

Beyond Screens and Earphones: Digital Well-Being, Student Flourishing, and Academic Engagement Among University Students in AI-Mediated Higher Education

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ABSTRACT

Background: Higher education is increasingly mediated by digital platforms and AI-enabled learning environments. Although these technologies can widen access and support learning, universities also face ethical and pastoral questions about how everyday digital habits shape attention, emotional maturity, belonging, and student flourishing. This study does not test AI tools directly. Rather, it contributes to the broader AI, ethics, and society conversation by examining student digital well-being in technology-intensive university life. **Purpose:** The study examined associations among earphone overuse behavior, non-academic screen exposure, emotional regulation, social connectedness, and academic engagement among university students. **Methods:** A quantitative cross-sectional survey was conducted with 742 undergraduate and postgraduate students from four East African universities. Self-report instruments assessed earphone overuse behavior, non-academic screen exposure, emotional regulation, social connectedness, and academic engagement. Analyses included descriptive statistics, Pearson correlations, multiple regression, and observed-variable path analysis using an SEM framework. **Results:** A high proportion of students reported more than five hours of daily earphone use (68.5%) and more than six hours of daily non-academic screen exposure (74.1%). Earphone overuse behavior and non-academic screen exposure were negatively associated with emotional regulation, social connectedness, and academic engagement. Emotional regulation was positively associated with social connectedness and academic engagement, and the SEM-based path model showed satisfactory fit (CFI = .96, TLI = .95, RMSEA = .052, SRMR = .041). The structural path from emotional regulation to academic engagement was positive ($\beta = .51, p < .001$). **Conclusion:** The findings suggest that intensive non-academic digital engagement is associated with poorer emotional regulation, weaker connectedness, and lower academic engagement. Because the design was cross-sectional and based on self-report, directionality and causality remain tentative. Universities should treat the findings as a basis for ethical reflection, monitoring, and pilot programs rather than as proof of intervention effects.

Keywords: earphone overuse behavior; non-academic screen exposure; emotional regulation; social connectedness; academic engagement; digital well-being; AI-mediated education; student flourishing; East African higher education

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1. INTRODUCTION

1.1 Background and Journal Fit

The integration of digital technologies into higher education has changed how university students learn, communicate, manage stress, and participate in campus life. Smartphones, laptops, social media platforms, streaming services, wireless earphones, learning management systems, and increasingly AI-enabled applications now shape ordinary academic and social routines. These tools can support access to information, flexible learning, communication, inclusion, and academic productivity. At the same time, persistent non-academic screen exposure and prolonged earphone use raise questions about attention, embodied presence, emotional regulation, and the quality of human relationships in university communities (Abi-Jaoude et al., 2020; Bond et al., 2021; Keles et al., 2020; Valkenburg et al., 2022).

The present study is situated within the broader concerns of AI, ethics, and society, although it does not examine AI applications as its direct empirical object. Its relevance lies in the ethical and educational conditions that make AI-mediated learning possible. As universities adopt AI-enabled tutoring, chatbots, analytics, and digital platforms, the formation of students as emotionally mature, socially connected, and academically engaged persons becomes an institutional responsibility. UNESCO (2023) emphasizes that generative AI in education should be governed by a human-centered vision, while wider AI ethics scholarship highlights human dignity, autonomy, prevention of harm, and social well-being as key

evaluative concerns (Floridi et al., 2018). From this perspective, digital well-being is not a minor student-lifestyle issue. It is part of the ethical infrastructure of technology-mediated education.

In contemporary university settings, many students use digital devices not only for academic work but also for emotional relief, entertainment, social comparison, companionship, and withdrawal from immediate surroundings. Earphones may be used for music, lectures, privacy, concentration, religious content, or language learning. However, when earphone use becomes prolonged, dependent, or socially isolating, it may become associated with reduced face-to-face interaction and lower responsiveness to the campus environment. Likewise, non-academic screen exposure differs from purposeful academic screen use. The present study therefore distinguishes non-academic screen exposure from course-required learning activities, online library use, academic research, and supervised educational technology.

1.2 Problem Statement

Despite the growing dependence of university students on digital devices, relatively little research has examined how earphone overuse behavior and non-academic screen exposure are simultaneously associated with emotional regulation, social connectedness, and academic engagement in East African higher education contexts. Existing studies often focus on social media, smartphone dependence, digital addiction, online learning, or academic distraction as separate domains, with less attention to how ordinary patterns of digital immersion may relate to emotional and

relational functioning among university students (Orben & Przybylski, 2019; Odgers & Jensen, 2020; Valkenburg et al., 2022). This gap matters because universities are no longer merely physical learning spaces supplemented by technology. In many settings, they are digitally mediated communities in which communication, administration, learning support, social contact, and increasingly AI-assisted academic processes are embedded into daily life. If students rely heavily on non-academic screens or earphones for emotional escape, distraction, or social avoidance, universities may face a deeper formation problem: the same digital ecology that enables learning may also be associated with weakened attention, poorer emotional regulation, and lower interpersonal belonging.

1.3 Theoretical Framework and Regional Grounding

The study draws on three complementary theoretical concerns. First, emotion regulation theory emphasizes that students need capacities to understand, monitor, and modulate emotional responses in ways that support well-being, relationships, and goal-directed action (Gross & John, 2003). Second, social connectedness theory treats belonging, interpersonal trust, and perceived relational integration as important for psychological adjustment and academic persistence (Lee & Robbins, 1995). Third, digital ethics frames technology use through questions of human dignity, agency, responsibility, and institutional stewardship rather than through efficiency alone (Floridi et al., 2018; UNESCO, 2023).

Within this framework, earphone overuse behavior and non-academic screen exposure are not treated as inherently harmful technologies. The study instead focuses on patterns of prolonged, dependency-like, or socially withdrawing use. Such behaviors may be associated with emotional regulation because continuous stimulation can become a means of avoiding silence, discomfort, academic pressure, or interpersonal tension. They may be associated with social connectedness because heavy private listening and screen immersion can reduce availability for spontaneous conversation, peer support, and embodied participation in campus life. They may be associated with academic engagement because fragmented attention and emotional strain can coincide with lower participation, motivation, and persistence in learning activities.

The East African setting strengthens the contribution of the study. Higher education in the region is marked by rapid digital adoption, uneven digital infrastructure, mobile-first access, hybrid learning practices, and growing interest in AI-enabled education (Bekele et al., 2023; Bond et al., 2021). Students may rely on phones and earphones as central tools for lectures, communication, transport, residence life, entertainment, and social participation. This context makes it important to avoid a simplistic anti-technology conclusion. The ethical issue is not whether students use technology, but whether university cultures help students use technology in ways that support learning, emotional resilience, embodied community, and human flourishing.

1.4 Research Objectives

This study pursued three objectives: (a) to examine associations among earphone overuse behavior, non-academic screen exposure, and emotional regulation among university students; (b) to investigate associations among emotional regulation, social connectedness, and academic engagement; and (c) to evaluate whether emotional regulation represents a theory-guided indirect association linking technology-related behaviors with social connectedness and academic engagement. The third objective is stated cautiously because the cross-sectional design cannot establish temporal sequence or causality.

1.5 Research Questions

This study addressed three research questions: (1) To what extent are earphone overuse behavior and non-academic screen exposure associated with emotional regulation among university students? (2) How are emotional regulation, social connectedness, and academic engagement associated with one another? (3) How are earphone

overuse behavior and non-academic screen exposure indirectly associated with social connectedness and academic engagement through emotional regulation in a cross-sectional model?

1.6 Expected Contributions

The study contributes conceptually, methodologically, and practically to scholarship on digital well-being in higher education. Conceptually, it connects student digital habits with ethical concerns about human dignity, agency, emotional formation, and belonging in AI-mediated educational environments. Methodologically, it brings earphone overuse behavior, non-academic screen exposure, emotional regulation, social connectedness, and academic engagement into one quantitative model. Practically, the findings may help universities design careful, evidence-bounded pilot initiatives on digital habit reflection, emotional regulation support, classroom norms, and belonging-centered student services. These implications are not presented as tested interventions but as directions for responsible program design and future evaluation.

2. MATERIALS AND METHODS

2.1 Study Design

This study used a quantitative cross-sectional survey design to examine associations among earphone overuse behavior, non-academic screen exposure, emotional regulation, social connectedness, and academic engagement among university students. All variables were measured at one time point using self-report instruments. Therefore, the design supports descriptive and associational inference, including theory-guided indirect associations in a path model, but it does not establish temporal order, causality, or confirmed psychological mechanisms.

2.2 Setting, Recruitment, and Participants

Participants were undergraduate and postgraduate students enrolled in four East African universities. The survey was distributed through university mailing lists, student communication platforms, and social media groups commonly used within university communities. Because recruitment occurred through open electronic channels rather than individualized invitations, the precise recruitment denominator and response rate could not be calculated. The participating institutions are described at the regional level to preserve institutional confidentiality in the deidentified manuscript.

Eligibility criteria required participants to be between 18 and 30 years of age, enrolled in an undergraduate or postgraduate program, and regular users of smartphones, digital screens, and earphones for academic, social, or entertainment purposes. Students with incomplete, ineligible, or internally inconsistent responses were excluded before analysis. Exclusion counts were not recorded separately and are therefore unavailable. The final analytic sample comprised 742 students, including 371 females (50.0%) and 371 males (50.0%). Participants represented different academic disciplines and levels of study, allowing variation in age, academic experience, and technology-use patterns.

2.3 Procedure and Human-Subjects Ethics

Data were collected through a structured self-administered online questionnaire over a six-week period. Before accessing the questionnaire, participants viewed an electronic information and consent statement explaining the purpose of the study, voluntary participation, anonymity, confidentiality, estimated completion time, and the right to withdraw before submission. No names, student identification numbers, contact details, IP addresses, or direct personal identifiers were retained in the analytic file. Responses were stored in a password-protected electronic file accessible only to the research team.

The study followed minimal-risk anonymous online survey procedures focused on ordinary student experiences of technology use, emotional regulation, connectedness, and academic engagement. Institutional gatekeeper permission was obtained for survey distribution through student communication channels. No formal ethics approval number was available in the study record.

The survey was anonymous, voluntary, non-clinical, and did not collect sensitive identifying information.

2.4 Measures and Scoring

All instruments used five-point Likert-type response formats. Unless otherwise stated, higher scores indicated higher levels of the construct being measured. Composite mean scores were computed after screening responses for completeness and, where applicable, reverse-coding negatively worded items. The questionnaire version analyzed in this study was the English version, which was appropriate for the participating higher education programs represented in the analytic manuscript file. Future replications involving multilingual administration should use formal translation, back-translation, and measurement-invariance testing.

2.4.1 Earphone Overuse Behavior Scale

The Earphone Overuse Behavior Scale (EOBS) assessed excessive or dependency-like patterns of earphone use among university students. The 12-item measure covered prolonged listening, dependence on earphones, use of earphones for emotional escape, reduced responsiveness to the immediate environment, and perceived interference with social or academic functioning (Dushimimana & Nkurunziza, 2026). Responses ranged from 1 = strongly disagree to 5 = strongly agree. Higher scores indicated greater earphone overuse behavior. The EOBS was treated as a context-specific behavioral scale rather than as a diagnostic instrument. In the present sample, internal consistency was strong (Cronbach's $\alpha = .88$).

2.4.2 Screen Exposure Behavior Scale

The Screen Exposure Behavior Scale (SEBS) assessed excessive non-academic screen exposure. It was adapted from screen-exposure measurement work by Kaur et al. (2021) and revised for university students by focusing on prolonged non-academic screen use, digital multitasking, dependency on digital stimulation, reduced academic focus, and social withdrawal through screen-based activity. Academic screen use required for coursework, research, online lectures, library access, or institutional communication was not the conceptual focus of this measure. Responses ranged from 1 = strongly disagree to 5 = strongly agree, with higher scores indicating greater non-academic screen exposure. Internal consistency was strong (Cronbach's $\alpha = .89$).

2.4.3 Emotional Regulation Scale

Emotional regulation was assessed using an 18-item Emotional Regulation Scale (ERS) informed by the emotion-regulation framework associated with Gross and John (2003). The scale used in this study was not the original 10-item Emotion Regulation Questionnaire. Rather, it was a broader university-student adaptation covering emotional awareness, emotional control, stress management, and adaptive emotional responses. Responses ranged from 1 = strongly disagree to 5 = strongly agree. Higher scores indicated healthier emotional regulation capacities. Internal consistency was excellent (Cronbach's $\alpha = .90$). Because the ERS differs from the original Gross and John instrument, findings should be interpreted at the construct level rather than as direct replication of the original ERQ subscales.

2.4.4 Social Connectedness Scale

The Social Connectedness Scale (SCS) assessed interpersonal interaction, peer relationships, emotional belongingness, and perceived social integration within the university environment, drawing on the social connectedness tradition of Lee and Robbins (1995). The 20-item version used in this study asked students to rate perceived emotional connection with peers, participation in social interactions, and sense of belonging. Responses ranged from 1 = strongly disagree to 5 = strongly agree, with higher scores indicating stronger social connectedness. Internal consistency was good (Cronbach's $\alpha = .85$).

2.4.5 Academic Engagement Scale

Academic engagement was assessed using a 32-item Academic Engagement Scale (AES) aligned with student engagement measurement principles discussed by O'Donnell and Reschly (2020). Items covered classroom participation, academic focus, learning involvement, and commitment to educational responsibilities. Responses ranged from 1 = strongly disagree to 5 = strongly agree, with higher scores indicating greater academic engagement. Internal consistency was strong (Cronbach's $\alpha = .86$).

2.5 Measurement-Quality and Construct-Validity Reporting

Reliability coefficients alone do not establish construct validity. The revised manuscript therefore clarifies the provenance, adaptation, scoring, and interpretation of each measure. Construct-validity support in the present manuscript is limited to theoretical alignment with prior literature, item-theme correspondence with the target constructs, internal consistency, and the pattern of correlations among theoretically related variables. Item-level confirmatory factor analysis, measurement invariance across institutions, and full latent measurement modeling were not available from the available analysis output. For this reason, the SEM reported below should be interpreted as observed-variable path analysis using scale composites, not as a full latent-variable SEM with confirmed measurement structure. This limitation is explicitly retained to prevent overstatement of the evidence.

2.6 Statistical Analysis

Data were analyzed using SPSS version 29.0 and AMOS version 29.0. Preliminary screening examined completeness, eligibility, response consistency, outliers, and distributional assumptions. Complete-case analysis was used for the final analytic sample. Descriptive statistics summarized demographic characteristics and technology-use patterns. Internal consistency was assessed using Cronbach's alpha coefficients. Pearson correlations examined bivariate associations among the five main variables.

Multiple regression analyses examined whether earphone overuse behavior and non-academic screen exposure statistically predicted emotional regulation, social connectedness, and academic engagement in the models while controlling for selected demographic variables. Observed-variable path analysis using an SEM framework was then used to estimate the theory-guided direct and indirect associations among earphone overuse behavior, non-academic screen exposure, emotional regulation, social connectedness, and academic engagement. Model fit was evaluated using CFI, TLI, RMSEA, and SRMR. Standardized path coefficients are reported. Terms such as path, indirect association, and statistically predicted are used in their model-based statistical sense and should not be read as causal claims.

3. RESULTS

3.1 Demographic Characteristics of Participants

The final sample consisted of 742 university students who met the inclusion criteria. Of these participants, 371 (50.0%) were female and 371 (50.0%) were male. The mean age was 22.8 years ($SD = 3.14$), with ages ranging from 18 to 30 years. Regarding academic level, 612 participants (82.5%) were undergraduate students, while 130 (17.5%) were postgraduate students.

Concerning technology-related behaviors, 508 participants (68.5%) reported using earphones for more than five hours daily, while 550 participants (74.1%) reported non-academic screen exposure exceeding six hours per day. Additionally, 395 students (53.2%) indicated frequent digital multitasking during lectures or academic activities, and 458 participants (61.7%) reported reduced face-to-face social interaction associated with prolonged technology engagement.

Table 1. Demographic and Technology-Related Characteristics of Participants (N = 742)

Characteristic	Category	n	%
Gender	Female	371	50.0
	Male	371	50.0
Age group	18-20 years	198	26.7
	21-23 years	312	42.0
	24-26 years	157	21.2
	27-30 years	75	10.1
Level of study	Undergraduate	612	82.5
	Postgraduate	130	17.5
Daily earphone use	Less than 2 hours	94	12.7
	2-5 hours	140	18.9
	More than 5 hours	508	68.5
Daily non-academic screen exposure	Less than 3 hours	82	11.1
	3-6 hours	110	14.8
	More than 6 hours	550	74.1
Digital multitasking during lectures	Yes	395	53.2
	No	347	46.8
Reduced face-to-face interaction due to technology use	Yes	458	61.7
	No	284	38.3
Relationship status	Single	289	38.9
	In a relationship	376	50.7
	Married	77	10.4

Note. Percentages are based on the total sample size. Mean age was 22.8 years ($SD = 3.14$), with ages ranging from 18 to 30 years.

3.2 Descriptive Statistics and Reliability

Descriptive statistics and reliability coefficients are shown in Table 2. Earphone overuse behavior and non-academic screen exposure had mean scores above the midpoint of the response scale,

suggesting relatively elevated technology-related overuse patterns. Emotional regulation, social connectedness, and academic engagement were moderate on average. All five scales demonstrated acceptable to excellent internal consistency.

Table 2. Descriptive Statistics and Reliability of Study Variables (N = 742)

Variable	Items	M	SD	Cronbach's α
Earphone Overuse Behavior Scale (EOBS)	12	3.74	0.71	.88
Screen Exposure Behavior Scale (SEBS)	12	3.81	0.76	.89
Emotional Regulation Scale (ERS)	18	2.94	0.69	.90
Social Connectedness Scale (SCS)	20	3.06	0.70	.85
Academic Engagement Scale (AES)	32	3.18	0.73	.86

3.3 Correlation Analysis

Pearson correlations showed that earphone overuse behavior was negatively associated with emotional regulation ($r = -.53, p < .001$), social connectedness ($r = -.46, p < .001$), and academic engagement ($r = -.42, p < .001$). Non-academic screen exposure was also negatively associated with emotional regulation ($r = -.49, p < .001$), social connectedness ($r = -.44, p < .001$), and academic engagement ($r = -.47, p < .001$). These findings indicate that higher technology-

related overuse scores were associated with lower emotional, social, and academic adjustment scores.

Emotional regulation was positively associated with social connectedness ($r = .59, p < .001$) and academic engagement ($r = .55, p < .001$). Social connectedness was also positively associated with academic engagement ($r = .61, p < .001$). These associations are consistent with the theoretical expectation that healthier emotion regulation and stronger belonging are linked with greater academic participation.

Table 3. Pearson Correlation Matrix Among Study Variables (N = 742)

Variable	1	2	3	4	5
1. Earphone Overuse Behavior (EOBS)	-				
2. Non-academic Screen Exposure (SEBS)	.64***	-			
3. Emotional Regulation (ERS)	-.53***	-.49***	-		
4. Social Connectedness (SCS)	-.46***	-.44***	.59***	-	
5. Academic Engagement (AES)	-.42***	-.47***	.55***	.61***	-

Note. *** $p < .001$.

3.4 Multiple Regression Analysis

Multiple regression analyses examined model-based statistical prediction of emotional regulation, social connectedness, and academic engagement. Earphone overuse behavior ($\beta = -.44$, $p < .001$) and non-academic screen exposure ($\beta = -.29$, $p < .001$) statistically predicted lower emotional regulation, accounting for 39.1% of the variance in emotional regulation ($R^2 = .391$). In the

social connectedness model, earphone overuse behavior was negatively associated with social connectedness, while emotional regulation was positively associated with social connectedness. In the academic engagement model, non-academic screen exposure was negatively associated with academic engagement, while emotional regulation and social connectedness were positively associated with academic engagement.

Table 4. Multiple Regression Analysis Predicting Emotional Regulation, Social Connectedness, and Academic Engagement ($N = 742$)

Dependent variable	Predictor	β	t	p	R^2
Emotional Regulation	Earphone Overuse Behavior	-.44	-13.21	< .001	.391
	Non-academic Screen Exposure	-.29	-9.84	< .001	
	Age	.07	2.08	.038	
	Gender	.05	1.61	.108	
	Level of Study	.10	2.74	.006	
Social Connectedness	Earphone Overuse Behavior	-.37	-10.96	< .001	.356
	Emotional Regulation	.54	15.02	< .001	
	Age	.05	1.34	.181	
	Gender	.07	1.89	.059	
Academic Engagement	Non-academic Screen Exposure	-.33	-10.11	< .001	.417
	Emotional Regulation	.45	13.47	< .001	
	Social Connectedness	.31	8.76	< .001	
	Level of Study	.08	2.42	.016	

Note. β = standardized beta coefficient. R^2 = coefficient of determination. Statistical significance was evaluated at $p < .05$.

3.5 Observed-Variable Path Analysis Using an SEM Framework

Observed-variable path analysis was performed to evaluate the hypothesized associations among earphone overuse behavior, non-academic screen exposure, emotional regulation, social connectedness, and academic engagement. The model demonstrated satisfactory fit to the observed data: CFI = .96, TLI = .95, RMSEA = .052, and SRMR = .041. Because the model used scale composite scores, the results should be interpreted as structural associations among observed variables rather than as evidence from a fully validated latent measurement model.

The structural paths are shown in Table 5 and Figure 1. Earphone overuse behavior was negatively associated with emotional regulation ($\beta = -.48$, $p < .001$) and social connectedness ($\beta = -.36$, $p < .001$). Non-academic screen exposure was negatively associated with emotional regulation ($\beta = -.44$, $p < .001$) and academic engagement ($\beta = -.18$, $p < .001$). Emotional regulation was positively associated with social connectedness ($\beta = .56$, $p < .001$) and academic engagement ($\beta = .51$, $p < .001$), and social connectedness was positively associated with academic engagement ($\beta = .34$, $p < .001$). The positive emotional-regulation-to-academic-engagement coefficient is consistent with the correlation matrix, regression model, and theoretical interpretation.

Table 5. Structural Path Estimates in the Final Observed-Variable Model ($N = 742$)

Path	Standardized β	p	Interpretation
Earphone overuse behavior $\rightarrow$ Emotional regulation	-.48	< .001	Higher EOBS associated with lower ERS
Earphone overuse behavior $\rightarrow$ Social connectedness	-.36	< .001	Higher EOBS associated with lower SCS
Non-academic screen exposure $\rightarrow$ Emotional regulation	-.44	< .001	Higher SEBS associated with lower ERS
Non-academic screen exposure $\rightarrow$ Academic engagement	-.18	< .001	Higher SEBS associated with lower AES
Emotional regulation $\rightarrow$ Social connectedness	.56	< .001	Higher ERS associated with higher SCS
Emotional regulation $\rightarrow$ Academic engagement	.51	< .001	Higher ERS associated with higher AES
Social connectedness $\rightarrow$ Academic engagement	.34	< .001	Higher SCS associated with higher AES

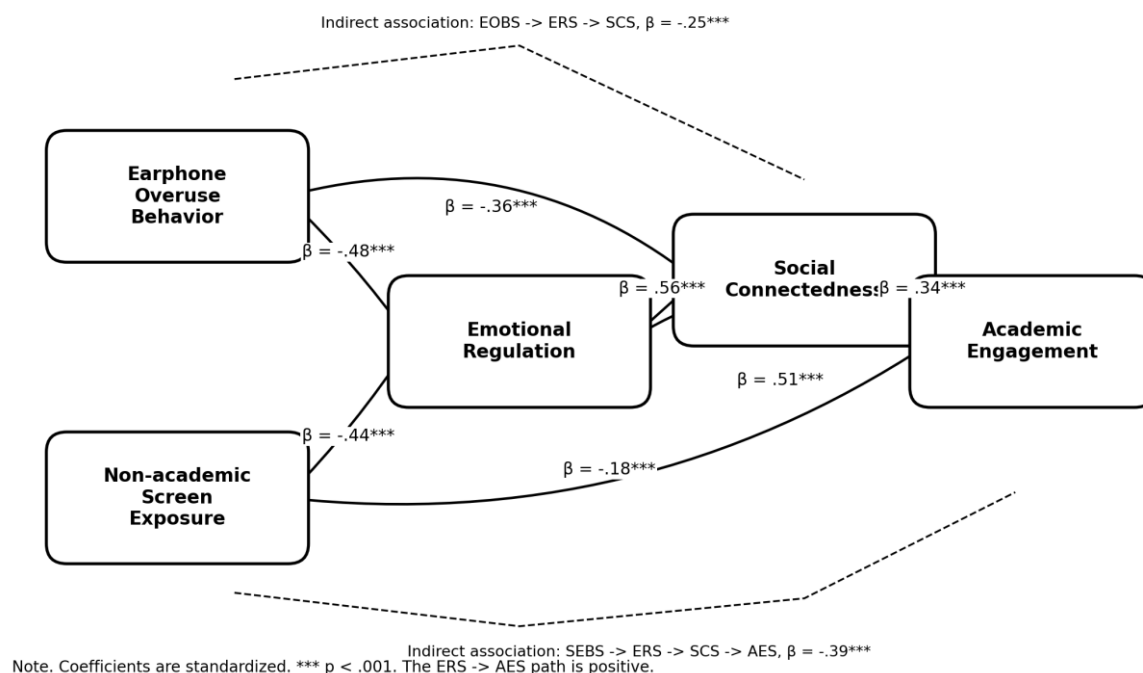
Note. These estimates are standardized associations from an observed-variable model. Unstandardized coefficients, standard errors, and bootstrap confidence intervals were not available in the available analysis output and should be appended if the original AMOS output is available.

Model-based indirect associations were statistically significant (Table 6). Emotional regulation partially accounted for the association between earphone overuse behavior and social connectedness (standardized indirect association $\beta = -.25$, $p < .001$). Emotional regulation and social connectedness jointly accounted for

part of the association between non-academic screen exposure and academic engagement (standardized indirect association $\beta = -.39$, $p < .001$). These results are described as indirect associations because the cross-sectional design cannot establish temporal mediation.

Table 6. Model-Based Indirect Associations ($N = 742$)

Indirect pathway	Standardized indirect β	p	Interpretive boundary
Earphone overuse behavior $\rightarrow$ Emotional regulation $\rightarrow$ Social connectedness	-.25	< .001	Theory-guided cross-sectional indirect association
Non-academic screen exposure $\rightarrow$ Emotional regulation $\rightarrow$ Social connectedness $\rightarrow$ Academic engagement	-.39	< .001	Theory-guided cross-sectional indirect association

Figure 1. Final Observed-Variable Structural Model (Standardized Estimates, $N = 742$)

Note. All coefficients are standardized. *** $p < .001$. The path from emotional regulation to academic engagement is positive ($\beta = .51$), consistent with the correlation matrix, regression results, and discussion.

4. DISCUSSION

This study examined associations among earphone overuse behavior, non-academic screen exposure, emotional regulation, social connectedness, and academic engagement among university students in East Africa. The revised framing places the findings within digital ethics and student flourishing rather than treating them only as a student-wellness issue. In increasingly AI-mediated universities, students' ordinary digital habits are ethically relevant because they may be associated with attention, emotional formation, social belonging, and academic participation.

The first major finding was that earphone overuse behavior and non-academic screen exposure were both negatively associated with emotional regulation. Students reporting prolonged or dependency-like digital behaviors also reported lower capacity to manage emotions, cope with stress, and respond adaptively to emotional experiences. This pattern is consistent with scholarship suggesting that problematic or excessive digital engagement can coincide with emotional strain, avoidance, fear of missing out, fragmented attention, and poorer well-being (Abi-Jaoude et al., 2020; Elhai et al., 2020; Marengo et al., 2020). Because the study is cross-sectional, it is also possible that students with lower emotional regulation were more likely to rely on screens or earphones for distraction, avoidance, or comfort. The direction of the association therefore remains tentative.

The second finding was that technology-related overuse was negatively associated with social connectedness. Earphone overuse behavior and non-academic screen exposure may be linked with weaker peer interaction, reduced availability for spontaneous conversation, and lower perceived belonging. Earphones can provide concentration, privacy, or access to meaningful content, but heavy use in shared learning spaces may also signal social unavailability. Similarly, screen-based communication can sustain relationships, but it may not always replace the emotional depth and immediacy of face-to-face interaction (Odgers & Jensen, 2020; Valkenburg et al., 2022). These findings are especially important for universities because social belonging is not peripheral to learning. It shapes persistence, motivation, and psychological adjustment.

The third finding was that emotional regulation was positively associated with both social connectedness and academic engagement. Students with stronger emotional regulation reported stronger interpersonal relationships and higher academic participation. This result is consistent with emotion-regulation theory, which links adaptive emotional management with attention, persistence, social competence, and well-being (Gross & John, 2003). The positive association between social connectedness and academic engagement further suggests that academic participation is not merely an individual cognitive activity. It is partly relational, supported by peer belonging, classroom interaction, and emotional security.

The corrected path model supports a cautious interpretation in which emotional regulation and social connectedness function as important correlates within the relationship between digital overuse patterns and student outcomes. The positive path from emotional regulation to academic engagement aligns the structural model with the correlation matrix, regression results, and theoretical argument. However, the path model remains cross-sectional. The results should not be read as proof that earphone use or screen exposure causes lower emotional regulation or that emotional regulation causally mediates academic engagement. Longitudinal and intervention studies are needed to test temporal sequence and change over time.

The East African higher education context gives these findings particular significance. Digital platforms, smartphones, earphones, and online communication tools may help students overcome constraints related to distance, scheduling, institutional communication, and resource access. AI-enabled tools may further expand academic support and personalized learning. Yet universities in the region also need culturally and institutionally grounded approaches to digital well-being. Ethical technology integration should protect students' agency, dignity, attention, relational formation, and capacity for meaningful academic participation. The study therefore supports a balanced view: technology is not the problem in itself, but unexamined patterns of non-academic digital immersion may be associated with student vulnerabilities.

4.1 Practical Implications for Universities

The findings support evidence-bounded implications rather than claims of proven intervention effectiveness. Universities may

consider monitoring student digital well-being as part of broader student-support systems, including orientation sessions on balanced technology use, reflective digital-habit inventories, counseling resources for stress and emotional regulation, classroom norms for earphone use, and campus initiatives that strengthen peer belonging. These initiatives should be piloted and evaluated rather than assumed to work. Particular care should be taken to distinguish necessary academic screen use from non-academic or compulsive screen exposure, since the ethical and educational implications differ substantially.

In AI-mediated learning environments, institutional responsibility also includes helping students become wise users of technology, not merely efficient users. Universities can support this through digital ethics education, transparent policies on AI tools, encouragement of embodied community, and student-wellness programs that connect attention, emotional resilience, and relational presence. Future intervention research should test whether such programs improve emotional regulation, social connectedness, and academic engagement over time.

5. LIMITATIONS AND FUTURE DIRECTIONS

Several limitations should be considered. First, the cross-sectional design prevents causal inference. The observed associations may reflect bidirectional or reciprocal processes, and temporal direction remains uncertain. Second, all measures were self-reported, which may introduce common-method bias, recall bias, and social desirability effects. Third, recruitment through open electronic channels prevented calculation of a precise response rate and may have introduced selection bias. Fourth, institutional identities and countries were not reported in the deidentified manuscript, limiting assessment of institutional context and representativeness.

Fifth, construct-validity evidence remains limited. Although the revised manuscript clarifies scale provenance, item themes, scoring, and internal consistency, item-level CFA, measurement invariance, and full latent measurement modeling were not available from the available analysis output. The structural model should therefore be interpreted as observed-variable path analysis rather than as a confirmed latent-variable SEM. Sixth, the study emphasizes potential risks of intensive non-academic technology use but does not directly measure beneficial academic, social, spiritual, or accessibility-related uses of digital technology. Future studies should distinguish academic screen use, non-academic exposure, compulsive use, AI-assisted learning, entertainment, and social communication with greater precision.

Future research should use longitudinal, experimental, and mixed-method designs to clarify directionality, examine lived experiences, and test whether digital well-being programs improve student outcomes. Future studies should also report full sampling denominators, response rates, exclusion counts, institutional ethics approval details, translation procedures where relevant, item-level factor analyses, and bootstrapped confidence intervals for indirect effects. In East African contexts, qualitative work could further examine how campus culture, residence life, connectivity, socioeconomic pressures, and AI-enabled learning tools shape student digital habits and social belonging.

6. CONCLUSION

This study examined associations among earphone overuse behavior, non-academic screen exposure, emotional regulation, social connectedness, and academic engagement among university students in East Africa. The findings indicate that higher earphone overuse behavior and non-academic screen exposure were associated with lower emotional regulation, weaker social connectedness, and lower academic engagement. Emotional regulation and social connectedness were positively associated with academic engagement, and the structural path from emotional regulation to academic engagement was positive.

The study contributes to the technology-and-society conversation by showing that digital well-being is an ethical concern for higher education, especially as universities move toward AI-mediated learning environments. The evidence does not justify causal claims, but it does suggest that universities should attend to the relationship between digital habits, emotional maturity, interpersonal belonging, and academic participation. Student flourishing in digital and AI-shaped institutions requires more than connectivity and platform access. It requires institutional practices that protect attention, encourage emotionally healthy learning, and sustain meaningful human community.

DECLARATIONS

Ethics approval and consent to participate: The study used anonymous minimal-risk online survey procedures. Electronic informed consent was obtained from all participants before survey completion. No formal ethics approval number was available in the study record. Institutional gatekeeper permission was obtained for distribution through student communication channels.

Data availability: Deidentified aggregate data may be made available by the corresponding author upon reasonable request, subject to institutional permissions and privacy safeguards.

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REFERENCES

- Abi-Jaoude, E., Naylor, K. T., & Pignatiello, A. (2020). Smartphones, social media use and youth mental health. *Canadian Medical Association Journal*, 192(6), E136-E141. <https://doi.org/10.1503/cmaj.190434>
- Alshaikh, A. A., AlAmri, A. M., Albraik, M. A., Amer, K. A. N., Alqahtani, A. A. A., Almugharrid, R. M. S., Alzuhari, A. M. S., Alshahrani, O. M. O., & Mahmood, S. E. (2025). The association between headphone use during study and concentration among medical students at King Khalid University: A cross-sectional study. *Medicine*, 104(8), e41655. <https://doi.org/10.1097/MD.00000000000041655>
- Al-Zahrani, A. M. (2025). Exploring the impact of artificial intelligence chatbots on human connection and emotional support among higher education students. *SAGE Open*, 15(2), 21582440251340615. <https://doi.org/10.1177/21582440251340615>
- Andersson, M. (2025). Companionship in code: AI's role in the future of human connection. *Humanities and Social Sciences Communications*, 12, Article 1177. <https://doi.org/10.1057/s41599-025-05536-x>
- Arghode, V., & Nafukho, F. M. (2026). Emotionally intelligent and ethically grounded AI: Reimagining learning and development in the digital age. *European Journal of Training and Development*, 50(1/2). <https://doi.org/10.1108/EJTD-04-2025-0072>
- Azpiazu, L., Fernández-Zabala, A., Rodríguez-Fernández, A., & Ramos-Díaz, E. (2023). Perceived emotional intelligence and subjective well-being during adolescence: The moderating effect of age and sex. *Current Psychology*, 42(35), 31048-31063. <https://doi.org/10.1007/s12144-022-04128-1>
- Bekele, T. A., Amponsah, S., & Karkouti, I. M. (2023). African philosophy for successful integration of technology in

- higher education. *British Journal of Educational Technology*, 54(6), 1520-1538. <https://doi.org/10.1111/bjet.13364>
- Bond, M., Bedenlier, S., Marín, V. I., & Händel, M. (2021). Emergency remote teaching in higher education: Mapping the first global online semester. *International Journal of Educational Technology in Higher Education*, 18, Article 50. <https://doi.org/10.1186/s41239-021-00282-x>
- Dushimimana, F., & Nkurunziza, A. (2026). Artificial intelligence and intimacy development in university students: A gender-based systematic review and meta-analysis. *International Journal of Psychology Research*, 8(2), 15-25. <https://doi.org/10.33545/26648903.2026.v8.i2a.141>
- Elhai, J. D., Yang, H., Rozgonjuk, D., & Montag, C. (2020). Using machine learning to model problematic smartphone use severity: The significant role of fear of missing out. *Addictive Behaviors*, 103, 106261. <https://doi.org/10.1016/j.addbeh.2019.106261>
- Floridi, L., Cows, J., Beltrametti, M., Chatila, R., Chazerand, P., Dignum, V., Luetge, C., Madelin, R., Pagallo, U., Rossi, F., Schafer, B., Valcke, P., & Vayena, E. (2018). AI4People: An ethical framework for a good AI society: Opportunities, risks, principles, and recommendations. *Minds and Machines*, 28(4), 689-707. <https://doi.org/10.1007/s11023-018-9482-5>
- Gross, J. J., & John, O. P. (2003). Individual differences in two emotion regulation processes: Implications for affect, relationships, and well-being. *Journal of Personality and Social Psychology*, 85(2), 348-362. <https://doi.org/10.1037/0022-3514.85.2.348>
- Janssen, X., Martin, A., Hughes, A. R., Hill, C. M., Kotronoulas, G., & Hesketh, K. R. (2020). Associations of screen time, sedentary time and physical activity with sleep in under 5s: A systematic review and meta-analysis. *Sleep Medicine Reviews*, 49, 101226. <https://doi.org/10.1016/j.smrv.2019.101226>
- Kardefelt-Winther, D., Rees, G., & Livingstone, S. (2020). Contextualising the link between adolescents' use of digital technology and their mental health: A multi-country study of time spent online and life satisfaction. *Journal of Child Psychology and Psychiatry*, 61(8), 875-889. <https://doi.org/10.1111/jcpp.13280>
- Kaur, G., Anand, A., Chakraborty, P., Pravin, T., Khalilullah, M., Tarafdar, R., Raj, D., & Mukherjee, S. (2025). Use of headphones and its impact on hearing: A cross-sectional survey of medical, nursing, and pharmacy students. *Cureus*, 17(8), e96900. <https://doi.org/10.7759/cureus.96900>
- Kaur, N., Gupta, M., Kiran, T., Malhi, P., & Grover, S. (2021). Development and evaluation of the digital-screen exposure questionnaire (DSEQ) for young children. *PLOS ONE*, 16(6), e0253313. <https://doi.org/10.1371/journal.pone.0253313>
- Keles, B., McCrae, N., & Grealish, A. (2020). A systematic review: The influence of social media on depression, anxiety and psychological distress in adolescents. *International Journal of Adolescence and Youth*, 25(1), 79-93. <https://doi.org/10.1080/02673843.2019.1590851>
- Kirk, H. R., Gabriel, I., Summerfield, C., Vidgen, B., & Hale, S. A. (2025). Why human-AI relationships need socioaffective alignment. *Humanities and Social Sciences Communications*, 12, Article 728. <https://doi.org/10.1057/s41599-025-04532-5>
- Korkmaz, M., & Tek Ayaz, S. (2024). Development of the evaluating the screen exposure of adolescents (ESEA) scale: A validation and reliability study. *Journal of Pediatric Nursing*, 78, e213-e218. <https://doi.org/10.1016/j.pedn.2024.07.008>
- Lee, R. M., & Robbins, S. B. (1995). Measuring belongingness: The Social Connectedness and the Social Assurance scales. *Journal of Counseling Psychology*, 42(2), 232-241. <https://doi.org/10.1037/0022-0167.42.2.232>
- Malfacini, K. (2025). The impacts of companion AI on human relationships: Risks, benefits, and design considerations. *AI & Society*, 40(7), 5527-5540. <https://doi.org/10.1007/s00146-025-02318-6>
- Marengo, D., Sindermann, C., Elhai, J. D., & Montag, C. (2020). One social media company to rule them all: Associations between use of Facebook-owned social media platforms, sociodemographic characteristics, and the Big Five personality traits. *Frontiers in Psychology*, 11, 936. <https://doi.org/10.3389/fpsyg.2020.00936>
- Montag, C., & Hegelich, S. (2020). Understanding detrimental aspects of social media use: Will the real culprits please stand up? *Frontiers in Sociology*, 5, 599270. <https://doi.org/10.3389/fsoc.2020.599270>
- Odgers, C. L., & Jensen, M. R. (2020). Annual Research Review: Adolescent mental health in the digital age: Facts, fears, and future directions. *Journal of Child Psychology and Psychiatry*, 61(3), 336-348. <https://doi.org/10.1111/jcpp.13190>
- O'Donnell, K., & Reschly, A. L. (2020). Assessment of student engagement. In A. L. Reschly, A. J. Pohl, & S. L. Christenson (Eds.), *Student engagement* (pp. 55-76). Springer. https://doi.org/10.1007/978-3-030-37285-9_3
- Orben, A., & Przybylski, A. K. (2019). The association between adolescent well-being and digital technology use. *Nature Human Behaviour*, 3(2), 173-182. <https://doi.org/10.1038/s41562-018-0506-1>
- Scott, H., Biello, S. M., & Woods, H. C. (2019). Social media use and adolescent sleep patterns: Cross-sectional findings from the UK millennium cohort study. *BMJ Open*, 9(9), e031161. <https://doi.org/10.1136/bmjopen-2019-031161>
- Twenge, J. M., & Campbell, W. K. (2018). Associations between screen time and lower psychological well-being among children and adolescents: Evidence from a population-based study. *Preventive Medicine Reports*, 12, 271-283. <https://doi.org/10.1016/j.pmedr.2018.10.003>
- UNESCO. (2023). Guidance for generative AI in education and research. UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf0000386693>
- Valkenburg, P. M., Meier, A., & Beyens, I. (2022). Social media use and its impact on adolescent mental health: An umbrella review of the evidence. *Current Opinion in Psychology*, 44, 58-68. <https://doi.org/10.1016/j.copsyc.2021.08.017>
- Zhang, Q., Zhang, R., Xiong, Y., Sui, Y., Tong, C., & Lin, F.-H. (2025). Generative AI mental health chatbots as therapeutic tools: Systematic review and meta-analysis of their role in reducing mental health issues. *Journal of Medical Internet Research*, 27, e78238. <https://doi.org/10.2196/78238>