated these revisions to improve linguistic clarity, contextual relevance, and respondent understanding before the main survey was administered.

To ensure transparency in instrument development, Table 2a summarizes the sources of the questionnaire items, the number of items adapted from each instrument, their allocation to thematic clusters, and the modifications made to reflect smartphone-use experiences in the Bangladeshi higher-education context. This overview clarifies the

contribution of established instruments and author-developed items to the final questionnaire used in this study.

Table 2a. Item provenance and adaptation

Source scale	Items	Cluster	Nature of adaptation
Lepp, Barkley & Karpinski (2014), Cell Phone Use	3	A	Frequency wording simplified to a five-point agreement format; referent changed from "cell phone" to "smartphone"; social media and entertainment use separated into distinct items
van Deursen, Bolle, Hegner & Kommers (2015), Smartphone Use and Skills	5	A, B	Instrumental-use items reframed around study tasks (accessing materials, supporting learning) rather than general functionality
Bianchi & Phillips (2005), Mobile Phone Problem Use Scale	4	A, D	Clinical phrasing softened for a non-clinical student sample; items on dependency, isolation, anxiety and physical discomfort retained
Samaha & Hawi (2016), Smartphone Addiction Scale – Short Version	5	B, D, E	Adolescent referents replaced with university study contexts; items on checking, sleep, control during study and intention to reduce use retained
Author-developed	7	B, C, E	Written for the Bangladeshi higher-education context: perceived academic impact, study distraction, online vs. face-to-face communication, family/friend time, and awareness of harm
Total	24		

The 24 Likert items demonstrated acceptable overall reliability (α = .837; standardized α = .822). Cluster mean inter-item correlations ranged from .32 to .48, although alpha values for Social and Behavioural Outcomes (.68) and Self-Regulation (.64) were modest. Because factor analysis was not conducted, clusters were treated as theoretical categories, and five single-item indicators were used in regression to avoid unverified dimensionality and potential part–whole overlap in Table 2b.

Table 2b. Variables entered the regression model

Variable	Questionnaire item	Cluster	Role
freq_use	Smartphone use throughout the day	A	Dependent variable
acad_use	Use mobile technology for academic purposes	B	Predictor
socmed_daily	Daily social media use	A	Predictor
comm_dep	Depending on phone for communication	A	Predictor
easy_access	Easy access to study materials	B	Predictor

Table 2b summarizes the dependent variable and predictors included in the simultaneous multiple regression model. The variables represent smartphone-use frequency, academic use, daily social media use, communication dependency, and access

to study materials. Each variable is mapped to its questionnaire item and thematic cluster to clarify its analytical role. Qualitative data from ten students and ten faculty members or administrators were analysed using reflexive thematic analysis (Weiss & Samenow, 2010), with integration achieved by comparing themes against quantitative clusters (Table 11) to identify convergence and divergence. Interview participants were purposively selected from consenting survey respondents who strongly endorsed the surveyed behaviours; no data transformation or joint statistical modelling was performed. Quantitative analyses were conducted using IBM SPSS Statistics 26, and an a priori G Power calculation (Faul *et al.*, 2007; George & Mallery, 2003) indicated a minimum sample of 92 participants (five predictors, $f^2 = .15$, $\alpha = .05$, power = .80), below the final sample of 353. The regression model explained 10.0% of the variance in smartphone-use frequency ($R^2 = .100$; $f^2 = .111$), while ordinal logistic regression yielded substantively similar results. One respondent omitted the phone-anxiety item, but no regression variables had missing data.

RESULT AND DISCUSSION

Overview of descriptive findings and interpretive criteria

The 24 Likert-scale items were grouped into five thematic clusters addressing smartphone-use behaviours, academic use and impact, psychological and health outcomes, social and behavioural outcomes, and self-regulation in higher education. These themes were interpreted in relation to students' learning experiences, academic engagement, access to learning materials, classroom-related activities, and interactions with lecturers and peers. Item means were interpreted using predefined criteria: means of 3.50 or higher indicated wide endorsement, means of 2.50–3.49 indicated moderate endorsement, and means below 2.50 indicated weak endorsement. Where prevalence was reported, the number and percentage of respondents selecting either 4 (agree) or 5 (strongly agree) were presented alongside the mean. No reverse coding was required because all items were positively worded and coded in the same direction, with higher scores indicating stronger endorsement. The findings were considered in terms of their implications for teaching practices, students' learning behaviours, and the integration of smartphones into higher education.

The findings in this section are based on self-reported perceptions of smartphone-use behaviours and outcomes rather than objective measurements. Descriptive statistics for all 24 items are presented in Table 3, while frequency distributions for key items are provided in Table 4. Overall, the findings indicate widespread endorsement of social media engagement and perceived academic disruption, moderate endorsement of self-regulatory capacity, and substantial endorsement of reported social, psychological, and health-related experiences associated with smartphone use. From an education and teaching perspective, these findings highlight the importance of understanding how smartphone use may shape students' academic engagement, learning behaviours, self-regulation, and interactions within higher education. However, these descriptive results reflect students' perceptions and should not be interpreted as evidence of causal effects on teaching effectiveness or academic performance.

Table 3. Descriptive statistics for all study variables (N = 353)

Variabel	Item	Mean ± SD
Usage Behaviour	Smartphone use throughout the day	3.36 ± 1.12
	Daily social media use	4.05 ± 1.04
	Depending on phone for communication	3.22 ± 1.41
	Use mobile apps for learning	3.90 ± 1.04
	Use phones mainly for entertainment	2.83 ± 1.29
	Smartphone use throughout the day	3.36 ± 1.12
Academic Use & Impact	Use mobile technology to support studies	3.53 ± 1.23
	Use mobile technology for academic purposes	3.36 ± 1.04
	Easy access to study materials	3.72 ± 1.13
	Mobile technology improves learning	3.32 ± 1.35
	Can control phone use during study	2.92 ± 1.48
	Academic performance affected by phone use	3.54 ± 1.32
	Feel distracted during study	3.82 ± 1.16
	Distracted by non-academic content	3.62 ± 1.18
Social & Behavioural Outcomes	Communicate more online than face-to-face	2.85 ± 1.31
	Mobile use reduces time with family/friends	3.56 ± 1.26
	Social media helps stay connected	4.01 ± 0.95
Psychological & Health Outcomes	Feel isolated without phone	3.84 ± 1.31
	Feel anxious without phone (n = 352)	3.72 ± 1.21
	Check phone repeatedly	3.84 ± 1.25
	Sleep affected by mobile use	3.98 ± 1.19
	Experience physical discomfort	3.41 ± 1.43
Self-Regulation & Awareness	Can limit screen time	3.20 ± 1.26
	Aware of negative effects	3.46 ± 1.13
	Try to reduce unnecessary use	3.70 ± 1.00

Note. All statistics are based on N = 353 except the phone-anxiety item, for which one respondent gave no answer (n = 352). The mean and percentages for that item are calculated on the 352 valid responses.

Table 3 shows that daily social media use received the highest mean in the Usage Behaviour cluster (M = 4.05, SD = 1.04), while perceived control over phone use during study was relatively low (M = 2.92, SD = 1.48). Students also reported relatively high means for access to study materials (M = 3.72, SD = 1.13), study-related distraction (M = 3.82, SD = 1.16), and sleep affected by smartphone use (M = 3.98, SD = 1.19). These findings illustrate the dual role of smartphones in higher education as learning resources and potential sources of distraction. To provide a clearer picture of how students responded to these key items, Table 4 presents their frequency and percentage distributions across the five-point Likert scale, allowing the prevalence of reported experiences to be examined directly. These patterns suggest that students recognize the academic benefits of smartphones while also experiencing challenges in managing their use during learning activities. The relatively high mean for access to study materials indicates the perceived value of mobile technology in supporting learning, whereas the lower mean for control during study suggests potential difficulties with digital self-regulation (Rahaman, 2017). Similarly, the reported effects on concentration and sleep highlight concerns relevant to students' learning engagement and well-being. However, these results reflect self-reported perceptions rather than objectively measured outcomes. Table 4 therefore provides

additional detail by showing the number and percentage of respondents selecting each response category, enabling a more precise assessment of the extent to which these experiences were endorsed.

Table 4. Frequency distribution of key variables (Likert Scale 1–5)

Variable	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean
Smartphone frequent use	10.2	11.3	19.0	51.0	8.5	3.36
Social media daily use	4.8	4.0	10.5	42.8	38.0	4.05
Phone dependency (comm.)	17.0	18.7	11.0	32.3	21.0	3.22
Learning apps use	3.7	8.8	10.2	48.2	29.2	3.90
Non-academic distraction	3.7	20.7	11.6	38.0	26.1	3.62
Entertainment use	18.4	30.3	8.5	35.1	7.6	2.83
Study distraction (phone)	3.7	16.7	5.7	41.6	32.3	3.82
Isolation without phone	6.8	16.4	5.1	29.7	41.9	3.84
Phone anxiety (n = 352)	3.7	22.1	2.5	41.9	29.5	3.72
Compulsive phone checking	4.8	19.0	2.0	36.3	38.0	3.84
Sleep affected by phone	3.7	15.0	4.8	32.3	44.2	3.98
Physical discomfort	17.6	11.3	9.6	35.7	25.8	3.41
Awareness of neg. effects	5.1	20.1	14.2	44.8	15.9	3.46
Tries to reduce usage	4.0	12.5	7.6	61.2	14.7	3.70
Isolation without phone	6.8	16.4	5.1	29.7	41.9	3.84

Note: Phone-anxiety percentages use n = 352; all others use N = 353.

Group comparisons by demographic variables

Independent-samples t-tests and one-way ANOVA examined demographic differences in smartphone-use frequency. As shown in Table 5, no significant differences emerged by gender, $t(351) = 1.23$, $p = .219$, $d = 0.14$; institution type, $t(351) = 0.89$, $p = .373$, $d = 0.10$; or age, $F(2, 350) = 1.87$, $p = .154$, $\eta^2 = .011$. Education-level differences were significant overall, $F(2, 350) = 3.21$, $p = .041$, $\eta^2 = .018$, but no Tukey-adjusted pairwise comparisons were significant, warranting cautious interpretation.

Table 5. Group comparisons of smartphone use frequency by demographic variables

Variable	Mean	Test statistic	p	Effect size
Gender: Male	3.38	t(351) = 1.23	.219	d = 0.14
Gender: Female	3.31			
Institution: Public	3.38	t(351) = 0.89	.373	d = 0.10
Institution: Private	3.33			
Education: Undergrad	3.29	F(2, 350) = 3.21	.041*	$\eta^2 = .018$
Education: Postgrad	3.45			
Education: HSC/College	3.34			
Age: 18–20	3.33	F(2, 350) = 1.87	.154	$\eta^2 = .011$
Age: 21–22	3.40			
Age: 23–25	3.35			

Note. $p < .05$; effect sizes (Cohen's d and η^2) were small. No Tukey-adjusted education-level comparisons were significant.

Bivariate correlations among regression variables

Pearson correlations between the six variables that were included in the regression analysis are presented in Table 6. The six variables listed above were chosen as single item indicators to represent different theoretical constructs and are not necessarily the 5 thematic clusters in which the descriptive results are organised, so care should be taken in

interpreting the variables as equivalent. The five predictors were all positively and significantly related to use frequency, ranging from r = .13 (easy_access, p < .05) to r = .22 (comm_dep, p < .01). Inter-predictor correlations were all less than .35 and VIFs from the regression model indicated that multicollinearity was not a problem (VIFs 1.54–1.71; Table 10). Such coefficient(s) represent only covariation and does not imply any directionality.

Table 6. Bivariate pearson correlations among regression variables (N = 353)

Variable	1	2	3	4	5
freq_use (DV)	—				
acad_use	.18**	—			
socmed_daily	.15**	.22**	—		
comm_dep	.22**	.19**	.17**	—	
easy_access	.13*	.31**	.09	.15**	—
acad_impact	.20**	.26**	.11*	.21**	.18**

Note. p < .05; ** p < .01. Variable 1 is the dependent variable; variables 2–6 are predictors.

Descriptive Findings Across Five Thematic Clusters

Daily social media use (M = 4.05, SD = 1.04; 80.8%) and maintaining social connections (M = 4.01, SD = 0.95; 81.9%) received the highest mean scores, followed by accessing study materials (M = 3.72, SD = 1.13) and supporting learning (M = 3.53, SD = 1.23). Students also reported study-related distraction (73.9%), sleep disruption (76.5%), repeated checking (74.3%), isolation without a phone (71.6%), reduced social time (70.8%), phone-related anxiety (71.4%; n = 352), and physical discomfort (61.5%). Although 75.9% tried to reduce unnecessary use (M = 3.70, SD = 1.00), perceived control during study (M = 2.92, SD = 1.48) and screen-time management (M = 3.20, SD = 1.26) were lower, suggesting a potential gap between intentions and perceived control. These self-reported findings do not establish objective outcomes or clinical conditions, and the cross-sectional design precludes causal inference. Table 7 summarizes item means and endorsement patterns across the five thematic clusters.

Table 7. Cluster summary: Item means and endorsement patterns (N = 353)

Thematic cluster	Highest item mean	M	Lowest item mean	M	Endorsement
Usage Behaviour	Social media daily use	4.05	Entertainment use only	2.83	Widely
Academic Use & Impact	Study distraction (phone)	3.82	Control during study	2.92	Widely
Social Outcomes	Social media stays connected	4.01	Online vs. face-to-face	2.85	Moderately
Psychological & Health	Sleep affected by phone use	3.98	Physical discomfort	3.41	Widely
Self-Regulation	Tries to reduce use	3.70	Can limit screen time	3.20	Moderately

Note. Endorsement categories follow the criterion set in Section 5.1: widely endorsed = highest item mean ≥ 3.50; moderately endorsed = 2.50–3.49.

Regression analysis: model summary and overall fit

Multiple linear regression using the forced-entry method examined the associations between five predictors and self-reported smartphone-use frequency (*freq_use*). Model fit statistics and the overall ANOVA test are presented in Table 8. The model's explanatory

power was assessed using R^2 and adjusted R^2, while the F-statistic and corresponding *p*-value evaluated its overall statistical significance. The results indicate how well the five predictors jointly explain variation in reported smartphone-use frequency, although the model does not establish causal relationships.

Table 8. Multiple regression model summary

R	R^2	Adj. R^2	Std. error	Sig. F change
.316	.100	.087	1.065	.000***

Table 8 summarizes the multiple regression model, which showed a modest association between the five predictors and smartphone-use frequency (R = .316). The model explained 10.0% of the variance (R^2 = .100; adjusted R^2 = .087), with a standard error of 1.065. The overall model was statistically significant ($p < .001$), as confirmed by the ANOVA results in Table 9, although its explanatory power was modest, suggesting that other factors may also be associated with smartphone-use frequency.

Table 9. ANOVA — Regression model for smartphone use frequency

Source	Sum of squares	df	Mean square	F	Sig.
Regression	43.732	5	8.746	7.706	.000***
Residual	393.854	347	1.135		
Total	437.586	352			

The model was statistically significant, $F(5, 347) = 7.706$, $p < .001$, but explained only 10.0% of the variance in reported smartphone-use frequency (R^2 = .100; adjusted R^2 = .087), indicating limited explanatory power. The remaining variance cannot be attributed to specific factors because they were not measured; personality, peer norms, platform design, and socioeconomic factors are potential directions for future research, not findings of this study. Comparisons with Paterna *et al.* (2024) are also limited because their meta-analysis examined the correlation between problematic smartphone use and academic achievement, whereas this study modeled use frequency using behavioural indicators.

Regression coefficients: individual predictor associations

Table 9 presents the ANOVA results assessing whether the five predictors jointly explained significant variance in smartphone-use frequency beyond the intercept-only model. Table 10 reports the unstandardized and standardized coefficients, standard errors, 95% confidence intervals, and collinearity diagnostics for each predictor.

Table 10. Multiple regression coefficients

Predictor	B	SE	β	t	Sig.	95% CI	VIF
(Constant)	1.610	.299	—	5.380	.000***	[1.021, 2.199]	—
Academic use	.109	.058	.102	1.863	.063	[−.006, .223]	1.71
Social media use	.108	.061	.101	1.760	.079	[−.013, .228]	1.63
Comm. dependency	.129	.041	.163	3.103	.002**	[.048, .210]	1.58
Easy access	.031	.058	.031	.538	.591	[−.083, .145]	1.54
Academic impact	.119	.045	.141	2.615	.009**	[.030, .208]	1.67

The Controlling for other predictors, communication dependency (β = .163, B = .129, SE = .041, t = 3.103, p = .002, 95% CI [.048, .210]) and perceived academic impact (β = .141, B = .119, SE = .045, t = 2.615, p = .009, 95% CI [.030, .208]) were significantly associated with smartphone-use frequency. Although communication dependency had the larger standardized coefficient, overlapping confidence intervals preclude concluding that its association was definitively stronger. The positive association with perceived academic impact does not establish causality, and findings from Grant *et al.* (2019) and Yang *et al.* (2019) provide contextual rather than direct comparisons. Academic use (β = .102, p = .063), daily social media use (β = .101, p = .079), and ease of access to study materials (β = .031, p = .591) were nonsignificant; limited response variation may partly explain these results. Thus, only communication dependency and perceived academic impact were significant correlates in the model.

Qualitative findings and integration

Ten student in-depth interviews and ten faculty and administrator key informant interviews were analyzed using reflexive thematic analysis, in the following six-phase process: (1) familiarizing oneself with the data; (2) generating initial codes; (3) organizing codes into themes; (4) defining and naming themes; (5) producing a textual account; and (6) refining themes. Transcripts were used to create codes, not quantitative cluster structure, and themes were developed at the interpretive level there was a reflexive journal to record analytic decisions and prevent the codes from being driven by the quantitative results. The criterion of sample 'adequacy' was not determined based on 'saturation' but based on information power: the sample was narrowly focused, comprising both private and public institutions, undergraduate and postgraduate, and interviews were sufficiently deep to be themed around a small corpus. Table 11 provides a listing of themes and illustrative material drawn from the interview data collected.

Table 11. Qualitative themes and illustrative content from IDIs and KIIs

Theme	Illustrative content (anonymized)	Participant	Source	Theme
Academic distraction as a daily norm	Describes picking up the phone for an assignment and losing half an hour without noticing.	Female undergraduate student	IDI-03	Academic distraction as a daily norm
Social connectivity paradox	Notes that students are more connected to distant friends than to classmates seated beside them.	Faculty member, social sciences	KII-02	Social connectivity paradox
Psychological dependency and discomfort	Describes feeling cut off from family, friends and news when the phone battery dies.	Male postgraduate student	IDI-07	Psychological dependency and discomfort
Awareness without action in self-regulation	Reports knowing overuse is harmful and intending to cut back, but resuming after notifications, with no real support to stop.	Female undergraduate student	IDI-01	Awareness without action in self-regulation
Absence of institutional policy	Observes students on their phones during lectures and states there is no formal policy to address this.	Department Head, private university	KII-08	Absence of institutional policy

The interviews complemented the survey findings in three ways. First, they contextualized reported study-related distraction (M = 3.82), limited perceived control during study (M = 2.92), and phone-related unease, reported by 71.4% of respondents. Second, they revealed how notifications may prompt renewed smartphone use despite intentions to reduce it, offering a potential explanation for self-regulation challenges that the survey could not capture. However, this mechanism was not tested as a predictor in the regression model. Third, the interviews revealed differing perspectives on distraction: students tended to view it as a personal self-control issue, whereas faculty emphasized the lack of institutional guidance and classroom policies.

Integration of Quantitative and Qualitative Evidence

Integrating the five quantitative clusters with the five qualitative themes reveals a consistent, although partial, picture of smartphones' roles in students' academic and social lives. The theme of *academic distraction as a daily norm* aligns with the findings on academic experiences, particularly students' reported study-related distraction (M = 3.82) and relatively low perceived control over smartphone use during study (M = 2.92). Similarly, the *social-connectivity paradox* reflects the coexistence of strong perceived social connectivity (M = 4.01; 81.9% agreement) and reported reductions in time spent with family and friends (M = 3.56; 70.8% agreement), illustrating a possible tension within social interactions. One interpretation is that online interaction may sometimes substitute for face-to-face contact, although this relationship was not directly tested. From a social-constructivist perspective, digital spaces can facilitate peer interaction and social connection (Vygotsky, 1978; Subba & Chingnunhoih, 2023); however, this perspective does not, by itself, explain the reported reduction in face-to-face contact.

The qualitative findings also highlight a potential gap between awareness of the negative effects of smartphone use and efforts to regulate it. Participants described returning to smartphone use after receiving notifications despite intending to reduce unnecessary use, providing context for the findings on self-regulation. These accounts are best understood as participants' descriptions of habitual or prompt-triggered use rather than evidence of a confirmed self-regulation deficit. Finally, key informants reported an absence of formal classroom smartphone-use policies in their institutions, alongside concerns about distraction during lectures. This finding should be interpreted cautiously because it reflects accounts from a limited number of participants and institutions, and institutional policy documents were not examined. Nevertheless, it provides institutional context for interpreting the findings across academic experiences, social interactions, psychological and health-related outcomes, and self-regulation.

Theoretical Implications

The regression model can only partially and qualifiedly support the technology acceptance model. The constructs most closely aligned with TAM, academic use ($\beta = .102$, $p = .063$) and ease of access to study materials ($\beta = .031$, $p = .591$) were not significantly associated with use frequency, whereas communication dependency ($\beta = .163$, 95% CI [.048, .210]) and perceived academic impact ($\beta = .141$, 95% CI [.030, .208]) were. This

trend is like the one in TAM when the level of adoption approaches saturation, as proposed by Venkatesh and Davis (2000). It does not show that affective/habitual dependence is influencing use, as affective and habitual dependence were not differentiated from each other as separate constructs in this study, and there was no direct measurement of perceived usefulness, and the one indicator of communication dependency cannot differentiate between all three of these explanations. It is not a limit to the pathway of perceived usefulness as measured here, but rather an identification of a limit (Benvenuti et al., 2023).

Throughout, the Vygotskian reading is interpretive. Communication dependency can be taken as a narrow construct, as an issue related to problematic attachment to an object, or as a broader construct, as evidence of peer mediated and technology supported communication that is normal for this generation, especially for students who are living away from home. Here, neither of the constructions are tested. Scaffolding, learning interaction and the content of the student communication were not assessed, and no clinical assessment was carried out, therefore neither of the two readings have an empirical priority and the qualitative data should not be used to decide on the priority. This ambiguity is, however, meaningful because the two readings suggest different ways of intervening: limiting use as against guiding use towards structured academic uses. Both these are interpretations of the study and hypotheses which were not examined in this study.

Practical and Policy Implications

Three implications follow each related to a particular finding and each needs to be evaluated prior to implementation. First, key informants at participating institutions did not mention having a formal policy regarding the use of phones in the classroom, and the study distraction was widely reported (M = 3.82; 73.9% agreement). However, creating explicit classroom policy is a plausible beginning, but this study does not cost such a policy nor test its impact and the evidence for the policy gap is based on a small number of interviews. Second, communication dependency had the biggest of the two significant associations with frequency of use ($\beta = .163$), whereas academic use and entertainment use did not. It indicates that restricting class time might not be the most effective strategy to handle behaviour most related to overall use, and suggests that notification management be investigated but the regression does not point to an intervention, and there was no notification management tested. Third, individuals reported higher awareness of harm (M = 3.46) than they reported higher perceived control (M = 3.20); this suggests that simply raising awareness may be not enough, and that skills-based self-regulation training, as proposed in the digital well-being literature (Fabio *et al.*, 2022), may be worth trialling. This is an untested effect of it in this population. All three are presented as testable hypotheses for experimental or longitudinal study, not as "solutions," because of cross-sectional design, one city sample.

Situating the Findings within the Existing Literature

The current results are consistent with other studies that report small associations and are unique to a region that has not been well studied. This explained variance ($R^2 = .100$) is not unusual for the model used in this field but is not directly comparable with the

reported pooled correlation of r = .110 found by Paterna *et al.* (2024) who summarized associations between problematic SMU and academic performance across 29 studies with primarily younger samples. The two statistics are based on two different models and two different constructs; the comparison is only one of small associations, not one of convergence of findings. Both indicate that much of the variation in smartphone use and correlates is unexplained by the typical measures that are taken.

The positive correlation between perceived academic impact and usage frequency is generally in line with many studies that report that the perception of harm has little relationship to the reduction in usage. Grant *et al.*, (2019) surveyed over 31,000 university students in the United States, and modelled grade point average (GPAs) instead of using frequency, while Yang *et al.*, (2019) measured Chinese university students, and applied path analysis to model academic anxiety and academic procrastination, with self-regulation serving as a partial mediator. The two are also different in terms of population, outcome variable and analytic design, and none of them test the awareness–use relationship directly, which is also tested in the present study. The convergence is not empirical, and the awareness interpretation given in the integration section is one of the possible readings of the coefficient.

The non-significant coefficient for academic use makes it comparable with the results of Winskel *et al.* (2019) who reported a modest relationship between students' GPA and the use of the smartphone and that the relationship was different between Korean and Australian undergraduates (Chatterjee, 2014). Their conclusion that type of use may be more important than its frequency is reasonable and consistent with their finding of high scores for academic uses on Cluster B but not with a finding from the present study, which did not test type against frequency. A similar difference was found by Aghosh Zahra et al. (2026) with a self-reported, cross-sectional design similar to this one, but with different measures and a mediation model that this study did not model.

Lastly, these findings provide hearers with the evidence of Bangladesh outside Dhaka. The theme of the associations with communication dependency and perceived academic impact aligns with the findings from India, where adolescent mobile phone dependence was found to be associated with behavioural change and poorer academic performances (Yadav *et al.*, 2021), and with a structural equation model of Bangladeshi undergraduates, which found that disrupted study hours and relational strain mediated the indirect link between social media use and depression, anxiety and stress (Sarker *et al.*, 2026). Both are different than the present study in sample, in measures and analytic approach, and the SEM especially tests indirect pathways not modeled in the present study. Evidence from the regions also indicates that mobile learning applications have been identified as having positive impacts on engagement, but also on limitations of connectivity, cost and usability (Shokal *et al.*, 2024). The enabling and disruptive patterns reported by the students in this sample do not seem to be unique to Rangpur, and the reported usage seems to depend on the use of the device as well as the availability of the device. This is an association of self-reported perceptions, and no effect of mobile technology is established by this study or in the comparisons made here.

CONCLUSION

This cross-sectional mixed-methods study examined smartphone use among 353 students aged 18–25 years in Rangpur, Bangladesh, complemented by interviews with 10 students and 10 faculty members or administrators. The findings indicate that smartphones serve both beneficial and disruptive functions in students' academic and social lives. Communication dependency ($\beta = .163$, 95% CI [.048, .210], $p = .002$) and perceived academic impact ($\beta = .141$, 95% CI [.030, .208], $p = .009$) were significantly associated with self-reported use frequency, although the model explained only 10.0% of its variance ($R^2 = .100$). Interviews contextualized these patterns by revealing spontaneous "on-call" uses not captured by the survey and an absence of formal classroom phone-use policies reported by institutional informants. Together, these findings highlight the value of examining smartphone use in relation to students' everyday practices and institutional contexts, while supporting educational approaches that encourage purposeful use, academic engagement, and digital self-regulation.

These findings are limited by the cross-sectional design, self-reported measures, and student-level convenience sampling, which constrain causal inference, measurement accuracy, and representativeness. The regression used single-item indicators without factor-analytic validation and treated use frequency as continuous, although ordinal logistic analysis retained the same two significant predictors. Without clinically validated measures, the findings reflect reported behaviours and perceptions rather than clinical diagnoses. The model's limited explanatory power warrants further investigation using longitudinal designs, objective usage measures, validated instruments, and representative samples. Examining technological, social, familial, and individual factors may clarify additional correlates and assess the generalizability of findings beyond Rangpur.

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Author Contributions

Lubna Akter led conceptualization, methodology, analysis, and drafting. All authors contributed to manuscript revision, approved the final version, and accepted accountability.

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Conflict of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data are available from the corresponding author upon reasonable request, subject to ethical and confidentiality requirements.

Declaration of Generative AI and AI-Assisted Technologies

ChatGPT was used for language refinement. The authors reviewed and approved the final manuscript and take full responsibility for its content.

Ethical Approval and Informed Consent

Ethical approval was obtained from Begum Rokeya University, Rangpur (Ref. 20252647114, 10 March 2025). Informed consent, anonymity, and the right to withdraw were ensured.

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