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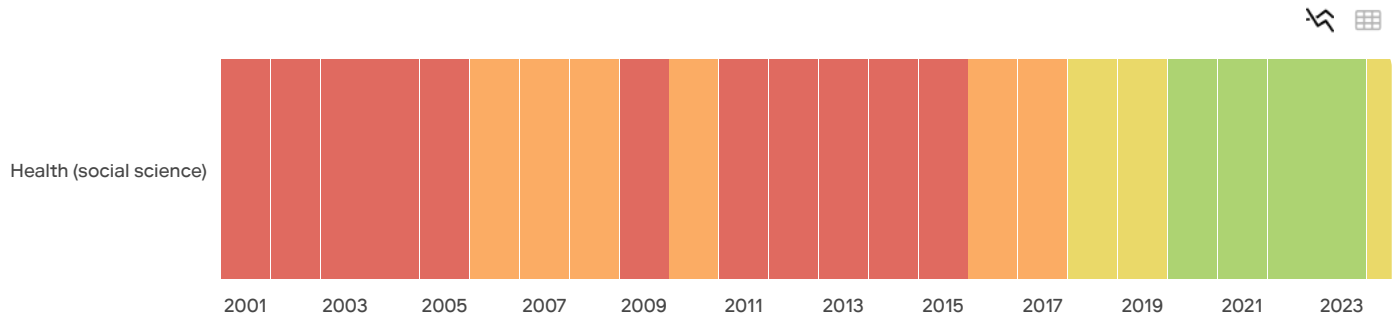

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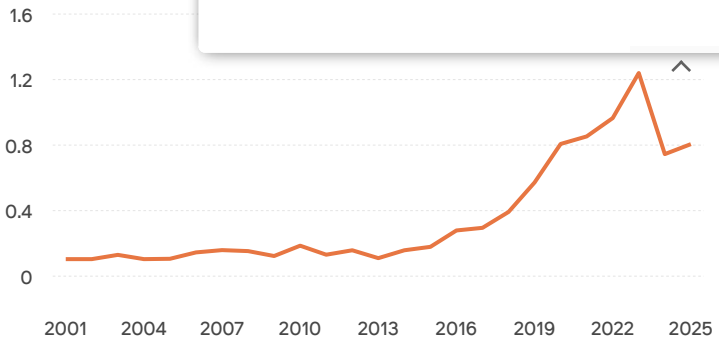

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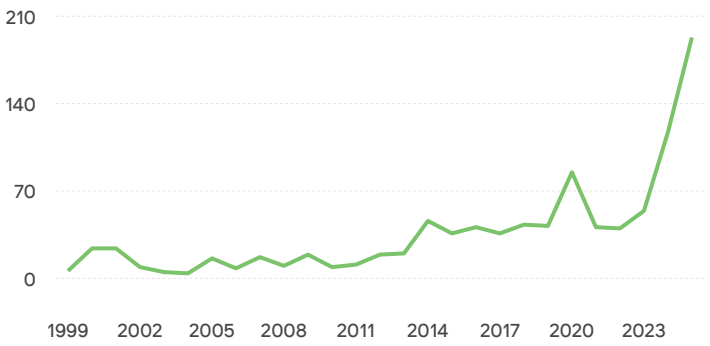

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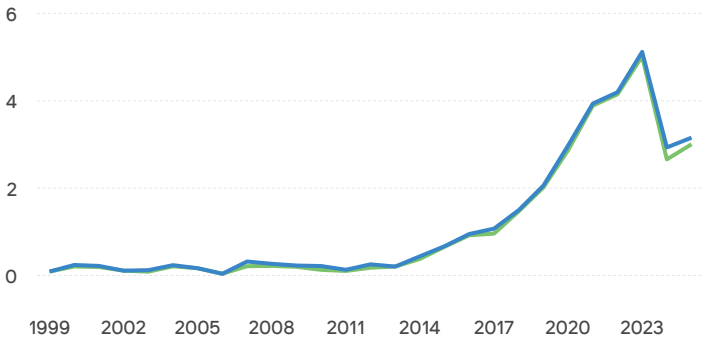

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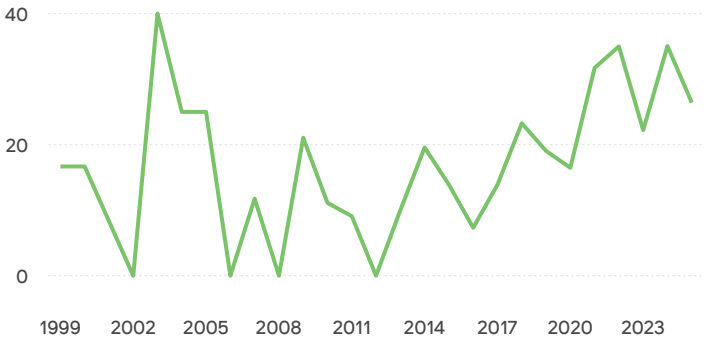

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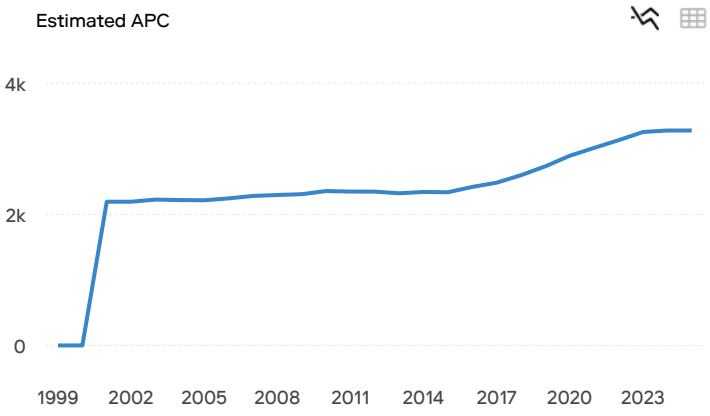

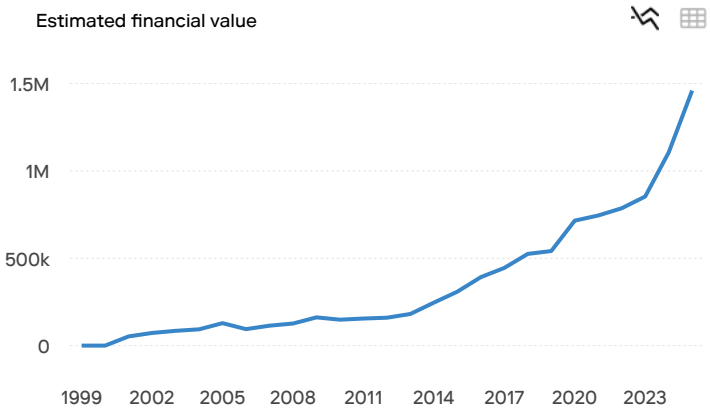

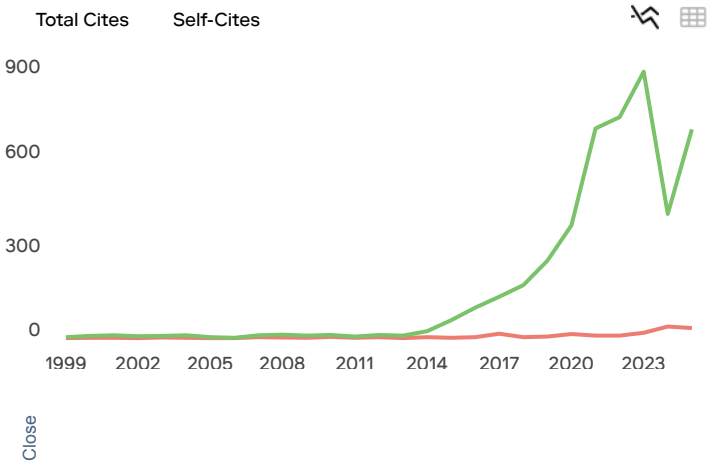

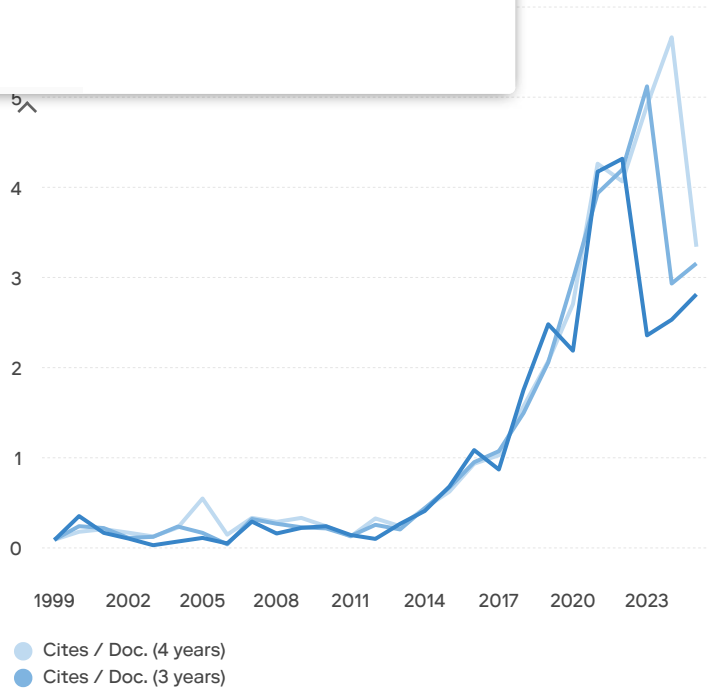

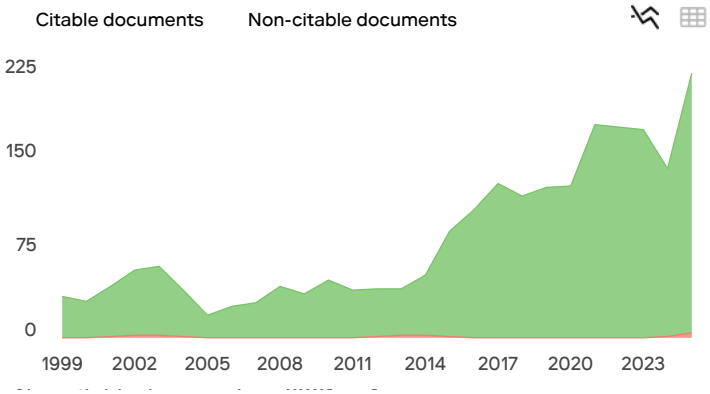

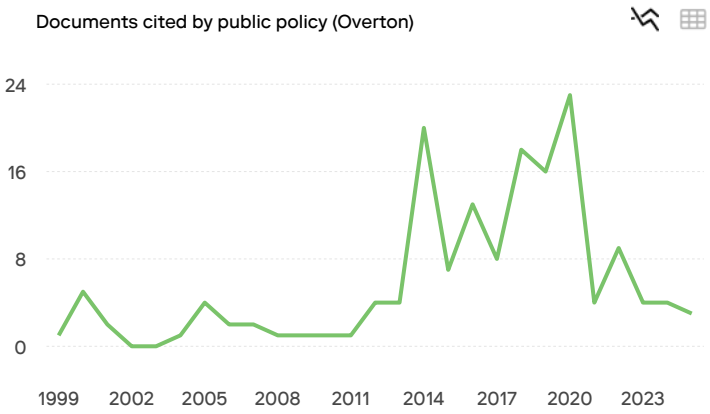

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Research Article

Social connectedness, problematic tiktok use, and adolescent academic motivation: the roles of sleep and mental health

Fransisca Iriani Roesmala Dewi, Bonar Hutapea, Ernawati Ernawati, Bagus Mulyawan & Yohanes Firmansyah

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Abstract

Academic motivation during adolescence is shaped by social, digital, and psychological factors. This cross-sectional study examined an integrated model linking social connectedness, problematic TikTok use, emotional–behavioral difficulties, sleep disturbance, psychological well-being, psychological distress, and academic motivation among 510 Indonesian secondary-school students (M age = 13.57 years, SD = 1.30; 265 males [52.0%], 245 females [48.0%]) from Salatiga and Jakarta. Data

with fewer emotional–behavioral difficulties and sleep problems, greater psychological well-being, higher autonomous motivation, and lower amotivation. Problematic TikTok use was associated with increased emotional–behavioral difficulties and sleep disturbance and indirectly related to psychological distress and amotivation. Social connectedness showed indirect associations with greater autonomous motivation and lower amotivation through psychological well-being and emotional–behavioral functioning. No significant differences were observed between school contexts, findings suggest the interconnected roles of social relationships, digital behavior, sleep, and mental health in adolescent academic motivation.

Keywords:

Academic motivation adolescence problematic TikTok use social connectedness

sleep disturbance mental health

Introduction

Academic motivation is central to adolescent learning because this developmental period involves the formation of academic identity, educational expectations, and future goal orientations. From a self-determination theory perspective, academic motivation varies in quality, ranging from autonomous motivation, in which students engage in learning because it is personally meaningful or valued, to controlled motivation and amotivation, in which learning is driven by pressure or lacks clear purpose (Ryan & Deci, 2020). A meta-analysis of student motivation further shows that need-supportive social contexts are consistently linked with more self-determined forms of motivation (Bureau et al., 2022). Among the basic psychological needs proposed by self-determination theory, relatedness is especially relevant during adolescence because school motivation develops within everyday relationships with peers, teachers, and family members. Social connectedness, defined as a perceived sense of belonging, acceptance, and interpersonal closeness,

may therefore operate as a protective social resource that supports well-being and adaptive academic motivation (Allen et al., 2021; Wu et al., 2022).

Adolescents' motivational development now occurs within social environments that are also digitally saturated. Digital media are embedded in adolescents' communication, entertainment, and learning routines, but their implications for well-being and functioning are complex. Large-scale and review evidence suggests that broad digital technology use is often only weakly associated with adolescent well-being, highlighting the need to examine more specific patterns of use rather than screen time alone (Odgers & Jensen, 2020; Orben & Przybylski, 2019; Valkenburg et al., 2022). Short-form video platforms such as TikTok may be particularly relevant because they provide rapid, personalised, and emotionally salient content that can encourage habitual or poorly regulated use. In the present study, problematic TikTok use is conceptualised as a digital risk factor rather than as a clinical diagnosis. Its relevance to academic motivation lies not only in potential displacement of study time but also in its links with self-regulatory strain, sleep disturbance, and emotional difficulties (Jain et al., 2025; Montag et al., 2021; Yu et al., 2024).

Sleep disturbance provides one plausible regulatory pathway linking adolescents' social and digital experiences with motivational functioning. Adequate sleep supports attention, memory consolidation, executive functioning, and emotion regulation, all of which are relevant for sustained academic engagement (Tarokh et al., 2016). Experimental and longitudinal evidence also indicates that sleep restriction can worsen mood and emotion regulation in adolescents, while electronic device and social media use are commonly associated with poorer sleep outcomes (Baum et al., 2014; Dibben et al., 2023). Problematic social media use may interfere with sleep through delayed bedtime, prolonged nighttime engagement, emotional arousal, and difficulty disengaging from online content. Conversely, social connectedness may support emotional security and self-regulation, which may reduce vulnerability to sleep-related difficulties. In this framework, sleep disturbance is not only a health-related outcome but also a potential statistical pathway through which social and digital factors are linked with academic motivation.

Emotional–behavioural difficulties and mental health provide a second regulatory pathway. Adolescents experiencing emotional symptoms, behavioural difficulties, or peer problems may have fewer psychological resources for persistence, attention, and goal-directed academic behaviour. Psychological well-being may support autonomous motivation by strengthening energy, confidence, and meaningful engagement, whereas psychological distress may undermine motivation by increasing emotional burden and reducing self-regulatory capacity. Previous research has linked social connectedness with more favourable psychological and educational outcomes, while problematic social media use has been associated with sleep problems and symptoms of depression, anxiety, and stress (Allen et al., 2021; Dibben et al., 2023; Jain et al., 2025; Wu et al., 2022; Yu et al., 2024). Taken together, these findings suggest that emotional–behavioural functioning, sleep, well-being, and distress can be understood as interconnected indicators of regulatory functioning through which social connectedness and problematic TikTok use may relate to academic motivation (Durlak et al., 2011; Eccles & Roeser, 2011; Ryan & Deci, 2020; Tarokh et al., 2016).

Although previous studies have examined social connectedness, social media use, sleep, and mental health in relation to adolescent academic outcomes, these domains are often studied separately. This limits understanding of how protective social resources and digital risk factors operate simultaneously within the same motivational framework. Existing evidence on social media and academic engagement also suggests that sleep-related and psychological pathways may help explain links between problematic social media use and academic functioning, but these pathways have rarely been examined alongside social connectedness and distinct motivation outcomes (Zhuang et al., 2023). In addition, most studies focus on academic performance or engagement rather than distinguishing autonomous motivation, controlled motivation, and amotivation.

School context may also shape these associations. Adolescents in different school settings may vary in social climate, digital exposure, academic expectations, and available support systems. From an ecological perspective, students' sense of belonging and school functioning develop within layered social environments rather than through individual factors alone (El Zaatari & Maalouf, 2022). However, when

interpreted as school-context differences rather than as population-level rural–urban differences. Examining whether the same structural associations appear across two Indonesian school contexts can provide preliminary evidence about the consistency or context-specificity of the proposed model.

While previous research has established the independent roles of social connectedness and digital media use, examining them in isolation limits our understanding of how protective and risk factors operate simultaneously. The present study extends Self-Determination Theory (SDT) by proposing an integrated regulatory framework. Rather than merely confirming established bivariate relationships, this model theorises that digital risk (problematic TikTok use) and social resources (connectedness) do not influence academic motivation in a vacuum; instead, their effects are channelled through specific regulatory pathways—namely, sleep and emotional–behavioural functioning—which differentially impact distinct motivational outcomes (autonomous motivation vs. amotivation). Sleep disturbance and mental health were selected as the principal regulatory mechanisms for strong conceptual reasons. From a biopsychosocial perspective, adequate sleep and emotional stability are foundational prerequisites for the cognitive and affective resources required for self-determined learning. Problematic TikTok use is theorised to deplete these regulatory resources by displacing sleep and inducing emotional arousal, while social connectedness buffers against such depletion. Therefore, sleep and mental health are not merely health outcomes in this model, but the critical psychological bridges that translate social and digital experiences into academic motivational states.

Based on this integrated framework, the present study tested the following hypotheses: (H1) Social connectedness will be positively associated with autonomous motivation and negatively with amotivation, both directly and indirectly through psychological well-being and emotional–behavioural difficulties. (H2) Problematic TikTok use will be positively associated with sleep disturbance and emotional–behavioural difficulties, and indirectly associated with amotivation through these regulatory pathways, but will not have a direct association with autonomous motivation. (H3) Psychological distress will be positively predicted by sleep

disturbance and emotional–behavioural difficulties, but will not directly predict academic motivation when well-being is accounted for.

Materials and methods

Study design and setting

This cross-sectional analytical study examined associations among social connectedness, problematic TikTok use, emotional–behavioural difficulties, sleep disturbance, psychological well-being, psychological distress, and academic motivation among Indonesian adolescents. Data were collected between August and September 2025 from two secondary-school settings: one public secondary school in Salatiga, Central Java, and one secondary school in Jakarta. In the Indonesian academic calendar, this period corresponds to the first two months of the odd semester (school months), a time when students are adjusting to new academic workloads, which may inherently influence stress and motivation levels. This contextual timing is acknowledged in the limitations. Because each location was represented by one participating school, comparisons were framed as school-context comparisons rather than population-level rural–urban comparisons.

Participants and recruitment

Participants were junior and senior secondary-school students aged 11–18 years who were enroled at one of the participating schools, able to complete the questionnaires independently, and willing to participate with parental or guardian consent and adolescent assent. Students were excluded if a severe neurodevelopmental or psychiatric condition prevented independent questionnaire completion, if they were absent during data collection, or if their questionnaire responses were substantially incomplete. An a priori power analysis using G*Power 3.1 (Faul et al., 2009) for a multiple regression model with 7 predictors and an expected medium effect size (f^2 = 0.15) at α = .05 and power = .95 indicated a minimum required sample size of 107. However, to ensure stable parameter estimates for the complex path model and

was set based on recommendations for composite path modelling (Kline, 2015). Participants were recruited using purposive school-based sampling. The final analytical sample comprised 510 adolescents, including 204 students from the Salatiga school and 306 students from the Jakarta school. The non-probability sampling design was considered when interpreting generalisability.

Data-collection procedures

Data collection was coordinated with school administrators and classroom teachers after ethical and institutional approval had been obtained. Participants received standardised information about the study aims, voluntary participation, confidentiality, and their right to withdraw without penalty. Questionnaires were completed anonymously in classrooms under researcher supervision. Researchers clarified procedural questions when necessary but did not interpret questionnaire content or suggest responses. Completed questionnaires were checked for completeness before data entry.

Measures

Social connectedness

Social connectedness was assessed using the 20-item Indonesian adaptation of the Social Connectedness Scale–Revised (Lee & Robbins, 1995; Widyaningrum & Subandi, 2019). Items were rated on a 5-point Likert scale. Negatively worded items were reverse-scored before summation, with higher total scores indicating stronger perceived belonging, interpersonal closeness, and social connection.

Problematic tiktok use

Problematic TikTok use was assessed using the 20-item TikTok Addiction Scale (Wang et al., 2022). The scale covers salience, mood modification, tolerance, withdrawal, conflict, and relapse. Items were rated on a 5-point response scale, with higher scores indicating more pronounced problematic-use characteristics. The term problematic

TikTok use was used because the scale assessed behavioural tendencies rather than a clinically established addictive disorder.

Emotional–behavioural difficulties

Emotional–behavioural functioning was assessed using the 25-item Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997). The measure includes emotional symptoms, conduct problems, hyperactivity–inattention, peer problems, and prosocial behaviour. The four difficulties subscales were summed to form the Total Difficulties score used in the principal path model, with higher scores indicating greater emotional–behavioural difficulties. Prosocial behaviour was retained as a separate descriptive measure and was not included in the Total Difficulties score.

Sleep disturbance

Sleep disturbance was assessed using the 26-item Sleep Disturbance Scale for Children (SDSC; Bruni et al., 1996). The scale assesses difficulties initiating and maintaining sleep, sleep-breathing problems, arousal disorders, sleep–wake transition problems, excessive somnolence, and sleep hyperhidrosis. Items were rated on a 5-point response scale, with higher total scores indicating more severe sleep disturbance.

Psychological well-being

Psychological well-being was assessed using the five-item WHO-5 Well-Being Index (Topp et al., 2013). Items were scored so that higher scores represented better subjective well-being.

Psychological distress

Psychological distress was assessed using the 21-item Depression Anxiety Stress Scales for Youth (DASS-Y; Szabo, 2010). Items were coded from 0 to 3. A total psychological-distress score was used in the principal path model. Depression, anxiety, and stress subscale scores were retained for supplementary analyses. Higher scores indicated greater psychological distress.

Academic motivation

Academic motivation was assessed using the 28-item Academic Motivation Scale for High School (AMS; Vallerand et al., 1992). The scale distinguishes intrinsic motivation to know, intrinsic motivation toward accomplishment, intrinsic motivation to experience stimulation, identified regulation, introjected regulation, external regulation, and amotivation. Three scores were derived in line with self-determination theory. Autonomous motivation comprised the three intrinsic-motivation dimensions and identified regulation. Controlled motivation comprised introjected and external regulation. Amotivation was retained as a separate motivational outcome and was not reverse-scored or combined with adaptive motivation. Autonomous motivation was the principal academic outcome, amotivation was the secondary outcome, and controlled motivation was examined as a supplementary outcome.

Data preparation and quality screening

Analyses were conducted in Python using Google Colab. Raw item-level data were used to reconstruct scale and subscale scores according to the scoring procedures for each instrument. Data were checked for missing values, duplicate records, duplicate participant identifiers, impossible response values, and scores outside each instrument's theoretical range. Score direction was standardised before analysis so that higher scores represented stronger social connectedness, more problematic TikTok use, greater emotional–behavioural difficulties, more severe sleep disturbance, better psychological well-being, greater psychological distress, stronger autonomous motivation, stronger controlled motivation, or greater amotivation. The dataset contained no missing item-level responses; therefore, no imputation or listwise deletion was necessary.

Psychometric evaluation

Internal consistency was evaluated using Cronbach's alpha and standardised alpha for each principal scale and theoretically defined subscale. Multidimensional instruments were interpreted according to their established scoring structures rather than as single reflective factors. Items were not removed solely to improve statistical

Average Variance Extracted (AVE), and Heterotrait-Monotrait (HTMT) ratios, are reported in Supplementary Tables S1, S2, and S4.

Composite path analysis

The hypothesised associations were evaluated using regression-based composite path analysis. Scale and subscale composite scores were standardised before estimation. Each endogenous variable was estimated using ordinary least-squares regression with prespecified upstream variables. Emotional–behavioural difficulties and sleep disturbance were regressed on social connectedness and problematic TikTok use. Psychological well-being was regressed on social connectedness, emotional–behavioural difficulties, and sleep disturbance. Psychological distress was regressed on social connectedness, problematic TikTok use, emotional–behavioural difficulties, and sleep disturbance. Autonomous motivation was regressed on social connectedness, emotional–behavioural difficulties, sleep disturbance, psychological well-being, and psychological distress. Amotivation was regressed on social connectedness, problematic TikTok use, emotional–behavioural difficulties, sleep disturbance, psychological well-being, and psychological distress. The analysis used observed composite scores and standardised regression equations rather than latent-variable PLS estimation; therefore, it is referred to as composite path analysis.

While Structural Equation Modelling (SEM) with latent variables is often used for multi-item instruments, composite path analysis was selected for this study for two primary reasons. First, the sample size ($N = 510$), while adequate for observed-variable path analysis, is relatively modest for latent variable SEM involving highly multidimensional constructs with many items (e.g. SDQ, DASS-Y), which can lead to convergence issues and improper solutions. Second, using validated composite scores aligns the analysis directly with the established scoring protocols of the instruments, providing robust and interpretable estimates of the structural relationships among the theoretical constructs without the noise of item-level measurement error (Hair et al., 2019).

Structural-model evaluation

For each structural association, standardised regression coefficients, standard errors, two-sided *p* values, bootstrap standard errors, and percentile-based 95% bootstrap confidence intervals were calculated. Bootstrap estimates were based on 5,000 resamples. Model performance was evaluated using R^2 and adjusted R^2 for each endogenous equation. Predictor contribution was quantified using Cohen's f^2, calculated from the change in R^2 after removing the predictor from the corresponding equation. Predictor collinearity was assessed using variance inflation factors. Predictive relevance was examined using 10-fold cross-validation and a Q^2-type statistic comparing cross-validated prediction error with prediction based on the outcome mean.

Indirect associations

Specific indirect associations were evaluated using nonparametric bootstrapping with 5,000 resamples. Indirect coefficients were calculated as products of standardised coefficients along prespecified pathways connecting social connectedness and problematic TikTok use with psychological distress, psychological well-being, autonomous motivation, and amotivation through emotional–behavioural difficulties and sleep disturbance. An indirect association was considered statistically supported when its 95% bootstrap confidence interval did not include zero. Because all variables were measured at one time point, indirect associations were interpreted as cross-sectional statistical pathways rather than temporal or causal mediation.

School-context variation

School-context variation in structural associations was examined using pooled interaction models. For each endogenous equation, school context was entered with the corresponding predictors and predictor-by-context interaction terms. Continuous predictors and outcomes were standardised before estimation. Interaction coefficients represented differences in conditional slopes between the Jakarta and Salatiga school samples. Robust HC3 standard errors and 95% confidence intervals were used for inference. Because 22 interaction terms were examined, Benjamini–Hochberg false-discovery-rate correction was applied.

Potential common-method influence was evaluated using an unrotated single-component diagnostic and full-collinearity variance inflation factors. These analyses were treated as supplementary diagnostics alongside procedural safeguards used during anonymous questionnaire administration.

Sensitivity analyses

The principal composite path model was re-estimated with age and gender included as covariates. Controlled motivation was examined as a supplementary academic outcome. Depression, anxiety, and stress were examined separately as supplementary psychological-distress outcomes. The absence of socioeconomic status, parental education, academic achievement, family structure, school climate, parental monitoring, and objective digital-access indicators was considered when interpreting possible residual confounding.

Statistical interpretation

All statistical tests were two-sided. Findings were interpreted using the magnitude, direction, precision, and consistency of estimates rather than *p* values alone. The terms associated with, linked to, statistical pathway, and indirect association were used to reflect the cross-sectional design.

Ethical considerations

The study was conducted in accordance with the Declaration of Helsinki. Ethical approval was obtained from the Universitas Tarumanagara Health Research Ethics Committee (No. 014-UTHREC/UNTAR/VII/2025). Written informed consent was obtained from parents or legal guardians, and participating adolescents provided assent before data collection. Participation was voluntary, and all responses were collected and analysed anonymously.

Results

The analytical sample included 510 adolescents, with 204 students from the Salatiga school and 306 students from the Jakarta school. No item-level responses were missing, and all composite scores were within their theoretical ranges. Internal consistency was acceptable to excellent across the principal measures: social connectedness (α = .859), problematic TikTok use (α = .929), emotional–behavioural difficulties (α = .720), sleep disturbance (α = .803), psychological well-being (α = .773), psychological distress (α = .917), autonomous motivation (α = .912), controlled motivation (α = .834), and amotivation (α = .750). Additional psychometric diagnostics are provided in Supplementary Table S1, and SDQ subscale reliabilities are reported in Supplementary Table S2.

Participant characteristics and school-context comparisons

The analytical sample comprised 510 adolescents (265 males [52.0%] and 245 females [48.0%]), with a mean age of 13.57 years (SD = 1.30, range = 11–18). Participant characteristics and school-context comparisons are presented in Table 1. The Jakarta sample was slightly older than the Salatiga sample (t = −2.39, p = .017, d = −0.18). Students in the Salatiga sample reported higher social connectedness (t = 6.54, p < .001, d = 0.57), psychological well-being (t = 5.55, p < .001, d = 0.52), autonomous motivation (t = 7.83, p < .001, d = 0.71), and controlled motivation (t = 6.79, p < .001, d = 0.60). Students in the Jakarta sample reported higher emotional–behavioural difficulties (t = −4.10, p < .001, d = −0.36), psychological distress (t = −3.88, p < .001, d = −0.34), and amotivation (t = −4.70, p < .001, d = −0.40). Problematic TikTok use (t = 1.89, p = .059, d = 0.17), prosocial behaviour (t = 1.93, p = .055, d = 0.17), and sleep disturbance (t = 1.13, p = .259, d = 0.10) did not differ significantly between the two samples. Median-based sensitivity analyses produced the same overall pattern, except for age (Supplementary Table S3).

Table 1. Participant characteristics and school-context comparisons.

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Descriptive statistics, reliability estimates, and zero-order correlations are shown in Table 2. Social connectedness was associated with higher psychological well-being, higher autonomous and controlled motivation, lower emotional–behavioural difficulties, lower sleep disturbance, lower psychological distress, and lower amotivation. Problematic TikTok use was associated with higher emotional–behavioural difficulties, sleep disturbance, psychological distress, controlled motivation, and amotivation. Emotional–behavioural difficulties and sleep disturbance were both associated with psychological distress. Supplementary discriminant-validity diagnostics are reported in Supplementary Table S4.

Table 2. Descriptive statistics, reliability, and correlations among principal study variables.

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Full-sample composite path model

Direct associations from the full-sample composite path model are shown in Table 3. Social connectedness was negatively associated with emotional–behavioural difficulties ($\beta = -.507$, SE = .038, 95% CI [−.578, −.428], $p < .001$) and sleep disturbance ($\beta = -.267$, SE = .041, 95% CI [−.347, −.185], $p < .001$). Problematic TikTok use was positively associated with both outcomes ($\beta = .215$, SE = .038, 95% CI [.137, .288], $p < .001$; $\beta = .342$, SE = .041, 95% CI [.261, .420], $p < .001$, respectively).

Table 3. Full-sample composite path model.

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Psychological well-being was positively associated with social connectedness ($\beta = .401$, SE = .042, 95% CI [.316, .480], $p < .001$) and negatively associated with sleep disturbance ($\beta = -.126$, SE = .044, 95% CI [−.222, −.040], $p = .003$). Psychological distress

[−.306, −.170], $p < .001$) and positively associated with emotional–behavioural difficulties ($\beta = .355$, SE = .040, 95% CI [.278, .433], $p < .001$) and sleep disturbance ($\beta = .342$, SE = .042, 95% CI [.260, .424], $p < .001$).

Autonomous motivation was positively associated with social connectedness ($\beta = .252$, SE = .053, 95% CI [.150, .359], $p < .001$) and psychological well-being ($\beta = .224$, SE = .054, 95% CI [.115, .328], $p < .001$). Amotivation was negatively associated with social connectedness ($\beta = -.188$, SE = .051, 95% CI [−.290, −.087], $p < .001$) and psychological well-being ($\beta = -.104$, SE = .047, 95% CI [−.194, −.013], $p = .024$), and positively associated with emotional–behavioural difficulties ($\beta = .181$, SE = .059, 95% CI [.065, .294], $p = .004$).

The model explained 30.1% of the variance in emotional–behavioural difficulties, 18.7% in sleep disturbance, 26.1% in psychological well-being, 54.9% in psychological distress, 14.4% in autonomous motivation, and 21.6% in amotivation. Cross-validated Q^2 values were positive for all endogenous variables, and VIF values were below 2.5. Regarding practical significance, the effect sizes (Cohen's f^2) for the primary predictors ranged from small to large. Social connectedness demonstrated a large effect on emotional–behavioural difficulties ($f^2 = .367$) and medium effects on psychological well-being ($f^2 = .161$) and distress ($f^2 = .093$). Problematic TikTok use showed a medium effect on sleep disturbance ($f^2 = .144$). The relatively modest explained variance for autonomous motivation (14.4%) and amotivation (21.6%) indicates that while social and digital factors are statistically significant correlates, adolescent academic motivation is highly complex and remains substantially influenced by other unmeasured determinants, such as classroom climate, teacher support, and individual achievement goals.

Indirect associations

Bootstrapped indirect associations are presented in Table 4. Problematic TikTok use was indirectly associated with psychological distress through sleep disturbance (Indirect $\beta = .117$, SE = .022, 95% CI [.078, .163], $p < .001$) and emotional–behavioural difficulties (Indirect $\beta = .076$, SE = .017, 95% CI [.045, .111], $p < .001$). Problematic TikTok

use was also indirectly associated with amotivation through emotional–behavioural difficulties (Indirect $\beta = .039$, SE = .014, 95% CI [.013, .068], $p = .004$).

Table 4. Bootstrapped indirect associations.

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Social connectedness was indirectly associated with autonomous motivation through psychological well-being (Indirect $\beta = .090$, SE = .024, 95% CI [.045, .138], $p < .001$) and with lower amotivation through emotional–behavioural difficulties (Indirect $\beta = -.092$, SE = .029, 95% CI [−.147, −.033], $p = .004$). Indirect pathways from problematic TikTok use to autonomous motivation were not statistically supported.

Variation across school contexts

Context-interaction results are presented in Table 5. Three interaction terms had nominal p values below .05: problematic TikTok use with sleep disturbance, emotional–behavioural difficulties with psychological well-being, and social connectedness with psychological distress. After Benjamini–Hochberg correction across the 22 prespecified interaction tests, all FDR-adjusted p values were above .05. The pattern of structural associations was therefore broadly similar across the Salatiga and Jakarta school samples. The complete set of context-interaction tests and context-specific path estimates is reported in Supplementary Tables S5 and S6.

Table 5. Nominal context interactions.

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Sensitivity analyses

Age- and gender-adjusted models yielded a similar pattern of results (Supplementary

anxiety, and stress outcomes are reported in Supplementary Table S8. Common-method and collinearity diagnostics are also provided in Supplementary Table S8.

Discussion

This study tested an integrated school-context model linking social connectedness, problematic TikTok use, emotional–behavioural difficulties, sleep disturbance, psychological well-being, psychological distress, and academic motivation among Indonesian adolescents. The findings provide partial support for the proposed regulatory framework. Before discussing the specific implications, it is important to summarise the extent to which the hypotheses were supported. H1 was partially supported: social connectedness was directly associated with higher autonomous motivation and lower amotivation, while only some of the specified indirect pathways were statistically supported. H2 was partially supported: problematic TikTok use was associated with sleep disturbance and emotional–behavioural difficulties and was indirectly associated with amotivation through emotional–behavioural difficulties, but not through sleep disturbance. A direct path from problematic TikTok use to autonomous motivation was not estimated in the present model. H3 was supported: sleep disturbance and emotional–behavioural difficulties were associated with greater psychological distress, whereas psychological distress was not independently associated with autonomous motivation or amotivation in the final model.

Social connectedness as a protective motivational resource

The most consistent finding was the role of social connectedness as a protective psychosocial resource. Adolescents reporting stronger social connectedness tended to report fewer emotional–behavioural difficulties, less sleep disturbance, higher psychological well-being, higher autonomous motivation, and lower amotivation. This pattern is consistent with self-determination theory, which proposes that relatedness is one of the basic psychological needs supporting more self-determined forms of motivation (Ryan & Deci, 2020). It also aligns with meta-analytic evidence showing that need-supportive social environments are associated with stronger autonomous

The findings extend this literature by situating social connectedness within a broader regulatory model. Social connectedness was not only directly associated with autonomous motivation and amotivation but was also indirectly associated with autonomous motivation through psychological well-being and with lower amotivation through emotional–behavioural difficulties. These results suggest that belonging and interpersonal closeness may support academic motivation partly by maintaining psychological resources and reducing emotional–behavioural strain. This interpretation is consistent with work conceptualising belonging as a core developmental resource for well-being, research linking teacher and peer relationships with academic motivation, and meta-analytic evidence connecting school belonging with students' motivational, social-emotional, behavioural, and academic outcomes (Allen et al., 2021; Korpershoek et al., 2020; Wu et al., 2022).

Problematic tiktok use, sleep, and emotional–behavioural difficulties

Problematic TikTok use was positively associated with both sleep disturbance and emotional–behavioural difficulties. These findings support the conceptualisation of problematic TikTok use as a digital risk factor related to adolescents' regulatory functioning, consistent with emerging evidence linking problematic TikTok use with mental health and sleep-related difficulties (Jain et al., 2025; Yu et al., 2024). Rather than implying a clinical diagnosis or a direct causal effect, the results suggest that poorly regulated engagement with short-form video content may co-occur with difficulties in sleep and emotional–behavioural adjustment.

The indirect findings further clarify this pattern. Problematic TikTok use was indirectly associated with psychological distress through both sleep disturbance and emotional–behavioural difficulties. It was also indirectly associated with amotivation through emotional–behavioural difficulties. These pathways are consistent with evidence that adolescent electronic device and social media use are linked with poorer sleep and mental health outcomes (Dibben et al., 2023; Yu et al., 2024). They also align with research suggesting that problematic social media use may be connected to academic engagement through sleep-related and psychological processes (Zhuang et al., 2023).

Importantly, problematic TikTok use was not directly associated with autonomous motivation after emotional–behavioural difficulties, sleep disturbance, well-being, and distress were included in the model. This null direct finding offers a critical theoretical insight: it suggests that problematic TikTok use does not inherently destroy a student's intrinsic desire or value for learning. Rather, its academic relevance lies in its capacity to induce regulatory depletion. By disrupting sleep and exacerbating emotional–behavioural difficulties, problematic TikTok use drains the psychological and physiological resources required to translate autonomous motivation into sustained academic engagement. This aligns with ego-depletion and self-regulatory fatigue models, highlighting that digital risk factors operate through indirect resource-draining pathways rather than direct motivational suppression.

This interpretation is consistent with recent digital-media scholarship emphasising that the implications of adolescent digital media use depend on specific patterns of use and intervening psychosocial processes rather than screen exposure alone (Odgers & Jensen, 2020; Orben & Przybylski, 2019; Valkenburg et al., 2022).

Sleep disturbance and mental health as regulatory pathways

Sleep disturbance emerged as a central correlate of psychological distress. Adolescents with greater sleep disturbance reported higher psychological distress, even after social connectedness, problematic TikTok use, and emotional–behavioural difficulties were included. This finding is consistent with developmental sleep research showing that sleep is closely linked to attention, executive functioning, mood, and emotion regulation during adolescence (Tarokh et al., 2016). Experimental evidence also shows that sleep restriction can worsen adolescents' mood and emotion regulation (Baum et al., 2014).

In the present model, sleep disturbance was also negatively associated with psychological well-being. However, its direct associations with autonomous motivation and amotivation were not statistically supported after well-being, distress, and emotional–behavioural difficulties were considered. This pattern suggests that sleep disturbance may be more closely tied to adolescents' psychological functioning

as part of a broader regulatory system that shapes well-being and distress, which may then relate to academic motivation.

Psychological well-being showed a positive association with autonomous motivation and a negative association with amotivation. These findings are consistent with self-determination theory and basic psychological need theory, which position well-being and need satisfaction as closely connected to more self-determined engagement (Ryan & Deci, 2020; Vansteenkiste et al., 2020). By contrast, psychological distress was strongly explained by social connectedness, emotional–behavioural difficulties, and sleep disturbance, but it was not independently associated with autonomous motivation or amotivation in the final model. This absence of a direct effect is theoretically meaningful. It suggests that in the presence of concurrent emotional–behavioural difficulties and low well-being, general psychological distress (e.g. symptoms of depression or anxiety) may act more as a distal outcome of cumulative strain rather than the most proximal driver of motivational states. Motivation appears to be more directly undermined by active behavioural disengagement and a lack of positive well-being, rather than by the mere presence of distress.

Autonomous motivation and amotivation as distinct outcomes

The findings also support the decision to treat autonomous motivation and amotivation as distinct outcomes rather than combining them into a single motivation score. Autonomous motivation was associated with higher social connectedness and better psychological well-being. Amotivation, in contrast, was associated with lower social connectedness, greater emotional–behavioural difficulties, and lower psychological well-being. This pattern is consistent with self-determination theory and meta-analytic evidence showing that different motivation types have distinct associations with student outcomes (Howard et al., 2021; Ryan & Deci, 2020).

The distinction is substantively important. Social connectedness and well-being were relevant to both adaptive and maladaptive motivational outcomes, whereas emotional–behavioural difficulties were more clearly linked with amotivation than with autonomous motivation. This suggests that promoting autonomous motivation

amotivation may additionally require attention to emotional and behavioural difficulties.

School-context variation

Although several context interactions were nominally significant, none remained statistically significant after Benjamini–Hochberg correction. The overall pattern therefore suggests that the main structural associations were broadly similar across the Salatiga and Jakarta school samples. It is crucial to emphasise that this analysis is strictly exploratory. Because each context was represented by only one school and the sampling design was non-probability based, these findings cannot be generalised as population-level rural–urban differences. Rather, they provide preliminary, context-specific evidence that the proposed regulatory model demonstrates comparable structural patterns across two distinct Indonesian school environments. Detecting robust, generalisable context-specific mechanisms will require broader, multisite sampling designs in future research.

Ecological perspectives emphasise that adolescents' development is shaped by school, family, peer, and community systems (El Zaatari & Maalouf, 2022). However, detecting robust context-specific mechanisms requires broader sampling across multiple schools within each context. The present findings therefore support the value of examining school-context variation while indicating that stronger evidence will require larger and more representative multisite designs.

Strengths and contributions

This study contributes to the adolescent motivation literature in three ways. First, it integrates protective social resources and digital risk factors within a single theoretically guided model. This responds to a limitation in prior research, where social connectedness, social media use, sleep, mental health, and motivation are often examined separately. Second, the study distinguishes autonomous motivation, controlled motivation, and amotivation rather than relying on a single global motivation score. This distinction is important for aligning empirical analysis with self-determination theory. Third, the study uses school-context interaction tests to

examine whether structural associations differed between the two participating school samples, while applying correction for multiple testing.

Limitations

Several limitations should be considered. First, the cross-sectional design prevents conclusions about temporal ordering or causality. The indirect associations reported in this study should therefore be interpreted as statistical pathways rather than evidence of mediation over time, because cross-sectional data do not establish temporal ordering among exposure, intervening variables, and outcomes (Shahar & Shahar, 2013). Reverse or reciprocal pathways are plausible; for example, psychological distress may contribute to poor sleep and problematic digital use, just as sleep and digital use may contribute to distress.

Second, all principal variables were measured using adolescent self-report. Although anonymous administration and standardised procedures were used, shared-method variance, recall bias, and social desirability may have influenced the observed associations. Objective or multi-informant measures of sleep, digital media use, academic functioning, and emotional–behavioural adjustment would strengthen future research, particularly because self-reported social media use can diverge from objective digital trace indicators (Verbeij et al., 2021).

Third, the study did not include several contextual and family-level variables that may confound or modify the observed associations, including socioeconomic status, parental education, academic achievement, family structure, parental monitoring, school climate, and objective digital-access indicators. Fourth, the comparison between Salatiga and Jakarta should be interpreted as a comparison between two school contexts rather than a population-level rural–urban comparison. Additionally, as noted in the methods, data collection occurred during the first two months of the academic semester (August–September 2025), a period of inherent academic adjustment that may have influenced baseline stress and motivation levels. Future studies should include multiple schools within each context and use longitudinal designs to test temporal pathways more rigorously.

The findings suggest that adolescent academic motivation may be supported by interventions that strengthen social connectedness, promote psychological well-being, and address emotional–behavioural difficulties. To translate these findings into practice, schools should move beyond broad recommendations and implement targeted, multi-tiered interventions. First, to strengthen social connectedness, schools can establish structured peer-support initiatives, such as cross-age mentoring programs, and teacher-led belonging activities that foster inclusive classroom climates. Second, addressing problematic TikTok use and sleep disturbance requires integrated digital literacy education that focuses on self-regulation and sleep hygiene, rather than mere screen-time restriction. Structured sleep promotion activities, such as "device-free" evening campaigns in collaboration with parents, can be highly effective. Finally, family-based strategies should be introduced to help parents monitor digital access and model healthy technology use, thereby creating a cohesive support system between the home and school environments.

Conclusion

This study tested an integrated model of adolescent academic motivation across two Indonesian school contexts. Social connectedness emerged as the most consistent protective correlate of psychological functioning and motivation, showing associations with fewer emotional–behavioural difficulties, less sleep disturbance, higher psychological well-being, higher autonomous motivation, and lower amotivation. Problematic TikTok use was linked with sleep disturbance and emotional–behavioural difficulties, which were associated with psychological distress and amotivation. Psychological well-being was positively associated with autonomous motivation and negatively associated with amotivation. Context-interaction tests suggested broadly similar structural associations across the Salatiga and Jakarta school samples after correction for multiple testing.

Overall, the findings support a regulatory framework in which social connectedness and problematic TikTok use are linked with academic motivation through sleep,

this study advances our understanding of adolescent academic motivation by demonstrating that in increasingly digital social environments, motivation is not merely a cognitive choice but a psychosocial and physiological state deeply dependent on regulatory health. These findings underscore the urgent need for educational practices and policies that protect adolescents' sleep and emotional well-being while actively fostering social belonging, ensuring that the digital age supports, rather than depletes, the foundational resources required for lifelong learning. Longitudinal and multisite studies are needed to examine temporal ordering and to determine whether these pathways generalise across broader school and community contexts.

Supplemental material

Supplementary Material

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Disclosure statement

No potential conflict of interest was reported by the author(s).

Supplementary material

Supplemental data for this article can be accessed at https://doi.org/10.1080/02673843.2026.2727980.

Additional information

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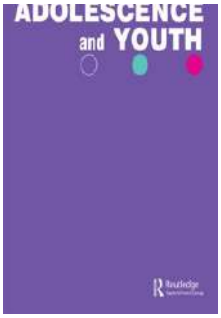

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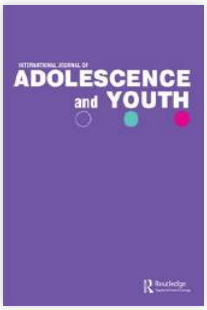

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Social connectedness, problematic tiktok use, and adolescent academic motivation: the roles of sleep and mental health

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ABSTRACT

Academic motivation during adolescence is shaped by social, digital, and psychological factors. This cross-sectional study examined an integrated model linking social connectedness, problematic TikTok use, emotional–behavioral difficulties, sleep disturbance, psychological well-being, psychological distress, and academic motivation among 510 Indonesian secondary-school students (M age = 13.57 years, SD = 1.30; 265 males [52.0%], 245 females [48.0%]) from Salatiga and Jakarta. Data were analyzed using composite path analysis. Social connectedness was associated with fewer emotional–behavioral difficulties and sleep problems, greater psychological well-being, higher autonomous motivation, and lower amotivation. Problematic TikTok use was associated with increased emotional–behavioral difficulties and sleep disturbance and indirectly related to psychological distress and amotivation. Social connectedness showed indirect associations with greater autonomous motivation and lower amotivation through psychological well-being and emotional–behavioral functioning. No significant differences were observed between school contexts, findings suggest the interconnected roles of social relationships, digital behavior, sleep, and mental health in adolescent academic motivation.

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Introduction

Academic motivation is central to adolescent learning because this developmental period involves the formation of academic identity, educational expectations, and future goal orientations. From a self-determination theory perspective, academic motivation varies in quality, ranging from autonomous motivation, in which students engage in learning because it is personally meaningful or valued, to controlled motivation and amotivation, in which learning is driven by pressure or lacks clear purpose (Ryan & Deci, 2020). A meta-analysis of student motivation further shows that need-supportive social contexts are consistently linked with more self-determined forms of motivation (Bureau et al., 2022). Among the basic psychological needs proposed by self-determination theory, relatedness is especially relevant during adolescence because school motivation develops within everyday relationships with peers, teachers, and family members. Social connectedness, defined as a perceived sense of belonging, acceptance, and interpersonal closeness, may therefore operate as a protective social resource that supports well-being and adaptive academic motivation (Allen et al., 2021; Wu et al., 2022).

Adolescents' motivational development now occurs within social environments that are also digitally saturated. Digital media are embedded in adolescents' communication, entertainment, and learning routines, but their implications for well-being and functioning are complex. Large-scale and review evidence suggests that broad digital technology use is often only weakly associated with adolescent well-being, highlighting the need to examine more specific patterns of use rather than screen time alone (Odgers & Jensen, 2020; Orben & Przybylski, 2019; Valkenburg et al., 2022). Short-form video platforms such

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as TikTok may be particularly relevant because they provide rapid, personalised, and emotionally salient content that can encourage habitual or poorly regulated use. In the present study, problematic TikTok use is conceptualised as a digital risk factor rather than as a clinical diagnosis. Its relevance to academic motivation lies not only in potential displacement of study time but also in its links with self-regulatory strain, sleep disturbance, and emotional difficulties (Jain et al., 2025; Montag et al., 2021; Yu et al., 2024).

Sleep disturbance provides one plausible regulatory pathway linking adolescents' social and digital experiences with motivational functioning. Adequate sleep supports attention, memory consolidation, executive functioning, and emotion regulation, all of which are relevant for sustained academic engagement (Tarokh et al., 2016). Experimental and longitudinal evidence also indicates that sleep restriction can worsen mood and emotion regulation in adolescents, while electronic device and social media use are commonly associated with poorer sleep outcomes (Baum et al., 2014; Dibben et al., 2023). Problematic social media use may interfere with sleep through delayed bedtime, prolonged nighttime engagement, emotional arousal, and difficulty disengaging from online content. Conversely, social connectedness may support emotional security and self-regulation, which may reduce vulnerability to sleep-related difficulties. In this framework, sleep disturbance is not only a health-related outcome but also a potential statistical pathway through which social and digital factors are linked with academic motivation.

Emotional–behavioural difficulties and mental health provide a second regulatory pathway. Adolescents experiencing emotional symptoms, behavioural difficulties, or peer problems may have fewer psychological resources for persistence, attention, and goal-directed academic behaviour. Psychological well-being may support autonomous motivation by strengthening energy, confidence, and meaningful engagement, whereas psychological distress may undermine motivation by increasing emotional burden and reducing self-regulatory capacity. Previous research has linked social connectedness with more favourable psychological and educational outcomes, while problematic social media use has been associated with sleep problems and symptoms of depression, anxiety, and stress (Allen et al., 2021; Dibben et al., 2023; Jain et al., 2025; Wu et al., 2022; Yu et al., 2024). Taken together, these findings suggest that emotional–behavioural functioning, sleep, well-being, and distress can be understood as interconnected indicators of regulatory functioning through which social connectedness and problematic TikTok use may relate to academic motivation (Durlak et al., 2011; Eccles & Roeser, 2011; Ryan & Deci, 2020; Tarokh et al., 2016).

Although previous studies have examined social connectedness, social media use, sleep, and mental health in relation to adolescent academic outcomes, these domains are often studied separately. This limits understanding of how protective social resources and digital risk factors operate simultaneously within the same motivational framework. Existing evidence on social media and academic engagement also suggests that sleep-related and psychological pathways may help explain links between problematic social media use and academic functioning, but these pathways have rarely been examined alongside social connectedness and distinct motivation outcomes (Zhuang et al., 2023). In addition, most studies focus on academic performance or engagement rather than distinguishing autonomous motivation, controlled motivation, and amotivation.

School context may also shape these associations. Adolescents in different school settings may vary in social climate, digital exposure, academic expectations, and available support systems. From an ecological perspective, students' sense of belonging and school functioning develop within layered social environments rather than through individual factors alone (El Zaatari & Maalouf, 2022). However, when each setting is represented by a single school, such comparisons should be interpreted as school-context differences rather than as population-level rural–urban differences. Examining whether the same structural associations appear across two Indonesian school contexts can provide preliminary evidence about the consistency or context-specificity of the proposed model.

While previous research has established the independent roles of social connectedness and digital media use, examining them in isolation limits our understanding of how protective and risk factors operate simultaneously. The present study extends Self-Determination Theory (SDT) by proposing an integrated regulatory framework. Rather than merely confirming established bivariate relationships, this model theorises that digital risk (problematic TikTok use) and social resources (connectedness) do not influence academic motivation in a vacuum; instead, their effects are channelled through specific regulatory pathways—namely, sleep and emotional–behavioural functioning—which differentially impact distinct motivational outcomes (autonomous motivation vs. amotivation). Sleep disturbance and mental health

were selected as the principal regulatory mechanisms for strong conceptual reasons. From a biopsychosocial perspective, adequate sleep and emotional stability are foundational prerequisites for the cognitive and affective resources required for self-determined learning. Problematic TikTok use is theorised to deplete these regulatory resources by displacing sleep and inducing emotional arousal, while social connectedness buffers against such depletion. Therefore, sleep and mental health are not merely health outcomes in this model, but the critical psychological bridges that translate social and digital experiences into academic motivational states.

Based on this integrated framework, the present study tested the following hypotheses: (H1) Social connectedness will be positively associated with autonomous motivation and negatively with amotivation, both directly and indirectly through psychological well-being and emotional–behavioural difficulties. (H2) Problematic TikTok use will be positively associated with sleep disturbance and emotional–behavioural difficulties, and indirectly associated with amotivation through these regulatory pathways, but will not have a direct association with autonomous motivation. (H3) Psychological distress will be positively predicted by sleep disturbance and emotional–behavioural difficulties, but will not directly predict academic motivation when well-being is accounted for.

Materials and methods

Study design and setting

This cross-sectional analytical study examined associations among social connectedness, problematic TikTok use, emotional–behavioural difficulties, sleep disturbance, psychological well-being, psychological distress, and academic motivation among Indonesian adolescents. Data were collected between August and September 2025 from two secondary-school settings: one public secondary school in Salatiga, Central Java, and one secondary school in Jakarta. In the Indonesian academic calendar, this period corresponds to the first two months of the odd semester (school months), a time when students are adjusting to new academic workloads, which may inherently influence stress and motivation levels. This contextual timing is acknowledged in the limitations. Because each location was represented by one participating school, comparisons were framed as school-context comparisons rather than population-level rural–urban comparisons.

Participants and recruitment

Participants were junior and senior secondary-school students aged 11–18 years who were enroled at one of the participating schools, able to complete the questionnaires independently, and willing to participate with parental or guardian consent and adolescent assent. Students were excluded if a severe neurodevelopmental or psychiatric condition prevented independent questionnaire completion, if they were absent during data collection, or if their questionnaire responses were substantially incomplete. An a priori power analysis using G*Power 3.1 (Faul et al., 2009) for a multiple regression model with 7 predictors and an expected medium effect size ($f^2 = 0.15$) at $\alpha = .05$ and power = .95 indicated a minimum required sample size of 107. However, to ensure stable parameter estimates for the complex path model and account for potential multivariate non-normality, a target of at least 500 participants was set based on recommendations for composite path modelling (Kline, 2015). Participants were recruited using purposive school-based sampling. The final analytical sample comprised 510 adolescents, including 204 students from the Salatiga school and 306 students from the Jakarta school. The non-probability sampling design was considered when interpreting generalisability.

Data-collection procedures

Data collection was coordinated with school administrators and classroom teachers after ethical and institutional approval had been obtained. Participants received standardised information about the study aims, voluntary participation, confidentiality, and their right to withdraw without penalty. Questionnaires were completed anonymously in classrooms under researcher supervision. Researchers clarified procedural

questions when necessary but did not interpret questionnaire content or suggest responses. Completed questionnaires were checked for completeness before data entry.

Measures

Social connectedness

Social connectedness was assessed using the 20-item Indonesian adaptation of the Social Connectedness Scale–Revised (Lee & Robbins, 1995; Widyaningrum & Subandi, 2019). Items were rated on a 5-point Likert scale. Negatively worded items were reverse-scored before summation, with higher total scores indicating stronger perceived belonging, interpersonal closeness, and social connection.

Problematic tiktok use

Problematic TikTok use was assessed using the 20-item TikTok Addiction Scale (Wang et al., 2022). The scale covers salience, mood modification, tolerance, withdrawal, conflict, and relapse. Items were rated on a 5-point response scale, with higher scores indicating more pronounced problematic-use characteristics. The term problematic TikTok use was used because the scale assessed behavioural tendencies rather than a clinically established addictive disorder.

Emotional–behavioural difficulties

Emotional–behavioural functioning was assessed using the 25-item Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997). The measure includes emotional symptoms, conduct problems, hyperactivity–inattention, peer problems, and prosocial behaviour. The four difficulties subscales were summed to form the Total Difficulties score used in the principal path model, with higher scores indicating greater emotional–behavioural difficulties. Prosocial behaviour was retained as a separate descriptive measure and was not included in the Total Difficulties score.

Sleep disturbance

Sleep disturbance was assessed using the 26-item Sleep Disturbance Scale for Children (SDSC; Bruni et al., 1996). The scale assesses difficulties initiating and maintaining sleep, sleep-breathing problems, arousal disorders, sleep–wake transition problems, excessive somnolence, and sleep hyperhidrosis. Items were rated on a 5-point response scale, with higher total scores indicating more severe sleep disturbance.

Psychological well-being

Psychological well-being was assessed using the five-item WHO-5 Well-Being Index (Topp et al., 2013). Items were scored so that higher scores represented better subjective well-being.

Psychological distress

Psychological distress was assessed using the 21-item Depression Anxiety Stress Scales for Youth (DASS-Y; Szabo, 2010). Items were coded from 0 to 3. A total psychological-distress score was used in the principal path model. Depression, anxiety, and stress subscale scores were retained for supplementary analyses. Higher scores indicated greater psychological distress.

Academic motivation

Academic motivation was assessed using the 28-item Academic Motivation Scale for High School (AMS; Vallerand et al., 1992). The scale distinguishes intrinsic motivation to know, intrinsic motivation toward accomplishment, intrinsic motivation to experience stimulation, identified regulation,

introjected regulation, external regulation, and amotivation. Three scores were derived in line with self-determination theory. Autonomous motivation comprised the three intrinsic-motivation dimensions and identified regulation. Controlled motivation comprised introjected and external regulation. Amotivation was retained as a separate motivational outcome and was not reverse-scored or combined with adaptive motivation. Autonomous motivation was the principal academic outcome, amotivation was the secondary outcome, and controlled motivation was examined as a supplementary outcome.

Data preparation and quality screening

Analyses were conducted in Python using Google Colab. Raw item-level data were used to reconstruct scale and subscale scores according to the scoring procedures for each instrument. Data were checked for missing values, duplicate records, duplicate participant identifiers, impossible response values, and scores outside each instrument's theoretical range. Score direction was standardised before analysis so that higher scores represented stronger social connectedness, more problematic TikTok use, greater emotional–behavioural difficulties, more severe sleep disturbance, better psychological well-being, greater psychological distress, stronger autonomous motivation, stronger controlled motivation, or greater amotivation. The dataset contained no missing item-level responses; therefore, no imputation or listwise deletion was necessary.

Psychometric evaluation

Internal consistency was evaluated using Cronbach's alpha and standardised alpha for each principal scale and theoretically defined subscale. Multidimensional instruments were interpreted according to their established scoring structures rather than as single reflective factors. Items were not removed solely to improve statistical indices. Detailed psychometric diagnostics, including Composite Reliability (CR), Average Variance Extracted (AVE), and Heterotrait-Monotrait (HTMT) ratios, are reported in Supplementary Tables S1, S2, and S4.

Composite path analysis

The hypothesised associations were evaluated using regression-based composite path analysis. Scale and subscale composite scores were standardised before estimation. Each endogenous variable was estimated using ordinary least-squares regression with prespecified upstream variables. Emotional–behavioural difficulties and sleep disturbance were regressed on social connectedness and problematic TikTok use. Psychological well-being was regressed on social connectedness, emotional–behavioural difficulties, and sleep disturbance. Psychological distress was regressed on social connectedness, problematic TikTok use, emotional–behavioural difficulties, and sleep disturbance. Autonomous motivation was regressed on social connectedness, emotional–behavioural difficulties, sleep disturbance, psychological well-being, and psychological distress. Amotivation was regressed on social connectedness, problematic TikTok use, emotional–behavioural difficulties, sleep disturbance, psychological well-being, and psychological distress. The analysis used observed composite scores and standardised regression equations rather than latent-variable PLS estimation; therefore, it is referred to as composite path analysis.

While Structural Equation Modelling (SEM) with latent variables is often used for multi-item instruments, composite path analysis was selected for this study for two primary reasons. First, the sample size ($N = 510$), while adequate for observed-variable path analysis, is relatively modest for latent variable SEM involving highly multidimensional constructs with many items (e.g. SDQ, DASS-Y), which can lead to convergence issues and improper solutions. Second, using validated composite scores aligns the analysis directly with the established scoring protocols of the instruments, providing robust and interpretable estimates of the structural relationships among the theoretical constructs without the noise of item-level measurement error (Hair et al., 2019).

Structural-model evaluation

For each structural association, standardised regression coefficients, standard errors, two-sided *p* values, bootstrap standard errors, and percentile-based 95% bootstrap confidence intervals were calculated. Bootstrap estimates were based on 5,000 resamples. Model performance was evaluated using R^2 and adjusted R^2 for each endogenous equation. Predictor contribution was quantified using Cohen's f^2, calculated from the change in R^2 after removing the predictor from the corresponding equation. Predictor collinearity was assessed using variance inflation factors. Predictive relevance was examined using 10-fold cross-validation and a Q^2-type statistic comparing cross-validated prediction error with prediction based on the outcome mean.

Indirect associations

Specific indirect associations were evaluated using nonparametric bootstrapping with 5,000 resamples. Indirect coefficients were calculated as products of standardised coefficients along prespecified pathways connecting social connectedness and problematic TikTok use with psychological distress, psychological well-being, autonomous motivation, and amotivation through emotional–behavioural difficulties and sleep disturbance. An indirect association was considered statistically supported when its 95% bootstrap confidence interval did not include zero. Because all variables were measured at one time point, indirect associations were interpreted as cross-sectional statistical pathways rather than temporal or causal mediation.

School-context variation

School-context variation in structural associations was examined using pooled interaction models. For each endogenous equation, school context was entered with the corresponding predictors and predictor-by-context interaction terms. Continuous predictors and outcomes were standardised before estimation. Interaction coefficients represented differences in conditional slopes between the Jakarta and Salatiga school samples. Robust HC3 standard errors and 95% confidence intervals were used for inference. Because 22 interaction terms were examined, Benjamini–Hochberg false-discovery-rate correction was applied.

Common-method diagnostics

Potential common-method influence was evaluated using an unrotated single-component diagnostic and full-collinearity variance inflation factors. These analyses were treated as supplementary diagnostics alongside procedural safeguards used during anonymous questionnaire administration.

Sensitivity analyses

The principal composite path model was re-estimated with age and gender included as covariates. Controlled motivation was examined as a supplementary academic outcome. Depression, anxiety, and stress were examined separately as supplementary psychological-distress outcomes. The absence of socioeconomic status, parental education, academic achievement, family structure, school climate, parental monitoring, and objective digital-access indicators was considered when interpreting possible residual confounding.

Statistical interpretation

All statistical tests were two-sided. Findings were interpreted using the magnitude, direction, precision, and consistency of estimates rather than *p* values alone. The terms associated with, linked to, statistical pathway, and indirect association were used to reflect the cross-sectional design.

Ethical considerations

The study was conducted in accordance with the Declaration of Helsinki. Ethical approval was obtained from the Universitas Tarumanagara Health Research Ethics Committee (No. 014-UTHREC/UNTAR/VII/2025). Written informed consent was obtained from parents or legal guardians, and participating adolescents provided assent before data collection. Participation was voluntary, and all responses were collected and analysed anonymously.

Results

Data quality and psychometric properties

The analytical sample included 510 adolescents, with 204 students from the Salatiga school and 306 students from the Jakarta school. No item-level responses were missing, and all composite scores were within their theoretical ranges. Internal consistency was acceptable to excellent across the principal measures: social connectedness ($\alpha = .859$), problematic TikTok use ($\alpha = .929$), emotional–behavioural difficulties ($\alpha = .720$), sleep disturbance ($\alpha = .803$), psychological well-being ($\alpha = .773$), psychological distress ($\alpha = .917$), autonomous motivation ($\alpha = .912$), controlled motivation ($\alpha = .834$), and amotivation ($\alpha = .750$). Additional psychometric diagnostics are provided in Supplementary Table S1, and SDQ subscale reliabilities are reported in Supplementary Table S2.

Participant characteristics and school-context comparisons

The analytical sample comprised 510 adolescents (265 males [52.0%] and 245 females [48.0%]), with a mean age of 13.57 years (SD = 1.30, range = 11–18). Participant characteristics and school-context comparisons are presented in Table 1. The Jakarta sample was slightly older than the Salatiga sample ($t = -2.39$, $p = .017$, $d = -0.18$). Students in the Salatiga sample reported higher social connectedness ($t = 6.54$, $p < .001$, $d = 0.57$), psychological well-being ($t = 5.55$, $p < .001$, $d = 0.52$), autonomous motivation ($t = 7.83$, $p < .001$, $d = 0.71$), and controlled motivation ($t = 6.79$, $p < .001$, $d = 0.60$). Students in the Jakarta sample reported higher emotional–behavioural difficulties ($t = -4.10$, $p < .001$, $d = -0.36$), psychological distress ($t = -3.88$, $p < .001$, $d = -0.34$), and amotivation ($t = -4.70$, $p < .001$, $d = -0.40$). Problematic TikTok use ($t = 1.89$, $p = .059$, $d = 0.17$), prosocial behaviour ($t = 1.93$, $p = .055$, $d = 0.17$), and sleep disturbance ($t = 1.13$, $p = .259$, $d = 0.10$) did not differ significantly between the two samples. Median-based sensitivity analyses produced the same overall pattern, except for age (Supplementary Table S3).

Correlations among principal study variables

Descriptive statistics, reliability estimates, and zero-order correlations are shown in Table 2. Social connectedness was associated with higher psychological well-being, higher autonomous and controlled motivation, lower emotional–behavioural difficulties, lower sleep disturbance, lower psychological distress, and lower amotivation. Problematic TikTok use was associated with higher

Table 1. Participant characteristics and school-context comparisons.

Variable	Total sample M (SD)	Salatiga M (SD)	Jakarta M (SD)	Welch's t	*p*	Cohen's d
Age	13.57 (1.30)	13.43 (0.58)	13.67 (1.61)	−2.39	.017	−0.18
Social connectedness	69.37 (9.26)	72.44 (8.07)	67.33 (9.45)	6.54	<.001	0.57
Problematic TikTok use	40.96 (14.47)	42.46 (14.70)	39.97 (14.25)	1.89	.059	0.17
Emotional–behavioural difficulties	14.30 (4.90)	13.25 (4.52)	15.00 (5.03)	−4.10	<.001	−0.36
Prosocial behaviour	6.95 (1.71)	7.12 (1.69)	6.83 (1.71)	1.93	.055	0.17
Sleep disturbance	52.99 (12.10)	53.74 (12.35)	52.50 (11.92)	1.13	.259	0.10
Psychological well-being	15.35 (5.83)	17.10 (6.14)	14.18 (5.32)	5.55	<.001	0.52
Psychological distress	14.05 (10.22)	11.99 (9.18)	15.42 (10.65)	−3.88	<.001	−0.34
Autonomous motivation	57.25 (9.59)	61.09 (9.02)	54.68 (9.10)	7.83	<.001	0.71
Controlled motivation	29.15 (5.26)	30.97 (4.63)	27.95 (5.32)	6.79	<.001	0.60
Amotivation	8.17 (2.89)	7.49 (2.39)	8.63 (3.09)	−4.70	<.001	−0.40

Note: Positive Cohen's d values indicate higher scores in the Salatiga sample. Higher scores indicate more of the named construct; higher psychological well-being scores indicate better well-being.

Table 2. Descriptive statistics, reliability, and correlations among principal study variables.

Variable	M	SD	α	1	2	3	4	5	6	7	8
1. Social connectedness	69.37	9.26	.859	—							
2. Problematic TikTok use	40.96	14.47	.929	.007	—						
3. Emotional–behavioural difficulties	14.30	4.90	.720	−.505***	.211***	—					
4. Sleep disturbance	52.99	12.10	.803	−.265***	.340***	.465***	—				
5. Psychological well-being	15.35	5.83	.773	.480***	−.037	−.351***	−.282***	—			
6. Psychological distress	14.05	10.22	.917	−.510***	.204***	.638***	.576***	−.449***	—		
7. Autonomous motivation	57.25	9.59	.912	.321***	.039	−.168***	−.028	.302***	−.128**	—	
8. Controlled motivation	29.15	5.26	.834	.225***	.102*	−.093*	.056	.195***	−.004	.734***	—
9. Amotivation	8.17	2.89	.750	−.375***	.118**	.388***	.273***	−.303***	.361***	−.452***	−.318***

Note: $N = 510$. Values are Pearson correlations. $p < .05$. $p < .01$. $p < .001$.

Table 3. Full-sample composite path model.

Outcome	Predictor	β	SE	95% bootstrap CI	*p*	f^2
Emotional–behavioural difficulties	Social connectedness	−.507	.038	[−.578, −.428]	<.001	.367
Emotional–behavioural difficulties	Problematic TikTok use	.215	.038	[.137, .288]	<.001	.066
Sleep disturbance	Social connectedness	−.267	.041	[−.347, −.185]	<.001	.088
Sleep disturbance	Problematic TikTok use	.342	.041	[.261, .420]	<.001	.144
Psychological well-being	Social connectedness	.401	.042	[.316, .480]	<.001	.161
Psychological well-being	Emotional–behavioural difficulties	−.086	.048	[−.180, .006]	.074	.006
Psychological well-being	Sleep disturbance	−.136	.044	[−.222, −.049]	.003	.020
Psychological distress	Social connectedness	−.241	.035	[−.306, −.170]	<.001	.093
Psychological distress	Problematic TikTok use	.015	.035	[−.053, .084]	.681	<.001
Psychological distress	Emotional–behavioural difficulties	.355	.040	[.278, .433]	<.001	.172
Psychological distress	Sleep disturbance	.342	.042	[.260, .424]	<.001	.187
Autonomous motivation	Social connectedness	.252	.053	[.150, .359]	<.001	.046
Autonomous motivation	Emotional–behavioural difficulties	−.056	.056	[−.161, .057]	.323	.002
Autonomous motivation	Sleep disturbance	.074	.055	[−.036, .182]	.176	.004
Autonomous motivation	Psychological well-being	.224	.054	[.115, .328]	<.001	.042
Autonomous motivation	Psychological distress	.094	.067	[−.036, .224]	.164	.005
Amotivation	Social connectedness	−.188	.051	[−.290, −.087]	<.001	.027
Amotivation	Problematic TikTok use	.045	.046	[−.046, .131]	.329	.002
Amotivation	Emotional–behavioural difficulties	.181	.059	[.065, .294]	.004	.022
Amotivation	Sleep disturbance	.061	.059	[−.054, .174]	.315	.003
Amotivation	Psychological well-being	−.104	.047	[−.194, −.013]	.024	.010
Amotivation	Psychological distress	.058	.063	[−.062, .186]	.341	.002
Model summary						
Outcome	**R^2**			**Adjusted R^2**		**Q^2**
Emotional–behavioural difficulties	.301			.299		.291
Sleep disturbance	.187			.184		.179
Psychological well-being	.261			.256		.250
Psychological distress	.549			.546		.536
Autonomous motivation	.144			.135		.115
Amotivation	.216			.206		.185

Note: Coefficients are standardised. Confidence intervals were based on 5,000 bootstrap samples. VIF values ranged from 1.00 to 2.30 and are reported in the supplementary materials.

emotional–behavioural difficulties, sleep disturbance, psychological distress, controlled motivation, and amotivation. Emotional–behavioural difficulties and sleep disturbance were both associated with psychological distress. Supplementary discriminant-validity diagnostics are reported in Supplementary Table S4.

Full-sample composite path model

Direct associations from the full-sample composite path model are shown in Table 3. Social connectedness was negatively associated with emotional–behavioural difficulties ($\beta = -.507$, SE = .038, 95% CI [−.578, −.428], $p < .001$) and sleep disturbance ($\beta = -.267$, SE = .041, 95% CI [−.347, −.185], $p < .001$). Problematic TikTok use was positively associated with both outcomes ($\beta = .215$, SE = .038, 95% CI [.137, .288], $p < .001$; $\beta = .342$, SE = .041, 95% CI [.261, .420], $p < .001$, respectively).

Psychological well-being was positively associated with social connectedness ($\beta = .401$, SE = .042, 95% CI [.316, .480], $p < .001$) and negatively associated with sleep disturbance ($\beta = -.136$, SE = .044, 95% CI [−.222, −.049], $p = .003$). Psychological distress was negatively associated with social connectedness ($\beta = -.241$, SE = .035, 95% CI [−.306, −.170], $p < .001$) and positively associated with emotional–behavioural difficulties

($\beta = .355$, SE = .040, 95% CI [.278, .433], $p < .001$) and sleep disturbance ($\beta = .342$, SE = .042, 95% CI [.260, .424], $p < .001$).

Autonomous motivation was positively associated with social connectedness ($\beta = .252$, SE = .053, 95% CI [.150, .359], $p < .001$) and psychological well-being ($\beta = .224$, SE = .054, 95% CI [.115, .328], $p < .001$). Amotivation was negatively associated with social connectedness ($\beta = -.188$, SE = .051, 95% CI [−.290, −.087], $p < .001$) and psychological well-being ($\beta = -.104$, SE = .047, 95% CI [−.194, −.013], $p = .024$), and positively associated with emotional–behavioural difficulties ($\beta = .181$, SE = .059, 95% CI [.065, .294], $p = .004$).

The model explained 30.1% of the variance in emotional–behavioural difficulties, 18.7% in sleep disturbance, 26.1% in psychological well-being, 54.9% in psychological distress, 14.4% in autonomous motivation, and 21.6% in amotivation. Cross-validated Q^2 values were positive for all endogenous variables, and VIF values were below 2.5. Regarding practical significance, the effect sizes (Cohen's f^2) for the primary predictors ranged from small to large. Social connectedness demonstrated a large effect on emotional–behavioural difficulties ($f^2 = .367$) and medium effects on psychological well-being ($f^2 = .161$) and distress ($f^2 = .093$). Problematic TikTok use showed a medium effect on sleep disturbance ($f^2 = .144$). The relatively modest explained variance for autonomous motivation (14.4%) and amotivation (21.6%) indicates that while social and digital factors are statistically significant correlates, adolescent academic motivation is highly complex and remains substantially influenced by other unmeasured determinants, such as classroom climate, teacher support, and individual achievement goals.

Indirect associations

Bootstrapped indirect associations are presented in Table 4. Problematic TikTok use was indirectly associated with psychological distress through sleep disturbance (Indirect $\beta = .117$, SE = .022, 95% CI [.078, .163], $p < .001$) and emotional–behavioural difficulties (Indirect $\beta = .076$, SE = .017, 95% CI [.045, .111], $p < .001$). Problematic TikTok use was also indirectly associated with amotivation through emotional–behavioural difficulties (Indirect $\beta = .039$, SE = .014, 95% CI [.013, .068], $p = .004$).

Social connectedness was indirectly associated with autonomous motivation through psychological well-being (Indirect $\beta = .090$, SE = .024, 95% CI [.045, .138], $p < .001$) and with lower amotivation through emotional–behavioural difficulties (Indirect $\beta = -.092$, SE = .029, 95% CI [−.147, −.033], $p = .004$). Indirect pathways from problematic TikTok use to autonomous motivation were not statistically supported.

Variation across school contexts

Context-interaction results are presented in Table 5. Three interaction terms had nominal p values below .05: problematic TikTok use with sleep disturbance, emotional–behavioural difficulties with psychological well-being, and social connectedness with psychological distress. After Benjamini–Hochberg correction across the 22 prespecified interaction tests, all FDR-adjusted p values were above .05. The pattern of structural associations was therefore broadly similar across the Salatiga and Jakarta school samples. The

Table 4. Bootstrapped indirect associations.

Indirect pathway	Indirect β	SE	95% bootstrap CI	*p*
Social connectedness → emotional–behavioural difficulties → autonomous motivation	.028	.028	[−.028, .082]	.323
Social connectedness → psychological well-being → autonomous motivation	.090	.024	[.045, .138]	<.001
Social connectedness → emotional–behavioural difficulties → psychological well-being → autonomous motivation	.010	.006	[−.001, .024]	.074
Problematic TikTok use → sleep disturbance → psychological distress	.117	.022	[.078, .163]	<.001
Problematic TikTok use → emotional–behavioural difficulties → psychological distress	.076	.017	[.045, .111]	<.001
Problematic TikTok use → sleep disturbance → psychological distress → autonomous motivation	.011	.008	[−.004, .028]	.164
Problematic TikTok use → emotional–behavioural difficulties → psychological distress → autonomous motivation	.007	.006	[−.003, .019]	.164
Problematic TikTok use → sleep disturbance → amotivation	.021	.021	[−.018, .062]	.315
Problematic TikTok use → emotional–behavioural difficulties → amotivation	.039	.014	[.013, .068]	.004
Social connectedness → emotional–behavioural difficulties → amotivation	−.092	.029	[−.147, −.033]	.004

Note: Indirect associations were estimated as products of standardised path coefficients and should be interpreted as cross-sectional statistical pathways rather than temporal mediation.

Table 5. Nominal context interactions.

Outcome	Predictor	Salatiga slope	Jakarta slope	Difference	95% CI	Raw p	FDR-adjusted p
Sleep disturbance	Problematic TikTok use	.450	.257	−.193	[−.358, −.029]	.022	.262
Psychological well-being	Emotional–behavioural difficulties	−.214	.012	.226	[.030, .421]	.024	.262
Psychological distress	Social connectedness	−.112	−.277	−.165	[−.323, −.007]	.041	.301

Note: Only interactions with raw $p < .05$ are shown. The full set of 22 prespecified interaction tests is reported in the supplementary materials. Difference represents the Jakarta minus Salatiga conditional slope. No interaction remained significant after Benjamini–Hochberg correction.

complete set of context-interaction tests and context-specific path estimates is reported in Supplementary Tables S5 and S6.

Sensitivity analyses

Age- and gender-adjusted models yielded a similar pattern of results (Supplementary Table S7). Supplementary models for controlled motivation and separate depression, anxiety, and stress outcomes are reported in Supplementary Table S8. Common-method and collinearity diagnostics are also provided in Supplementary Table S8.

Discussion

This study tested an integrated school-context model linking social connectedness, problematic TikTok use, emotional–behavioural difficulties, sleep disturbance, psychological well-being, psychological distress, and academic motivation among Indonesian adolescents. The findings provide partial support for the proposed regulatory framework. Before discussing the specific implications, it is important to summarise the extent to which the hypotheses were supported. H1 was partially supported: social connectedness was directly associated with higher autonomous motivation and lower amotivation, while only some of the specified indirect pathways were statistically supported. H2 was partially supported: problematic TikTok use was associated with sleep disturbance and emotional–behavioural difficulties and was indirectly associated with amotivation through emotional–behavioural difficulties, but not through sleep disturbance. A direct path from problematic TikTok use to autonomous motivation was not estimated in the present model. H3 was supported: sleep disturbance and emotional–behavioural difficulties were associated with greater psychological distress, whereas psychological distress was not independently associated with autonomous motivation or amotivation in the final model.

Social connectedness as a protective motivational resource

The most consistent finding was the role of social connectedness as a protective psychosocial resource. Adolescents reporting stronger social connectedness tended to report fewer emotional–behavioural difficulties, less sleep disturbance, higher psychological well-being, higher autonomous motivation, and lower amotivation. This pattern is consistent with self-determination theory, which proposes that relatedness is one of the basic psychological needs supporting more self-determined forms of motivation (Ryan & Deci, 2020). It also aligns with meta-analytic evidence showing that need-supportive social environments are associated with stronger autonomous motivation and lower amotivation among students (Bureau et al., 2022).

The findings extend this literature by situating social connectedness within a broader regulatory model. Social connectedness was not only directly associated with autonomous motivation and amotivation but was also indirectly associated with autonomous motivation through psychological well-being and with lower amotivation through emotional–behavioural difficulties. These results suggest that belonging and interpersonal closeness may support academic motivation partly by maintaining psychological resources and reducing emotional–behavioural strain. This interpretation is consistent with work conceptualising belonging as a core developmental resource for well-being, research linking teacher and peer relationships with academic motivation, and meta-analytic evidence connecting school belonging with students'

motivational, social-emotional, behavioural, and academic outcomes (Allen et al., 2021; Korpershoek et al., 2020; Wu et al., 2022).

Problematic tiktok use, sleep, and emotional–behavioural difficulties

Problematic TikTok use was positively associated with both sleep disturbance and emotional–behavioural difficulties. These findings support the conceptualisation of problematic TikTok use as a digital risk factor related to adolescents' regulatory functioning, consistent with emerging evidence linking problematic TikTok use with mental health and sleep-related difficulties (Jain et al., 2025; Yu et al., 2024). Rather than implying a clinical diagnosis or a direct causal effect, the results suggest that poorly regulated engagement with short-form video content may co-occur with difficulties in sleep and emotional–behavioural adjustment.

The indirect findings further clarify this pattern. Problematic TikTok use was indirectly associated with psychological distress through both sleep disturbance and emotional–behavioural difficulties. It was also indirectly associated with amotivation through emotional–behavioural difficulties. These pathways are consistent with evidence that adolescent electronic device and social media use are linked with poorer sleep and mental health outcomes (Dibben et al., 2023; Yu et al., 2024). They also align with research suggesting that problematic social media use may be connected to academic engagement through sleep-related and psychological processes (Zhuang et al., 2023).

Importantly, problematic TikTok use was not directly associated with autonomous motivation after emotional–behavioural difficulties, sleep disturbance, well-being, and distress were included in the model. This null direct finding offers a critical theoretical insight: it suggests that problematic TikTok use does not inherently destroy a student's intrinsic desire or value for learning. Rather, its academic relevance lies in its capacity to induce regulatory depletion. By disrupting sleep and exacerbating emotional–behavioural difficulties, problematic TikTok use drains the psychological and physiological resources required to translate autonomous motivation into sustained academic engagement. This aligns with ego-depletion and self-regulatory fatigue models, highlighting that digital risk factors operate through indirect resource-draining pathways rather than direct motivational suppression.

This interpretation is consistent with recent digital-media scholarship emphasising that the implications of adolescent digital media use depend on specific patterns of use and intervening psychosocial processes rather than screen exposure alone (Odgers & Jensen, 2020; Orben & Przybylski, 2019; Valkenburg et al., 2022).

Sleep disturbance and mental health as regulatory pathways

Sleep disturbance emerged as a central correlate of psychological distress. Adolescents with greater sleep disturbance reported higher psychological distress, even after social connectedness, problematic TikTok use, and emotional–behavioural difficulties were included. This finding is consistent with developmental sleep research showing that sleep is closely linked to attention, executive functioning, mood, and emotion regulation during adolescence (Tarokh et al., 2016). Experimental evidence also shows that sleep restriction can worsen adolescents' mood and emotion regulation (Baum et al., 2014).

In the present model, sleep disturbance was also negatively associated with psychological well-being. However, its direct associations with autonomous motivation and amotivation were not statistically supported after well-being, distress, and emotional–behavioural difficulties were considered. This pattern suggests that sleep disturbance may be more closely tied to adolescents' psychological functioning than to motivation directly. Within the proposed framework, sleep appears to operate as part of a broader regulatory system that shapes well-being and distress, which may then relate to academic motivation.

Psychological well-being showed a positive association with autonomous motivation and a negative association with amotivation. These findings are consistent with self-determination theory and basic psychological need theory, which position well-being and need satisfaction as closely connected to more self-determined engagement (Ryan & Deci, 2020; Vansteenkiste et al., 2020). By contrast, psychological distress was strongly explained by social connectedness, emotional–behavioural difficulties, and sleep disturbance, but it was not independently associated with autonomous motivation or amotivation in the final model. This

absence of a direct effect is theoretically meaningful. It suggests that in the presence of concurrent emotional–behavioural difficulties and low well-being, general psychological distress (e.g. symptoms of depression or anxiety) may act more as a distal outcome of cumulative strain rather than the most proximal driver of motivational states. Motivation appears to be more directly undermined by active behavioural disengagement and a lack of positive well-being, rather than by the mere presence of distress.

Autonomous motivation and amotivation as distinct outcomes

The findings also support the decision to treat autonomous motivation and amotivation as distinct outcomes rather than combining them into a single motivation score. Autonomous motivation was associated with higher social connectedness and better psychological well-being. Amotivation, in contrast, was associated with lower social connectedness, greater emotional–behavioural difficulties, and lower psychological well-being. This pattern is consistent with self-determination theory and meta-analytic evidence showing that different motivation types have distinct associations with student outcomes (Howard et al., 2021; Ryan & Deci, 2020).

The distinction is substantively important. Social connectedness and well-being were relevant to both adaptive and maladaptive motivational outcomes, whereas emotional–behavioural difficulties were more clearly linked with amotivation than with autonomous motivation. This suggests that promoting autonomous motivation may require strengthening social belonging and well-being, while reducing amotivation may additionally require attention to emotional and behavioural difficulties.

School-context variation

Although several context interactions were nominally significant, none remained statistically significant after Benjamini–Hochberg correction. The overall pattern therefore suggests that the main structural associations were broadly similar across the Salatiga and Jakarta school samples. It is crucial to emphasise that this analysis is strictly exploratory. Because each context was represented by only one school and the sampling design was non-probability based, these findings cannot be generalised as population-level rural–urban differences. Rather, they provide preliminary, context-specific evidence that the proposed regulatory model demonstrates comparable structural patterns across two distinct Indonesian school environments. Detecting robust, generalisable context-specific mechanisms will require broader, multisite sampling designs in future research.

Ecological perspectives emphasise that adolescents' development is shaped by school, family, peer, and community systems (El Zaatari & Maalouf, 2022). However, detecting robust context-specific mechanisms requires broader sampling across multiple schools within each context. The present findings therefore support the value of examining school-context variation while indicating that stronger evidence will require larger and more representative multisite designs.

Strengths and contributions

This study contributes to the adolescent motivation literature in three ways. First, it integrates protective social resources and digital risk factors within a single theoretically guided model. This responds to a limitation in prior research, where social connectedness, social media use, sleep, mental health, and motivation are often examined separately. Second, the study distinguishes autonomous motivation, controlled motivation, and amotivation rather than relying on a single global motivation score. This distinction is important for aligning empirical analysis with self-determination theory. Third, the study uses school-context interaction tests to examine whether structural associations differed between the two participating school samples, while applying correction for multiple testing.

Limitations

Several limitations should be considered. First, the cross-sectional design prevents conclusions about temporal ordering or causality. The indirect associations reported in this study should therefore be interpreted

as statistical pathways rather than evidence of mediation over time, because cross-sectional data do not establish temporal ordering among exposure, intervening variables, and outcomes (Shahar & Shahar, 2013). Reverse or reciprocal pathways are plausible; for example, psychological distress may contribute to poor sleep and problematic digital use, just as sleep and digital use may contribute to distress.

Second, all principal variables were measured using adolescent self-report. Although anonymous administration and standardised procedures were used, shared-method variance, recall bias, and social desirability may have influenced the observed associations. Objective or multi-informant measures of sleep, digital media use, academic functioning, and emotional–behavioural adjustment would strengthen future research, particularly because self-reported social media use can diverge from objective digital trace indicators (Verbeij et al., 2021).

Third, the study did not include several contextual and family-level variables that may confound or modify the observed associations, including socioeconomic status, parental education, academic achievement, family structure, parental monitoring, school climate, and objective digital-access indicators. Fourth, the comparison between Salatiga and Jakarta should be interpreted as a comparison between two school contexts rather than a population-level rural–urban comparison. Additionally, as noted in the methods, data collection occurred during the first two months of the academic semester (August–September 2025), a period of inherent academic adjustment that may have influenced baseline stress and motivation levels. Future studies should include multiple schools within each context and use longitudinal designs to test temporal pathways more rigorously.

Implications

The findings suggest that adolescent academic motivation may be supported by interventions that strengthen social connectedness, promote psychological well-being, and address emotional–behavioural difficulties. To translate these findings into practice, schools should move beyond broad recommendations and implement targeted, multi-tiered interventions. First, to strengthen social connectedness, schools can establish structured peer-support initiatives, such as cross-age mentoring programs, and teacher-led belonging activities that foster inclusive classroom climates. Second, addressing problematic TikTok use and sleep disturbance requires integrated digital literacy education that focuses on self-regulation and sleep hygiene, rather than mere screen-time restriction. Structured sleep promotion activities, such as "device-free" evening campaigns in collaboration with parents, can be highly effective. Finally, family-based strategies should be introduced to help parents monitor digital access and model healthy technology use, thereby creating a cohesive support system between the home and school environments.

Conclusion

This study tested an integrated model of adolescent academic motivation across two Indonesian school contexts. Social connectedness emerged as the most consistent protective correlate of psychological functioning and motivation, showing associations with fewer emotional–behavioural difficulties, less sleep disturbance, higher psychological well-being, higher autonomous motivation, and lower amotivation. Problematic TikTok use was linked with sleep disturbance and emotional–behavioural difficulties, which were associated with psychological distress and amotivation. Psychological well-being was positively associated with autonomous motivation and negatively associated with amotivation. Context-interaction tests suggested broadly similar structural associations across the Salatiga and Jakarta school samples after correction for multiple testing.

Overall, the findings support a regulatory framework in which social connectedness and problematic TikTok use are linked with academic motivation through sleep, emotional–behavioural functioning, and mental health-related pathways. Ultimately, this study advances our understanding of adolescent academic motivation by demonstrating that in increasingly digital social environments, motivation is not merely a cognitive choice but a psychosocial and physiological state deeply dependent on regulatory health. These findings underscore the urgent need for educational practices and policies that protect adolescents' sleep and emotional well-being while actively fostering social belonging, ensuring that the digital age supports, rather than depletes, the foundational resources required for lifelong learning. Longitudinal and multisite

studies are needed to examine temporal ordering and to determine whether these pathways generalise across broader school and community contexts.

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