

# Digital Distress in Higher Education: Problematic Internet Use, Cyberbullying, and Technostress Among Chilean University Students

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## Article

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# Abstract

## Background

The digitalization of higher education has intensified students' reliance on internet-connected devices, raising concerns about problematic internet use (PIU), cyberbullying, and technology-related stress. While the association between PIU and technostress is increasingly documented, the mechanisms linking these constructs remain poorly understood, particularly whether cyberbullying involvement operates as a mediating pathway.

## Methods

A cross-sectional sample of 755 Chilean university students ( $M_{age} = 21.6$  years,  $SD = 5.59$ ; 50.3% women) completed validated measures of PIU (IAT, 16-item unidimensional solution), cyberbullying roles (ECIPQ; Victimization and Aggression), and technostress (RED-TIC; Skepticism, Fatigue, Anxiety, Inefficacy). Three nested structural equation models (WLSMV, ordinal indicators) were compared per cyberbullying role, ranging from complete to partial mediation, with theoretically justified residual covariances. A sensitivity analysis using a general cyberbullying involvement factor was also conducted.

## Results

Complete mediation models showed poor fit ( $CFI = 0.951-0.975$ ,  $RMSEA = 0.086-0.095$ ). Partial mediation models incorporating direct IAT\_G effects on RED-TIC dimensions achieved satisfactory fit (Model A:  $CFI = 0.984$ ,  $RMSEA = 0.055$ ,  $SRMR = 0.061$ ; Model B:  $CFI = 0.989$ ,  $RMSEA = 0.056$ ,  $SRMR = 0.071$ ). IAT\_G predicted all four technostress dimensions directly ( $\beta = 0.21-0.48$ , all  $p < 0.001$ ). Cyberbullying involvement did not mediate effects on Skepticism, Fatigue, or Anxiety, but yielded significant indirect effects on Inefficacy via both Victimization ( $\beta = 0.049$ ,  $p = 0.033$ ) and Aggression ( $\beta = 0.122$ ,  $p < 0.001$ ). Sensitivity analysis with a general cyberbullying factor replicated this pattern ( $\beta_{indirect} = 0.089$ ,  $p = 0.001$ ).

## Conclusion

PIU is associated with technostress predominantly through direct mechanisms, while cyberbullying involvement plays a selective mediational role restricted to perceived technological inefficacy. These findings suggest distinct intervention targets at individual (digital self-regulation), curricular (digital literacy and agency), and institutional levels, with implications for higher education policies on well-being in the digital society in Latin America.

## 1. Introduction

The rapid expansion of digital technologies has transformed higher education well beyond pedagogical innovation. Across Chile and Latin America, universities have rapidly adopted hybrid learning models, increasing students' reliance on digital platforms within an increasingly hyperconnected society (Kaechele Obreque & Palma Ávila, 2025). While these technologies create new opportunities for interactive and engaging learning experiences (Müller & Mildemberger, 2021), they also blur the boundaries between productive academic engagement and potentially maladaptive patterns of technology use. Evidence indicates that prolonged digital exposure may compromise interpersonal relationships, daily functioning, and overall well-being (Natakuatoong et al., 2026). Similar concerns have been documented in Israel, where virtual instruction was associated with heightened exhaustion, worry, anxiety, burnout, discomfort, and stress during extended video conferencing (Tamir et al., 2026). As digital learning environments become increasingly embedded in higher education, they place greater cognitive and self-regulatory demands on students while expanding institutional responsibility to promote healthy and sustainable technology use. This shift highlights the need to better understand the psychological consequences of intensive digital engagement in contemporary university settings (Vega-Muñoz et al., 2026).

We use the term digital distress to describe the cluster of negative psychological experiences that arise from the intersection of dysfunctional patterns of internet use, technology-related demands, and hostile online interpersonal dynamics in digitally intensive environments (Owens & Mascarenas, 2025). Digital distress is not a single construct but a multidimensional phenomenon that manifests differently depending on which component predominates. From the perspective of digital well-being theory, it represents the negative pole of a dynamic balance between the benefits and costs of digital connectivity (Vanden Abeele, 2021; Büchi, 2024): when that balance is disrupted by compulsive use patterns, chronic techno-demands, or sustained interpersonal conflict in online environments, well-being erodes and distress emerges. In higher education, where digital connectivity is both an academic requirement and a social substrate, this disruption can affect multiple psychological domains simultaneously. The present study examines three interrelated components of digital distress in Chilean university students: problematic internet use as a behavioral pattern of failed self-regulation, cyberbullying involvement as an interpersonal stressor in digital environments, and technostress as the psychological strain associated with sustained ICT demands.

Research has increasingly documented links between problematic internet use (PIU) and technology-related stress, commonly conceptualized as technostress (Abdullah et al., 2023; Salanova et al., 2013). Technostress refers to a negative psychological state arising from the demands imposed by continuous information and communication technology (ICT) use, manifesting as fatigue, anxiety, skepticism toward technology, and perceived inefficacy in digital environments (Salanova et al., 2013). Among university students, these responses are particularly salient, as ICTs simultaneously constitute tools for academic participation and potential sources of chronic demand and overload (Samaha & Hawi, 2016). In Latin American higher education contexts specifically, technostress has been documented among university students, teachers, and administrators, with digital overload, technological anxiety, and exhaustion emerging as consistent manifestations (Vega-Muñoz et al., 2022, 2026). Prior research has also

documented links between internet overuse and burnout-like symptoms, loss of concentration, and sleep disruption in student populations (Lian et al., 2021; Qiu et al., 2024), yet the specific mechanisms through which PIU may contribute to technostress remain poorly understood.

A potentially important, but underexamined, mechanism is cyberbullying. The online environments through which students engage with their academic work also constitute spaces where interpersonal conflict, harassment, and exclusion occur. A recent systematic review of 32 studies involving nearly 30,000 university students found that cybervictimization was significantly associated with depression in 80% of studies, anxiety in 80%, and stress in all three studies that measured it (Arif et al., 2024). Importantly, cyberbullying in university populations does not conform to the discrete victim-aggressor categories observed in school settings: in university contexts, the roles of victim and aggressor tend to overlap considerably, with many students occupying both roles simultaneously (Jian et al., 2025; Souza et al., 2022).

Despite the co-occurrence of PIU and cyberbullying in student populations, the relationship between these phenomena and technostress has not been examined within a unified structural framework. Existing research has tended to study these constructs in isolation: PIU is consistently linked to psychological distress, academic burnout, and maladaptive coping (Männikkö et al., 2025; Mohd Yusof et al., 2022), while cyberbullying is associated with emotional harm, mental health deterioration, and reduced academic functioning (Arif et al., 2024; Doxbeck & Noel, 2023). Technostress, in turn, has been examined primarily as an outcome of ICT demands, overload, and problematic internet use (Abdullah et al., 2023). A plausible theoretical argument links all three: students who engage in unregulated or compulsive internet use are more likely to encounter or participate in cyberbullying dynamics (Romero-Rodríguez et al., 2022), and PIU has been shown to increase exposure to online conflict, addictive patterns, and emotional strain (Rasool et al., 2024; Romero-Rodríguez et al., 2022). These interpersonal stressors may erode students' sense of competence and well-being in digital environments, thereby heightening technostress responses (Abdullah et al., 2023). However, this mediation hypothesis has not been empirically tested with structural equation modelling (SEM) in a Latin American university sample. Whether cyberbullying operates as a general mediator of the PIU–technostress link, or whether PIU exerts its effects on technostress primarily through direct mechanisms independent of interpersonal online conflict, remains an open question.

Problematic internet use is most usefully conceptualized not as passive technological exposure but as a pattern of failed self-regulation. Students who report difficulty disconnecting, who use internet access to escape academic stress or negative affect, or who repeatedly fail to limit their online time despite intending to do so exhibit a recognizable behavioral profile, one in which volitional control over digital behavior is chronically compromised (Caplan, 2010; Young, 1998). From a behavior management perspective, this profile represents a demand-generating pattern: the same devices and platforms that structure academic participation become sources of compulsive engagement that compete with study, sleep, and interpersonal presence. Across systematic reviews, self-regulation consistently emerges as the strongest protective factor against PIU in university populations (Sánchez-Fernández & Borda-Mas,

2022). Interventions targeting this pattern require addressing self-regulatory processes rather than restricting access, making it essential to understand how compromised digital self-regulation may be linked to psychological strain.

In the digital era, higher education has increasingly concentrated learning, social interaction, and interpersonal conflict within the same technological ecosystem, making it more difficult for students to separate academic demands from their personal digital lives. Technology enhanced learning environments require students to remain constantly connected, allowing academic activities to extend beyond traditional boundaries and intrude into everyday communication and leisure (Wang et al., 2021). As a result, students must simultaneously manage academic, collaborative, and social roles through the same digital devices, creating a continuous flow of competing demands. Within this context, technostress emerges not only from the use of technology itself but also from the psychological burden of navigating multiple digital roles. This interpretation is supported by evidence showing that technical difficulties and excessive digital demands are major sources of dissatisfaction and technostress in online learning (Saleem et al., 2024). Similarly, frequent platform switching, prolonged screen exposure, and limited institutional support increase cognitive overload in hybrid learning environments (Daud, 2025). Moreover, when academic tasks, communication, and institutional monitoring occur through the same technological channels without clear boundaries, students are more likely to experience psychological distress and burnout (Lallmahomed, 2025). Collectively, these findings suggest that technostress has evolved into a structural characteristic of post pandemic higher education, reflecting the growing psychological complexity of studying in permanently connected digital environments.

A key theoretical consideration for understanding why cyberbullying might mediate some components of technostress but not others lie in the conceptual distinctiveness of the RED-TIC dimensions (Salanova et al., 2013). Fatigue and anxiety reflect energetic and affective costs of sustained digital engagement, driven primarily by the volume and persistence of ICT demands, and are thus most directly linked to behavioral patterns of use such as those captured by the IAT. Skepticism, in contrast, is a more attitudinal response that accumulates over time through repeated negative experiences with technology and tends to develop more slowly. Technological inefficacy, however, differs qualitatively from the other three: it concerns perceived competence and control in digital environments, that is, the belief in one's ability to manage digital tools effectively (Bandura, 1997). Because cyberbullying involvement entails hostile, unpredictable, and often humiliating interactions in digital spaces, it may specifically undermine this sense of competence without necessarily generating the acute fatigue or anxiety associated with overuse. This conceptual differentiation generates a theoretically grounded expectation: if cyberbullying mediates any technostress dimension, it is most likely to do so for Inefficacy, not for the dimensions more directly tied to ICT demand overload.

The present study addresses this gap by examining the structural relationships among PIU, cyberbullying involvement (victimization and aggression), and four dimensions of technostress (skepticism, fatigue, anxiety, and inefficacy) in a sample of 755 Chilean university students. Using WLSMV-based SEM with ordinal indicators, we compare complete and partial mediation specifications across two cyberbullying

roles and evaluate the robustness of findings through a sensitivity analysis using a general cyberbullying involvement factor. The study draws on psychometric evidence from companion validation studies of the IAT, ECIPQ, and RED-TIC conducted with the same sample, ensuring that structural conclusions rest on well-characterized measurement models. The theoretical framing of this research is situated within a broader project examining the tensions and challenges posed by learning environments in the digital society for Chilean higher education.

## 2. Methods

This section provides a detailed description of the sample characteristics, data collection procedures, psychometric instruments used, and the analytical strategy applied. It presents the specifications of the measurement models and the methodological decisions underlying the estimation of the structural relationships examined, ensuring transparency and reproducibility in accordance with research standards.

### 2.1. Participants and Procedure

The sample comprised 755 university students from Chile ( $M_{\text{age}} = 21.6$  years,  $SD = 5.59$ ; 50.3% women) enrolled in programs across health sciences, social sciences, and humanities. Data were collected during the 2023 academic year under fully in-person instructional conditions. Participation was voluntary and anonymous, conducted through an online self-report platform administered during regular class sessions. All participants provided informed consent prior to completing the survey. The study was approved by the institutional ethics committee and complied with the Declaration of Helsinki.

### 2.2. Instruments

The following instruments were selected for their psychometric validity and their relevance to assessing the three central dimensions of the study: problematic internet use, involved in cyberbullying, and technostress in university settings.

**2.2.1. Problematic Internet Use.** The Internet Addiction Test (IAT; Young, 1998) was used to assess problematic internet use. Following the evidence from prior psychometric work conducted with this sample, a refined 16-item version corresponding to the Panova et al. (2021) Colombian model was employed, treating the IAT as essentially unidimensional. Detailed psychometric analyses supporting these specifications are reported in companion manuscripts; only parameters directly relevant to the present SEM specification are summarized here. This decision was grounded in bifactor indices indicating that a general factor (IAT\_G) explained 80.6% of common item variance ( $ECV = 0.806$ ), with hierarchical omega  $\omega_h = 0.840$  and a percent of uncontaminated correlations ( $PUC = 0.832$ ), collectively supporting the use of a global latent factor. All constructs were modelled as latent variables using their ordinal items as indicators; no observed sum scores or factor scores were used in the SEM analyses. Items were rated on a five-point ordinal scale (0 = Never to 4 = Always). Composite reliability for the unidimensional solution was  $\omega = 0.931$  and  $AVE = 0.423$ . Although AVE fell below the conventional .50

threshold, this criterion is known to be overly conservative for instruments with heterogeneous loadings and strong general factors; the convergence of ECV,  $\omega_H$ , and composite reliability provides convergent support for the adequacy of the unidimensional solution (Rodriguez et al., 2016).

**2.2.2. Cyberbullying.** The European Cyberbullying Intervention Project Questionnaire (ECIPQ; Del Rey et al., 2015) assessed cyberbullying involvement. The ECIPQ contains 22 items divided into two parallel subscales: Victimization (11 items) and Aggression (11 items), rated on a five-point ordinal scale (0 = Never to 4 = Always). Validation in this sample confirmed a correlated two-factor structure with acceptable overall fit after incorporating theoretically justified residual covariances (CFI = 0.995, RMSEA = 0.077, SRMR = 0.084), with composite reliability  $\omega = 0.836$  and  $0.908$  for Victimization and Aggression, respectively. Consistent with the psychometric literature, the latent correlation between factors was high ( $\phi = 0.908$ ), indicating that victimization and aggression roles are empirically interdependent in university populations; both dimensions were retained and modelled separately. Given the high latent correlation between roles and the risk of suppression and estimation instability in simultaneous estimation, models were specified separately for each cyberbullying role. This decision prioritizes interpretive stability over parsimony, at the cost of not being able to distinguish unique role-specific effects; results across models should therefore be interpreted as complementary rather than independent.

**2.2.3. Technostress.** The RED-TIC scale (Salanova et al., 2013) assessed technology-related strain. The instrument comprises 16 items organized into four factors: Skepticism (4 items), Fatigue (4 items), Anxiety (4 items), and Inefficacy (4 items), rated on a five-point ordinal scale (0 = Never to 4 = Always). The four-factor model showed excellent fit in this sample (CFI = 0.991, RMSEA = 0.063, SRMR = 0.050), with composite reliability ranging from  $\omega = 0.753$  (Skepticism) to  $\omega = 0.865$  (Fatigue).

## 2.3. Analytic Strategy

All analyses were conducted in R (version 4.5.2) using the lavaan package (version 0.6–21; Rosseel, 2012). Given the ordinal nature of all response scales, models were estimated using the Weighted Least Squares Mean and Variance Adjusted estimator (WLSMV) with theta parameterization and latent variable standardization (std.lv = TRUE). Model fit was evaluated using CFI, TLI, RMSEA with 90% confidence intervals, and SRMR, applying conventional thresholds of CFI/TLI  $\geq 0.95$ , RMSEA  $\leq 0.06$ , and SRMR  $\leq 0.08$ , while acknowledging that RMSEA may be upwardly biased under WLSMV with ordinal data (Shi et al., 2020).

Three nested model specifications were compared for each cyberbullying role (see Table 2): M1 (complete mediation, no direct IAT\_G  $\rightarrow$  RED-TIC paths), M2 (direct effects specification), and M3 (direct effects specification with residual covariances in the ECIPQ measurement model specified a priori based on prior CFA). These residual covariances reflect local item dependence documented in the companion ECIPQ validation, attributable to semantic redundancy among adjacent behavioral items; they were not selected via modification indices in the current SEM. Specifically, for Model A (Victimization mediator), four residual covariances were specified among semantically adjacent victimization items: ecipq\_01  $\leftrightarrow$  ecipq\_02, ecipq\_01  $\leftrightarrow$  ecipq\_03, ecipq\_04  $\leftrightarrow$  ecipq\_05, and ecipq\_05  $\leftrightarrow$  ecipq\_06. For Model B (Aggression mediator), one residual covariance was specified among aggression items:

ecipq\_12↔ecipq\_13. The comparison between M1 and M2 addresses the substantive question of complete versus partial mediation; the transition from M2 to M3 reflects correction for pre-specified local dependencies in the measurement model rather than a structural respecification. Accordingly, fit improvement from M1 to M3 reflects both structural and measurement factors and should not be interpreted as evidence for the mediational hypothesis alone. Formal model comparisons used the scaled chi-square difference test (Satorra, 2000) appropriate for WLSMV. Indirect effects were estimated via the delta method. No missing data were present in the dataset.

### 3. Results

This section presents the empirical findings derived from descriptive analyses, comparisons of model fit among structural models, and estimates of the direct and indirect effects specified in the structural equation models. First, the general patterns of association among the variables are reported, followed by a systematic evaluation of the mediational specifications and the final structural coefficients, supplemented by a sensitivity analysis that examines the robustness of the results under an alternative unidimensional model of cyberbullying.

#### 3.1. Descriptive Statistics and Bivariate Associations

Table 1 presents descriptive statistics and zero-order correlations among the study variables. Mean levels of cyberbullying involvement were relatively low (Cybervictimization:  $M = 0.62$ ,  $SD = 0.64$ ; Cyberaggression:  $M = 0.35$ ,  $SD = 0.55$ ), consistent with the right-skewed distributions expected in general university samples. Among the technostress dimensions, Fatigue showed the highest mean level ( $M = 1.51$ ,  $SD = 0.96$ ), followed by Skepticism ( $M = 1.27$ ,  $SD = 0.78$ ), Anxiety ( $M = 1.10$ ,  $SD = 0.89$ ), and Inefficacy ( $M = 0.89$ ,  $SD = 0.82$ ). Problematic internet use showed moderate mean levels ( $M = 1.28$ ,  $SD = 0.74$ ). At the bivariate level, PIU showed moderate positive correlations with all technostress dimensions ( $r = 0.16$ – $0.41$ ) and with both cyberbullying roles ( $r = 0.40$ – $0.41$ ). Cybervictimization and cyberaggression were strongly correlated with each other ( $r = 0.72$ ), consistent with the high latent correlation documented in the measurement model and showed weaker associations with technostress dimensions ( $r = 0.06$ – $0.24$ ). These patterns provide preliminary descriptive support for the expectation that PIU may show broader associations with technostress than cyberbullying involvement, a pattern that the structural models examine more rigorously.

Table 1  
Descriptive Statistics and Zero-Order Correlations Among Study Variables (N = 755)

| Variable                    | M    | SD   | 1    | 2    | 3    | 4    | 5    | 6    | 7 |
|-----------------------------|------|------|------|------|------|------|------|------|---|
| 1. Problematic Internet Use | 1.28 | 0.74 | —    |      |      |      |      |      |   |
| 2. Cybervictimization       | 0.62 | 0.64 | 0.40 | —    |      |      |      |      |   |
| 3. Cyberaggression          | 0.35 | 0.55 | 0.41 | 0.72 | —    |      |      |      |   |
| 4. Skepticism               | 1.27 | 0.78 | 0.16 | 0.06 | 0.07 | —    |      |      |   |
| 5. Fatigue                  | 1.51 | 0.96 | 0.33 | 0.15 | 0.11 | 0.45 | —    |      |   |
| 6. Anxiety                  | 1.10 | 0.89 | 0.41 | 0.20 | 0.19 | 0.47 | 0.62 | —    |   |
| 7. Inefficacy               | 0.89 | 0.82 | 0.31 | 0.20 | 0.24 | 0.39 | 0.40 | 0.66 | — |

Note. All variables are observed composite scores (mean of items). Scale range: 0–4 for all variables. PIU = Problematic Internet Use (IAT, 16-item unidimensional solution). Cybervictimization and Cyberaggression from ECIPQ. Skepticism, Fatigue, Anxiety, and Inefficacy from RED-TIC. All correlations are Pearson *r*; all *p* < 0.01 except PIU–Skepticism (*p* = 0.001) and Cybervictimization/Cyberaggression–Skepticism (ns).

## 3.2. Model Fit Comparison

Table 2 presents goodness-of-fit indices for all six models. Complete mediation specifications (M1) showed poor to marginal fit in both models: Model A (Victimization): CFI = 0.951, RMSEA = 0.095 [0.093, 0.097], SRMR = 0.099; Model B (Aggression): CFI = 0.975, RMSEA = 0.086 [0.084, 0.088], SRMR = 0.104. Freeing direct paths from IAT\_G to RED-TIC outcomes (M2) produced substantial improvements. Final models incorporating theoretically justified residual covariances (M3) achieved satisfactory fit by all criteria: Model A: CFI = 0.984, TLI = 0.983, RMSEA = 0.055 [0.052, 0.057], SRMR = 0.061; Model B: CFI = 0.989, TLI = 0.989, RMSEA = 0.056 [0.054, 0.059], SRMR = 0.071. Scaled chi-square difference tests confirmed that M3 specifications fit significantly better than their complete mediation counterparts: Model A,  $\Delta\chi^2(8) = 426.34$ , *p* < 0.001; Model B,  $\Delta\chi^2(5) = 206.04$ , *p* < 0.001, indicating that, together with the improvement from M1 to M2, the complete mediation hypothesis was overly restrictive.

Table 2

Goodness-of-Fit Indices for SEM Models Examining Direct and Mediated Effects Between Problematic Internet Use, Cyberbullying, and Technostress

| Model                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | CFI   | TLI   | RMSEA [90% CI]       | SRMR  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------|----------------------|-------|
| <b>Model A: Victimization as mediator</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |       |       |                      |       |
| M1: Complete mediation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 0.951 | 0.948 | 0.095 [0.093, 0.097] | 0.099 |
| M2: Direct effects specification                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 0.979 | 0.977 | 0.063 [0.061, 0.065] | 0.070 |
| M3: Direct effects + residuals                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 0.984 | 0.983 | 0.055 [0.052, 0.057] | 0.061 |
| <b>Model B: Aggression as mediator</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |       |       |                      |       |
| M1: Complete mediation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 0.975 | 0.974 | 0.086 [0.084, 0.088] | 0.104 |
| M2: Direct effects specification                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 0.988 | 0.987 | 0.060 [0.058, 0.062] | 0.074 |
| M3: Direct effects + residuals                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 0.989 | 0.989 | 0.056 [0.054, 0.059] | 0.071 |
| <b>Note.</b> CFI = Comparative Fit Index; TLI = Tucker–Lewis Index; RMSEA = Root Mean Square Error of Approximation with 90% confidence interval; SRMR = Standardized Root Mean Square Residual. All models estimated with WLSMV. M1 = complete mediation specification; M2 = direct effects specification; M3 = direct effects with theoretically justified residual covariances in the ECIPQ (specified a priori from prior CFA). Because models differed in structural constraints, fit indices should be interpreted comparatively but not as evidence of strict model equivalence. M3 vs. M1 scaled chi-square difference tests (Satorra, 2000): Model A $\Delta\chi^2(8) = 426.34$ , $p < 0.001$ ; Model B $\Delta\chi^2(5) = 206.04$ , $p < 0.001$ . |       |       |                      |       |

### 3.3. Structural Paths

Table 3 and Fig. 1 present standardized path coefficients for the final models (M3A and M3B). IAT\_G was a significant predictor of both cyberbullying roles: Victimization ( $\beta = 0.469$ ,  $p < 0.001$ ) and Aggression ( $\beta = 0.508$ ,  $p < 0.001$ ). IAT\_G also showed strong and consistent direct effects on all four RED-TIC dimensions in both models. In M3A, standardized direct effects ranged from  $\beta = 0.213$  (Skepticism) to  $\beta = 0.475$  (Anxiety), all  $p < 0.001$ . In M3B, effects were comparable:  $\beta = 0.205$  (Skepticism) to  $\beta = 0.471$  (Anxiety), all  $p < 0.001$ .

Paths from cyberbullying roles to RED-TIC outcomes were largely non-significant. In M3A, Victimization did not significantly predict Skepticism ( $\beta = -0.012$ ,  $p = 0.814$ ), Fatigue ( $\beta = -0.018$ ,  $p = 0.721$ ), or Anxiety ( $\beta = 0.043$ ,  $p = 0.356$ ), but showed a significant small path to Inefficacy ( $\beta = 0.105$ ,  $p = 0.032$ ). In M3B, Aggression similarly failed to predict Skepticism ( $\beta = 0.005$ ,  $p = 0.930$ ), Fatigue ( $\beta = -0.100$ ,  $p = 0.089$ ), or Anxiety ( $\beta = 0.048$ ,  $p = 0.401$ ), while showing a significant path to Inefficacy ( $\beta = 0.239$ ,  $p < 0.001$ ).

### 3.4. Indirect Effects

Indirect effects of IAT\_G through cyberbullying roles were non-significant for Skepticism, Fatigue, and Anxiety in both models (all  $p > 0.050$ ). In M3A, the indirect effect via Victimization on Inefficacy was small but significant ( $\beta = 0.049$ ,  $p = 0.033$ ). In M3B, the indirect effect via Aggression on Inefficacy was

significant and somewhat larger ( $\beta = 0.122$ ,  $p < 0.001$ ). These results indicate that cyberbullying roles did not function as general mediators; significant mediational effects were limited to Inefficacy, with a notably stronger effect when Aggression served as the mediator (see Table 3 and Fig. 1).

Table 3  
Unstandardized and Standardized Path Coefficients for Final Models M3A (Victimization) and M3B (Aggression)

| Path                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Model A: Victimization |       |         |         | Model B: Aggression |       |         |         |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-------|---------|---------|---------------------|-------|---------|---------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | est                    | SE    | p       | $\beta$ | est                 | SE    | p       | $\beta$ |
| <b>IAT_G → Cyberbullying role</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                        |       |         |         |                     |       |         |         |
| IAT_G → Victimization                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 0.532                  | 0.049 | < 0.001 | 0.469   | —                   | —     | —       | —       |
| IAT_G → Aggression                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | —                      | —     | —       | —       | 0.589               | 0.060 | < 0.001 | 0.508   |
| <b>Cyberbullying role → RED-TIC</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                        |       |         |         |                     |       |         |         |
| → Skepticism                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | -0.011                 | 0.046 | 0.814   | -0.012  | 0.005               | 0.054 | 0.930   | 0.005   |
| → Fatigue                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | -0.017                 | 0.049 | 0.721   | -0.018  | -0.094              | 0.055 | 0.089   | -0.100  |
| → Anxiety                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0.044                  | 0.047 | 0.356   | 0.043   | 0.048               | 0.057 | 0.401   | 0.048   |
| → Inefficacy                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0.102                  | 0.047 | 0.032   | 0.105   | 0.231               | 0.058 | < 0.001 | 0.239   |
| <b>IAT_G → RED-TIC (direct effects)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                        |       |         |         |                     |       |         |         |
| → Skepticism                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0.218                  | 0.050 | < 0.001 | 0.213   | 0.210               | 0.054 | < 0.001 | 0.205   |
| → Fatigue                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0.440                  | 0.050 | < 0.001 | 0.404   | 0.487               | 0.054 | < 0.001 | 0.445   |
| → Anxiety                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0.547                  | 0.054 | < 0.001 | 0.475   | 0.542               | 0.057 | < 0.001 | 0.471   |
| → Inefficacy                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0.388                  | 0.050 | < 0.001 | 0.353   | 0.315               | 0.053 | < 0.001 | 0.281   |
| <b>Indirect effects (IAT_G → Role → RED-TIC)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                         |                        |       |         |         |                     |       |         |         |
| → Skepticism                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | -0.006                 | 0.024 | 0.814   | -0.006  | 0.003               | 0.032 | 0.930   | 0.003   |
| → Fatigue                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | -0.009                 | 0.026 | 0.722   | -0.008  | -0.055              | 0.033 | 0.093   | -0.051  |
| <b>Note.</b> est = unstandardized estimate; SE = standard error; $\beta$ = standardized coefficient (std.all). IAT_G = general factor of the Internet Addiction Test (16 items; Panova et al., 2021, Colombian model, refined). RED-TIC factors: Skepticism, Fatigue, Anxiety, Inefficacy. Significant indirect effects ( $p < 0.05$ ): IAT_G → Victimization → Inefficacy ( $\beta = 0.049$ ) and IAT_G → Aggression → Inefficacy ( $\beta = 0.122$ ). WLSMV estimation; std.lv = TRUE. |                        |       |         |         |                     |       |         |         |

| Path                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Model A: Victimization |       |       |         | Model B: Aggression |       |         |         |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-------|-------|---------|---------------------|-------|---------|---------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | est                    | SE    | p     | $\beta$ | est                 | SE    | p       | $\beta$ |
| <b>IAT_G → Cyberbullying role</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                        |       |       |         |                     |       |         |         |
| → Anxiety                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0.023                  | 0.025 | 0.359 | 0.020   | 0.028               | 0.034 | 0.403   | 0.024   |
| → Inefficacy                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0.054                  | 0.025 | 0.033 | 0.049   | 0.136               | 0.036 | < 0.001 | 0.122   |
| <b>Note.</b> est = unstandardized estimate; SE = standard error; $\beta$ = standardized coefficient (std.all). IAT_G = general factor of the Internet Addiction Test (16 items; Panova et al., 2021, Colombian model, refined). RED-TIC factors: Skepticism, Fatigue, Anxiety, Inefficacy. Significant indirect effects ( $p < 0.05$ ): IAT_G → Victimization → Inefficacy ( $\beta = 0.049$ ) and IAT_G → Aggression → Inefficacy ( $\beta = 0.122$ ). WLSMV estimation; std.lv = TRUE. |                        |       |       |         |                     |       |         |         |

### Note

Standardized path coefficients ( $\beta$ ). Curved dark lines = significant direct effects ( $p < 0.05$ ). Straight bold lines = significant mediating paths (both panels, equal visual weight). Dashed grey = non-significant paths. Inefficacy boxes highlighted = sole outcome with significant mediation in both models. \*  $p < 0.050$ , \*\*\*  $p < 0.001$ .

## 3.5. Sensitivity Analysis: General Cyberbullying Involvement Model

To address the concern that modeling victimization and aggression as separate mediators may artificially exaggerate their role-specific effects, a supplementary analysis was conducted using a single general cyberbullying involvement factor (ECIPQ\_G) comprising all 22 ECIPQ items. This specification is theoretically motivated by the high latent correlation between both roles ( $\varphi = 0.908$ ) documented in the companion validation study and parallels the unidimensional treatment of the IAT applied in the primary models. The same three-model nested comparison (M1–M3) was replicated with ECIPQ\_G as the sole mediator, retaining the same five a priori residual covariances across both subscales.

Results of the final sensitivity model (S-M3) replicated the pattern observed in the primary analyses with high fidelity. IAT\_G significantly predicted ECIPQ\_G ( $\beta = 0.501$ ,  $p < 0.001$ ). Direct effects of IAT\_G on all four RED-TIC dimensions remained significant and of comparable magnitude (Skepticism:  $\beta = 0.211$ ; Fatigue:  $\beta = 0.424$ ; Anxiety:  $\beta = 0.472$ ; Inefficacy:  $\beta = 0.314$ ; all  $p < 0.001$ ). Paths from ECIPQ\_G to Skepticism ( $\beta = -0.005$ ,  $p = 0.919$ ), Fatigue ( $\beta = -0.059$ ,  $p = 0.243$ ), and Anxiety ( $\beta = 0.046$ ,  $p = 0.345$ ) were all non-significant, while the path to Inefficacy remained significant ( $\beta = 0.177$ ,  $p = 0.001$ ). The indirect effect of IAT\_G through ECIPQ\_G on Inefficacy was significant ( $\beta = 0.089$ ,  $p = 0.001$ ); all other indirect effects were non-significant. Model fit was acceptable (CFI = 0.986, TLI = 0.985, RMSEA = 0.061 [0.059, 0.062], SRMR = 0.077). The slightly elevated SRMR relative to the primary models may reflect the greater measurement burden of the 22-item unidimensional specification rather than a structural misfit.

These results support the robustness of the selective mediational role of cyberbullying for Inefficacy across alternative operationalizations of cyberbullying involvement, indicating that it does not depend on the separate modelling of victimization and aggression roles.

## 4. Discussion

The present study examined whether cyberbullying involvement mediates the association between problematic internet use and technostress in Chilean university students, comparing complete and partial mediation specifications across two cyberbullying roles. The results revealed a consistent and theoretically meaningful pattern: the link between PIU and most technostress dimensions is predominantly direct, while cyberbullying demonstrates a limited and outcome-specific mediational role, restricted to perceived technological inefficacy. These findings highlight that digital distress in higher education is primarily due to failures in self-regulation of Internet use, while cyberbullying contributes selectively through competence-related pathways. This has implications for how universities understand and address their students' digital well-being.

### 4.1. Problematic Internet Use as a Direct Correlate of Technostress

The most robust finding of this study is the strong and consistent direct association between IAT\_G and all four technostress dimensions, which remained significant across model specifications. In the present sample, students reported moderate average levels of PIU ( $M = 1.28$  on a 0–4 scale), with fatigue emerging as the most elevated technostress dimension ( $M = 1.51$ ), followed by skepticism ( $M = 1.27$ ), anxiety ( $M = 1.10$ ), and inefficacy ( $M = 0.89$ ). This gradient is consistent with a demand-resource perspective (Demerouti et al., 2001): the behavioral characteristics captured by the IAT (difficulty disconnecting, using internet to escape negative affect, neglecting other activities) represent chronic digital demands that deplete cognitive and emotional resources, consistent with fatigue and anxiety emerging as the most strongly associated technostress dimensions. Skepticism, which reflects a more attitudinal disengagement from technology, showed the smallest direct effect ( $\beta \approx 0.21$ ), consistent with its conceptualization as a slower-developing response that requires accumulated negative experience rather than acute overload.

These findings are consistent with prior research linking internet overuse to burnout-like symptoms and technology-related exhaustion in student populations (Lian et al., 2021; Samaha & Hawi, 2016). They also align with evidence that PIU may partially mediate the relationship between internet use and technostress in university students, particularly among those higher in neuroticism (Abdullah et al., 2023). The present study extends this literature by modelling these associations within a structural framework that accounts for the multidimensionality of both predictors and outcomes.

It is important to note that the persistence of direct effects, even after accounting for involvement in cyberbullying, suggests that excessive Internet use (PIU) acts as a key behavioral factor in technological

stress, reflecting a pattern of chronic digital demands rather than a secondary consequence of online interpersonal conflicts. In higher education contexts within the digital society, where academic participation requires sustained digital engagement, unregulated connectivity can accumulate into a pervasive strain that becomes structurally embedded in students' daily routines.

## 4.2. The Selective Mediation Role of Cyberbullying: Why Inefficacy?

Against the hypothesis of general mediation, cyberbullying roles did not transmit the effects of PIU across most technostress dimensions. The significant exception was inefficacy, where both victimization ( $\beta_{\text{indirect}} = 0.049$ ) and aggression ( $\beta_{\text{indirect}} = 0.122$ ) yielded significant indirect effects. Importantly, this pattern was replicated in the sensitivity analysis using a general cyberbullying involvement factor (ECIPQ\_G) that collapsed both roles into a single latent variable ( $\beta_{\text{indirect}} = 0.089$ ,  $p = 0.001$ ), confirming that the finding does not depend on the separate modelling of victimization and aggression.

The specificity of this effect warrants careful theoretical attention. Technological inefficacy captures the perception of being unable to manage or master digital environments competently, a dimension conceptually distinct from fatigue or anxiety, which reflect energetic and affective costs. The prevalence data from this sample are instructive: 84.5% of students reported at least one episode of cybervictimization, and 67.2% reported at least one act of cyberaggression. In this context, cyberbullying-related experiences were widely reported in this sample, suggesting they are not peripheral events but a common feature of the digital social environment in this population. Engagement in cyberbullying dynamics, whether as victim, aggressor, or both, may erode the sense of purposeful and controlled digital engagement that underlies perceived competence. This interpretation is consistent with Bandura's (1997) social cognitive theory: participation in hostile or unpredictable online interactions may constitute negative mastery experiences that undermine self-efficacy beliefs about digital environments. Empirical support for this link comes from studies showing that ICT self-efficacy, defined as the perceived ability to manage digital environments competently, differs significantly across cyberbullying roles in university students, with both victims and perpetrators showing lower ICT self-efficacy relative to uninvolved peers (Musharraf et al., 2019).

The stronger indirect effect observed in the aggression model ( $\beta = 0.122$ ) compared to the victimization model ( $\beta = 0.049$ ) is noteworthy. One possible interpretation is that the aggression model may capture a more behaviorally active or dysregulated form of cyberbullying involvement, potentially contributing to the erosion of efficacy beliefs through mechanisms of moral disengagement or failed behavioral control (Bandura et al., 1996). However, given the cross-sectional design and the high empirical overlap between roles ( $\varphi = 0.908$ ), these differences should be interpreted cautiously and not as evidence of distinct causal pathways. More broadly, the absence of mediation for fatigue, anxiety, and skepticism reinforces that cyberbullying contributes selectively to competence-related strain rather than to energetic or affective technostress responses, which appear more tightly linked to chronic digital demand.

## 4.3. Implications

These findings have several implications organized across three levels. At the individual level, the strong and consistent direct effects of PIU on fatigue, anxiety, and skepticism indicate that self-regulatory capacity is a primary target for intervention. Students who struggle to limit their internet use, who use digital connectivity to escape negative affect, or who repeatedly fail to disconnect despite intending to do so are at elevated risk for multiple technostress dimensions. Practical strategies at this level include structured disconnection practices, screen time self-monitoring programs, and self-regulatory training that addresses the impulse-control dimension of digital behavior (Caplan, 2010; Sánchez-Fernández & Borda-Mas, 2022). These approaches target the behavioral pattern of unregulated use that appears to drive the most prevalent and broadly distributed technostress responses in this population.

At the curricular level, the selective mediational effect of cyberbullying on Inefficacy points to a qualitatively distinct intervention need: restoring students' sense of agency and mastery in digital environments. Digital literacy programs should go beyond technical skills to address online conflict management, bystander behavior, and resilience in hostile online spaces. Integrating digital and social-emotional skills into the curriculum could help mitigate the loss of skills associated with engaging in cyberbullying.

At the institutional level, the co-occurrence of significant PIU, widespread cyberbullying involvement, and meaningful technostress in this sample suggests that digital distress is a systemic feature of the university environment rather than an individual-level problem. Institutions designing or consolidating hybrid learning programs should integrate digital well-being monitoring into existing student health systems, establish clear protocols for cyberbullying reporting and response, and design academic workloads that account for the cumulative demand imposed by continuous digital availability. Policies that normalize structured disconnection and set reasonable expectations about digital responsiveness can serve as structural counterweights to the always-on culture of contemporary higher education (Vanden Abeele, 2021). Taken together, these implications highlight that digital distress emerges from the interaction between behavioral self-regulation, socioemotional digital competencies, and institutional digital culture.

Finally, from a methodological standpoint, the use of an essentially unidimensional IAT solution, grounded in bifactor evidence from companion validation work, proved analytically coherent: IAT\_G produced stable and consistent effects across all model specifications. Future studies may consider whether multidimensional PIU models yield differential predictions across technostress dimensions.

## 4.4. Limitations and Future Directions

Several limitations should be acknowledged. First, the cross-sectional design precludes causal inference. Future studies should examine whether problematic internet use prospectively predicts technostress and cyberbullying involvement, and whether interventions targeting internet use reduce subsequent technostress. Second, the sample was drawn from a single country and represents a

relatively homogeneous undergraduate population; replication in diverse cultural contexts is needed. Third, the high correlation between victimization and aggression scales ( $\varphi = 0.908$ ) limits the degree to which these roles can be examined as independent predictors, a structural feature of the phenomenon in university populations rather than a limitation of the instrument per se. Fourth, the absence of potential mediators such as emotion regulation or social support means that the direct effects observed may partially reflect unmodeled pathways.

Fifth, all measures relied exclusively on self-report, introducing the risk of common method variance. Shared method bias may inflate observed associations among constructs, particularly those measured within the same survey administration. Future studies should consider multi-source or behavioral indicators to complement self-report assessments. Sixth, the cyberbullying prevalence figures reported here are based on the criterion of at least one episode of victimization or aggression. These figures should not be interpreted as indicative of clinically significant or chronic cyberbullying exposure; they reflect any reported digital interpersonal conflict, regardless of frequency or severity. Seventh, although the study focuses on higher education in the digital society, the data were collected under conditions of fully in-person instruction during the 2023 academic year. The digital ecosystem remains relevant regardless of the mode of instruction, but the results may differ from the specific dynamics of technology-related stress in synchronous distance learning or fully online learning contexts. Eighth, the models do not distinguish between acute, episodic, and chronic forms of technostress. This temporal dimension is important for understanding accumulation effects and intervention timing and represents a productive direction for longitudinal follow-up research.

## 5. Conclusion

This study provides evidence that the association between problematic internet use and technostress in university students is predominantly direct and robust across most technostress dimensions, with cyberbullying demonstrating a limited and outcome-specific mediational role restricted to technological inefficacy, more pronounced via aggression than victimization. These findings challenge the assumption of general mediation and suggest that problematic internet use appears to function as an independent correlate of technological strain operating through mechanisms beyond interpersonal online conflict. Taken together with the psychometric evidence from companion studies validating the IAT, ECIPQ, and RED-TIC in this sample, these results contribute to a more precise understanding of the interplay between digital behavior patterns and psychological well-being in higher education.

## Declarations

### Data Available Statement

The datasets generated and analyzed during the current study are included in the Supplementary Material. Additional data or analytic scripts are available from the corresponding authors upon reasonable request.

## Author Contributions

Conceptualization, A.V.-M., J.B.-G. and D.C.-H.; methodology, A.V.-M., B.S. and D.C.-H.; software, D.C.-H.; validation, A.V.-M., J.B.-G. and G.S.-S.; formal analysis, A.V.-M. and D.C.-H.; investigation, A.V.-M. and G.S.-S.; resources, A.V.-M.; data curation, A.V.-M. and D.C.-H.; writing-original draft preparation, A.V.-M., B.S., D.C.-H., J.B.-G. and G.S.-S.; writing-review and editing, A.V.-M., B.S., D.C.-H., J.B.-G. and G.S.-S.; visualization, A.V.-M. and D.C.-H.; supervision, B.S. and J.B.-G.; project administration, A.V.-M.; funding acquisition, A.V.-M., D.C.-H. and G.S.-S. All authors have read and agreed to the published version of the manuscript.

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## Ethics Declaration

**Ethical approval:** The study was approved by the Scientific Ethics Committee of Universidad Central de Chile (protocol code 146-2023; approval date: 30 November 2023). All research procedures were performed in accordance with the Declaration of Helsinki and with all relevant institutional and national guidelines and regulations.

**Local approval:** All data were collected in Chile; therefore, no additional international approvals were required.

**Consent to participate:** Written informed consent was obtained from all human participants prior to data collection.

**Consent to publish:** Not applicable. The study does not include identifiable personal data.

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## Figures

Standardized path coefficients ( $\beta$ ). Solid lines = significant; dashed = non-significant. Thick solid lines from mediator = significant mediating path. Inefficacy boxes shaded = sole outcome with significant mediation.

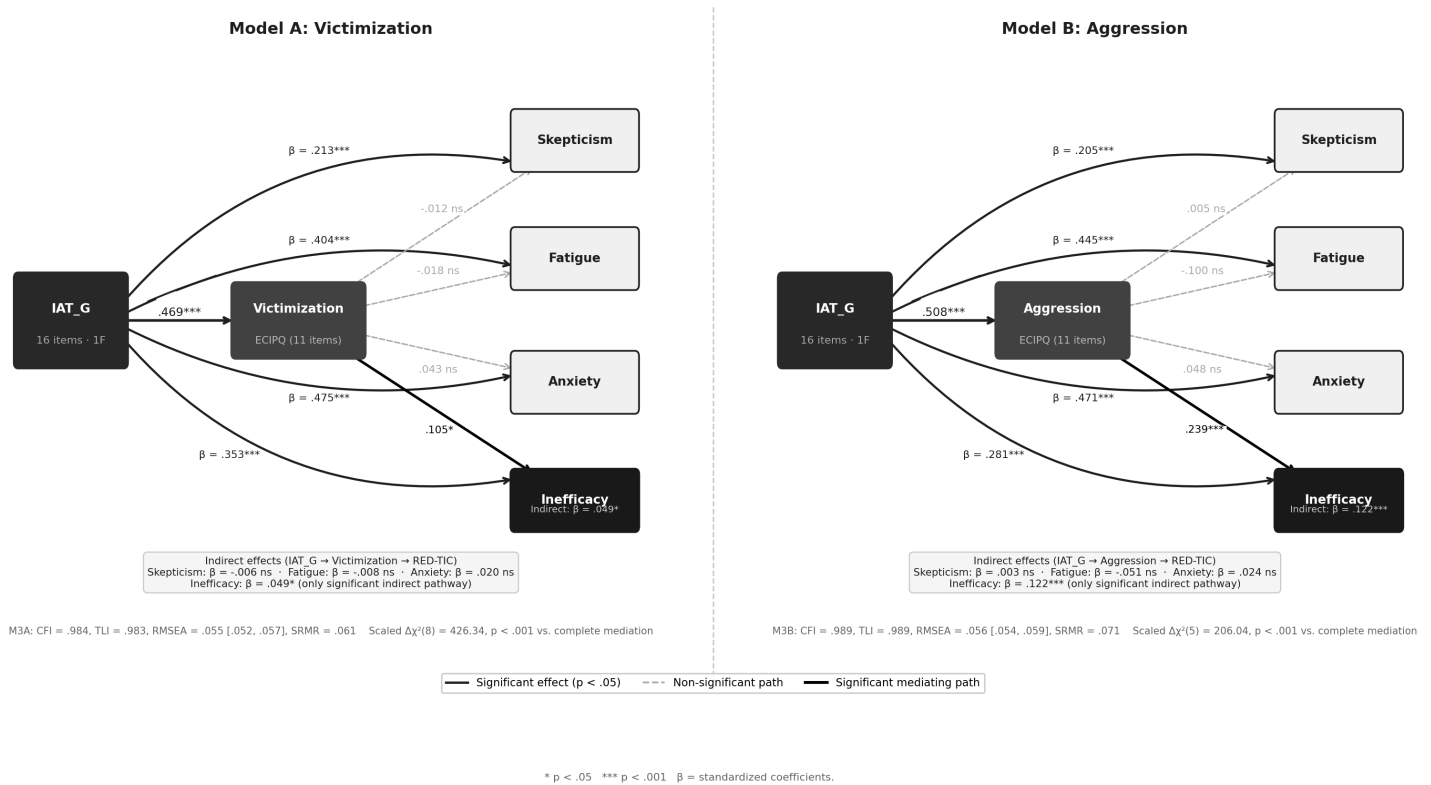


**Figure 1**

## Direct and Mediated Associations Between Problematic Internet Use, Cyberbullying, and Technostress

Note. Standardized path coefficients ( $\beta$ ). Curved dark lines = significant direct effects ( $p < 0.05$ ). Straight bold lines = significant mediating paths (both panels, equal visual weight). Dashed grey = non-significant paths. Inefficacy boxes highlighted = sole outcome with significant mediation in both models. \*  $p < 0.050$ , \*\*\*  $p < 0.001$ .

## Supplementary Files

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