



AI-assisted reflective writing and psychological well-being: the mediating role of emotion regulation

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Abstract: Guided by a salutogenic framework, this study examined within-group changes in perceived stress, emotion regulation, digital emotional safety and psychological well-being following participation in a 10-week AI-assisted reflective writing program. A single-group quasi-experimental pre–post mixed-methods design was employed with 114 undergraduate students participating. Quantitative data were analysed using structural equation modelling and qualitative data were examined through thematic analysis of weekly reflective journals. Results showed that participants reported lower perceived stress and higher psychological well-being after the programme. Perceived stress was negatively associated with psychological well-being, while digital emotional safety showed a positive association. Emotion regulation, particularly cognitive reappraisal, statistically mediated the association between perceived stress and well-being and partially mediated the association between digital emotional safety and well-being. Qualitative findings revealed enhanced emotional awareness, perceived safety in the AI environment and growth in adaptive coping skills. Given the absence of a control group, the findings should be interpreted as preliminary evidence of psychological changes associated with AI-assisted reflective writing rather than definitive causal evidence. In summary, the study suggests that emotionally safe AI-supported reflective writing may serve as a promising, accessible approach to supporting student mental health promotion in higher education.

Keywords: AI-assisted writing; psychological well-being; emotion regulation; digital emotional safety; academic stress; mental health promotion

Introduction

Mental health issues among college students have become a pressing global concern, with marked increases in perceived stress, anxiety, and emotional fatigue reported across higher education systems (Othman et al., 2019; Pérez-Jorge et al., 2025). These challenges are particularly salient in China, where intense academic competition intersects with sociocultural norms that discourage overt emotional expression (Guo et al., 2024). As a result, many students experience psychological distress privately, with limited access to non-stigmatizing opportunities for emotional processing (Derakhshan & Bai, 2025). This pattern highlights the need for accessible, student-centered approaches to mental health promotion embedded within everyday academic contexts (Bantjes et al., 2022).

Meanwhile, digital technologies have become deeply integrated into students' academic lives, reshaping how they learn, communicate and tackle stress. Artificial intelligence (AI)-assisted writing platforms such as ChatGPT and DeepSeek, initially designed to enhance linguistic accuracy and cognitive performance, are increasingly employed for reflective and expressive purposes (Borger et al., 2023). Unlike traditional interpersonal interactions, these tools provide immediate, private and non-judgmental engagement, allowing students to articulate stressful experiences without fear of negative evaluation. Although not designed as therapeutic systems, emerging evidence suggests that AI-assisted writing environments may offer supportive conditions for self-expression, emotional reflection, and stress-related meaning-making (Yeasmin et al., 2025).

Perceived stress and psychological well-being

Perceived stress refers to the extent to which individuals appraise life demands as unpredictable, uncontrollable, or overwhelming. Among university students, academic demands such as heavy coursework, frequent deadlines, high-stakes assessments, and future uncertainty can place sustained pressure on psychological resources. Academic stress is consistently associated with anxiety, depressive symptoms, sleep disturbances, emotional exhaustion, and reduced psychological well-being (Zhang et al., 2022; Chen et al., 2024).

In the present study, psychological well-being is conceptualized not merely as the absence of distress, but as a positive state involving emotional balance, optimism and effective functioning. From this perspective, perceived stress is important because it may undermine students' capacity to maintain positive mental functioning under academic pressure. Within a salutogenic framework, stress does not inevitably lead to poor well-being; rather, its influence depends on whether students possess sufficient coping resources to understand, manage, and give meaning to stressful experiences. However, when perceived stress becomes persistent and students lack adequate coping resources, it may weaken emotional balance and compromise well-being. Therefore, the first hypothesis is proposed:

H1: *Perceived stress is negatively associated with psychological well-being.*



Digital emotional safety and psychological well-being

Digital emotional safety refers to users' perceived sense of psychological security, privacy, and non-judgmental acceptance when interacting with digital or AI-mediated systems (Minartz et al., 2024). In AI-assisted reflective writing, digital emotional safety is particularly relevant because students are encouraged to express academic stressors, personal concerns, and emotional responses. A digital space perceived as private, respectful, and emotionally non-threatening may reduce fear of judgment and support more open self-disclosure. In the present study, digital emotional safety is conceptualized as a multidimensional experience involving perceived privacy, non-judgment, emotional comfort, and trust in the AI-supported environment. However, because validated measures of digital emotional safety in AI-assisted reflective writing remain limited, the empirical operationalization focuses specifically on the trust-based component of this broader construct. Trust is theoretically relevant because students' willingness to express emotions and engage in reflective processing depends partly on whether they perceive the AI system as benevolent, competent, and reliable. Thus, digital emotional safety is treated as a psychosocial resource, while its measurement is interpreted as a trust-based approximation of that resource. Recent research highlights digital emotional safety as a critical condition for emotional expression in online contexts. For instance, Zong and Yang (2025) report that students who perceive digital environments as emotionally safe are more likely to engage openly in reflective practices, which may support emotional regulation and adaptive stress responses. From a salutogenic perspective, digital emotional safety can be understood as an external psychosocial resource that strengthens students' sense of manageability and emotional security. When students feel that an AI-supported writing environment is safe and trustworthy, they may be more likely to process difficult experiences and sustain psychological well-being. Therefore, the second hypothesis is proposed:

H2: *Digital emotional safety is positively associated with psychological well-being.*

Emotion regulation as a salutogenic coping resource

Emotion regulation represents a central mechanism through which students respond to academic stress. Among different emotion regulation strategies, cognitive reappraisal is widely regarded as adaptive because it enables individuals to reinterpret stressful experiences in ways that reduce their negative emotional impact. For university students, cognitive reappraisal may help transform academic challenges from uncontrollable threats into more manageable learning experiences.

The salutogenic framework provides a clear theoretical basis for positioning emotion regulation as a health-promoting coping resource. Antonovsky's salutogenic theory emphasizes resources that strengthen individuals' sense of coherence, including the perception that life experiences are comprehensible, manageable, and meaningful (Antonovsky, 1979; Mittelmark et al., 2016). Cognitive reappraisal is closely aligned with this logic because it helps students make sense of stressors, identify coping

possibilities, and construct more manageable interpretations of emotional experiences.

Prior studies indicate that students who can regulate emotions adaptively through strategies such as cognitive reappraisal, acceptance, and mindful awareness are better able to manage academic demands and maintain psychological well-being (Doorley & Kashdan, 2021; Brites et al., 2023). However, high perceived stress may impair students' ability to use such adaptive strategies. When students feel overwhelmed, they may find it more difficult to step back from negative experiences, reinterpret stressors, or maintain emotional balance. Reduced emotion regulation may then contribute to lower psychological well-being. Therefore, the third hypothesis is proposed:

H3: *Emotion regulation statistically mediates the association between perceived stress and psychological well-being.*

Digital emotional safety, emotion regulation and psychological well-being

Reflective writing has been widely shown to promote cognitive reappraisal, emotional clarity, and reductions in psychological distress (Artoli et al., 2021; Ellis et al., 2023). When reflective writing is supported by AI-generated responses perceived as neutral or encouraging, its emotional benefits may be enhanced. AI-assisted writing environments offer a combination of privacy, immediacy and emotional neutrality that could promote sustained reflection and emotional engagement.

Digital emotional safety may also support psychological well-being indirectly by facilitating emotion regulation. In a safe AI-assisted reflective writing environment, students may feel more comfortable disclosing emotions, examining stressors, and engaging with prompts that encourage reflection and reappraisal. In this sense, digital emotional safety operates as an external salutogenic condition that enables the use of internal coping resources. While emotion regulation represents an internal psychological resource, digital emotional safety represents an environmental resource that may activate and sustain that resource.

Empirical studies suggest that AI writing tools can reduce cognitive load, alleviate writing-related anxiety, and enhance positive affect during composition (Feng, 2024; Lin & Wang, 2025). However, scholars caution that these benefits depend on reflective engagement rather than passive reliance on AI output (Cardon et al., 2023). When used critically, AI writing tools may function as reflective supports that scaffold emotional processing rather than replace it. Accordingly, AI-assisted writing may be most beneficial when it supports students' active emotional processing rather than simply generating text on their behalf. Therefore, the fourth hypothesis is proposed:

H4: *Emotion regulation statistically mediates the association between digital emotional safety and psychological well-being.*

Salutogenic integration of the conceptual model

Antonovsky's salutogenic theory provides the overarching framework for this study. The salutogenic model conceptualizes mental health as a continuum and emphasizes

resources that support movement toward health rather than focusing only on pathology or distress. In the present model, perceived stress represents a psychological demand that may undermine well-being, whereas digital emotional safety and emotion regulation represent health-promoting resources. Digital emotional safety functions as an external psychosocial resource by providing a secure and non-judgmental context for reflection. Emotion regulation functions as an internal coping resource by helping students reinterpret and manage stressful experiences. Applied to AI-assisted writing, a salutogenic perspective suggests that emotionally safe digital environments may operate as micro-contexts that facilitate meaning-making, emotional regulation, and resilience. Rather than eliminating academic stressors, such environments may enhance students' capacity to manage emotional demands and maintain psychological balance. This theoretical framing clarifies why digital emotional safety and emotion regulation are central to the proposed model and why their relationships with psychological well-being warrant empirical examination.

Goals of the study

Although previous research has examined academic stress, emotion regulation, and the educational use of AI tools, integrated models linking these constructs to student well-being are limited. In particular, little is known about whether perceived digital emotional safety within AI platforms enhances emotion regulation or how these processes jointly influence psychological well-being among university students (Limpanopparat et al., 2024; Volpato et al., 2025).

To address this gap, the present study proposes and tests a conceptual model in which perceived stress and digital emotional safety are associated with psychological well-being through the statistical mediating role of emotion regulation. Grounded in a salutogenic framework and situated within the experiences of Chinese college students, this study examines within-person psychological changes following participation in an AI-assisted reflective writing program, rather than making definitive causal claims about intervention effectiveness. Specifically, the study investigates whether AI-assisted reflective writing may operate as not only a cognitive support tool but also an emotionally supportive digital environment associated with enhanced emotion regulation and psychological resilience. Given the single-group pre-post design, the findings are intended to provide preliminary evidence of psychological change and plausible mechanisms that should be confirmed in future controlled studies. The conceptual model of the study is presented in Figure 1.

Methods

Research design

This study employed a single-group quasi-experimental pre-post mixed-methods design to examine changes in students' perceived stress, digital emotional safety, emotion regulation, and psychological well-being following participation in a 10-week AI-supported reflective writing programme. The intervention was grounded in the salutogenic model, which conceptualizes health promotion as

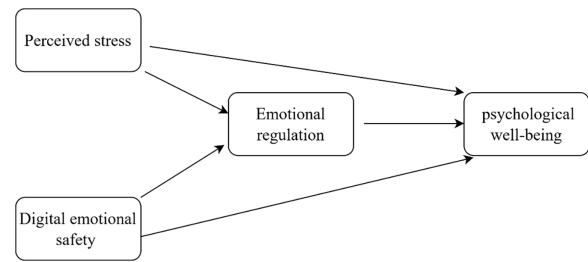


Figure 1. Conceptual framework

the strengthening of adaptive capacities such as emotional coherence and regulation. In designing the program, particular attention was given to digital emotional safety and reflective dialogue, as emerging evidence suggests that supportive digital environments may facilitate emotional expression and reduce writing-related anxiety (Jin, 2023). Data were collected at two time points: baseline and post-intervention. Because the study did not include a randomized control or comparison group, the design was intended to provide preliminary evidence of within-group psychological change and to explore potential mechanisms rather than to establish definitive causal effects. The qualitative component, based on students' weekly reflective journal entries, was used to contextualize the quantitative findings and provide insight into how students experienced the AI-supported writing process.

Participants

Participants were 120 undergraduate students recruited from a comprehensive public college in China through course announcements in a compulsory undergraduate writing course. Eligible participants were full-time undergraduates with prior exposure to AI-assisted writing tools who consented to participate in weekly reflective writing activities. Participation was voluntary, and students were informed that their participation or non-participation would not affect course assessment or academic standing.

Of the initial sample, 114 students completed both pre- and post-intervention surveys and were included in the final quantitative analyses, yielding a retention rate of 95%. Cases with substantial missing data were excluded through listwise deletion. Participants ranged in age from 18 to 23 years ($M = 20.4$, $SD = 1.3$), with 68% identifying as female and represented a broad range of majors across the humanities, social sciences and sciences. No exclusions were made based on academic performance, stress level, or mental health status, which was intended to enhance inclusivity and ecological validity within a natural educational setting.

For the qualitative component, weekly reflective journal entries rather than interviews served as the primary qualitative data source. A purposive subset of entries was selected for thematic analysis to ensure variation in gender, academic background, baseline perceived stress, and patterns of pre-post psychological change. This strategy was intended to include diverse experiences, including positive, hesitant, and limited-engagement reflections.

Procedure

Data collection was conducted over a ten-week academic period within a compulsory undergraduate writing course. The study was approved by the Nanyang Normal University Ethics Committee (NYNU-ERC-2025-120). All participants provided informed consent before participating. They were informed of the study's purpose, confidentiality procedures, and their right to participate voluntarily and withdraw at any time. In Week 1, participants received study information, provided informed consent, and completed baseline measures of perceived stress, digital emotional safety, emotion regulation, and psychological well-being, reflecting their typical academic and emotional experiences at the start of the semester. From Weeks 2 to 10, participants completed weekly AI-supported reflective writing tasks using a generative AI tool, guided by structured prompts on recent academic or emotional experiences and supported by AI-generated emotion-regulation suggestions informed by salutogenic principles. Reflective journal entries constituted the qualitative data and were completed individually through a secure online platform. No separate interviews were conducted. Reflective journals were used because they provided repeated, process-oriented accounts of students' emotional reflection, perceived safety, and coping development during the programme. Instructors did not access, read, grade, or evaluate the reflective content.

In Week 10, participants completed the post-intervention questionnaire using the same measures as at baseline. A purposive subset of reflective entries was then selected to capture variation in gender, academic background, perceived stress levels, and patterns of response to the program. The qualitative findings were integrated with the quantitative results at the interpretation stage, following an explanatory logic: quantitative analyses identified within-group changes and statistical associations, while qualitative analysis contextualized how students experienced emotional safety, reflection, and coping processes during the intervention. All procedures were conducted online, participants were provided with information about campus mental-health services, and the study complied with institutional ethical standards.

Instruments

Perceived stress. Perceived stress was measured using the 10-item Perceived Stress Scale (PSS-10; Cohen et al., 1983). Participants rated stress-related thoughts and feelings over the past month on a five-point scale ranging from 0 = never to 4 = very often. Four positively worded items were reverse-scored, with higher total scores indicating greater perceived stress. The PSS-10 has demonstrated satisfactory reliability and validity across diverse populations (Lee, 2012; Xiao et al., 2023; Milo et al., 2025). In the present study, Cronbach's α was 0.88.

Digital emotional safety. Digital emotional safety refers to students' perceptions of privacy, trust, and emotional comfort when interacting with AI-assisted reflective writing tools. Because no widely established scale specifically measures digital emotional safety in AI-assisted reflective writing contexts, the present study operationalized this construct through a trust-based proxy measure.

In this study, the construct was operationalized using the Trusting Beliefs subscale from the validated Trust in Technology Scale (McKnight et al., 2002), which captures users' perceptions of a system's benevolence, integrity and competence. These dimensions were considered relevant to digital emotional safety because students are more likely to disclose emotions and engage in reflective writing when they perceive the system as reliable, respectful, and non-threatening.

Students rated their agreement with items on a five-point scale (1 = strongly disagree to 5 = strongly agree), with higher scores indicating greater perceived emotional safety. Although the Trusting Beliefs subscale does not capture all affective and relational dimensions of emotional safety, it provides a theoretically relevant indicator of the trust component of digital emotional safety. Therefore, the construct should be interpreted in this study as perceived trust-based digital emotional safety rather than as a comprehensive measure of digital emotional safety. The Trust in Technology Scale has demonstrated strong internal consistency ($\alpha = 0.83\text{--}0.94$) and robust construct validity across digital learning and AI-interaction contexts. In the present study, reliability was high (Cronbach's $\alpha = 0.92$).

Emotion regulation. Emotion regulation was assessed using the cognitive reappraisal subscale of the Emotion Regulation Questionnaire (ERQ; Gross & John, 2003). Participants rated their agreement with items on a seven-point scale ranging from 1 = strongly disagree to 7 = strongly agree. Higher scores indicated greater use of cognitive reappraisal. The subscale has shown acceptable psychometric properties in Chinese samples (Wang et al., 2020). In the present study, Cronbach's α was 0.87.

Psychological well-being. Psychological well-being was measured using the seven-item Short Warwick-Edinburgh Mental Well-Being Scale (SWEMWBS; Stewart-Brown et al., 2009). Participants rated their experiences over the past two weeks on a five-point scale ranging from 1 = none of the time to 5 = all of the time. Higher scores indicated greater psychological well-being. The scale has demonstrated good reliability and construct validity in previous research (Tennant et al., 2007). In the present study, Cronbach's α was 0.89.

Intervention protocol

The intervention consisted of a ten-week AI-supported reflective writing program embedded in a compulsory undergraduate writing course. Students completed one 30–40-min session per week using DeepSeek through a secure online platform. The programme was designed to support emotional processing within a private and emotionally safe digital environment. All participants used the same AI platform, weekly prompts, and interaction guidelines to ensure consistency.

Each session followed a standardized four-stage sequence. First, students responded to a reflective prompt about a recent academic or emotional experience, such as academic stress, emotional reactions, coping challenges, or possible cognitive reappraisal. Second, students interacted with the AI tool, which asked clarifying questions and encouraged elaboration of emotional responses. Third,

Table 1. Weekly AI-supported reflective writing sessions

Session stage	Description	Intended function
Reflective prompt	Students described a recent academic or emotional experience using the same weekly prompt.	Initiates reflection and supports emotional awareness.
Initial reflection	Students wrote their own reflection before using AI feedback.	Ensures active engagement and authentic self-expression.
AI-guided exploration	AI asked clarifying questions and encouraged emotional elaboration.	Promotes reflective depth and perceived emotional safety.
Emotion-regulation guidance	AI suggested general strategies such as reappraisal, acceptance, coping, or action planning.	Strengthens adaptive coping resources.
Reflection closure	Students summarized insights or identified coping intentions.	Consolidates meaning-making and coherence.
Session format	One 30–40-min session per week for ten weeks.	Ensures consistent intervention exposure.

the AI provided general non-clinical emotion-regulation suggestions, such as cognitive reframing, acceptance, problem-focused coping, or action planning. Finally, students completed a brief closure reflection summarizing personal insights or coping intentions.

Students were instructed to write their own reflections before using AI feedback and to treat AI responses as reflective support rather than generated answers. To maintain intervention fidelity, the research team provided a standardized weekly prompt list, written instructions, and a fixed AI role instruction asking the tool to act as a supportive reflective writing assistant. Instructors clarified expectations, emphasized privacy and voluntary engagement, and did not read or grade students' reflective content. Campus mental-health service information was provided throughout the programme. [Table 1](#) presents the structure and intended function of each session.

Data analysis

Quantitative data were analyzed using SPSS and AMOS. Preliminary analyses included data screening, assessment of missing values and normality, and calculation of descriptive statistics, Pearson correlations, and Cronbach's alpha coefficients for all study variables. Missing data were minimal and were handled using listwise deletion. Paired-sample *t*-tests were conducted to compare baseline and post-intervention scores, with Cohen's *d* calculated to estimate the magnitude of within-group change. Because the study employed a single-group pre–post design without a randomized control or comparison group, these analyses were interpreted as evidence of change over time among participants rather than definitive evidence of causal intervention effects.

Structural equation modeling (SEM) was then employed to examine the hypothesized associations among perceived stress, digital emotional safety, cognitive reappraisal, and psychological well-being. Model fit was evaluated using the comparative fit index (CFI), Tucker–Lewis index (TLI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR), according to conventional criteria. Bias-corrected bootstrapping with 5000 resamples was used to estimate indirect effects. Because all quantitative measures were collected through self-report questionnaires from the same participants,

common method bias was considered a potential concern. Although procedural steps were taken to reduce response bias, including voluntary participation, anonymity, and assurance that responses would not affect course assessment, formal statistical tests of common method bias were not conducted. Similarly, the primary SEM model did not include covariate adjustment for demographic variables or baseline outcome levels. Accordingly, the mediation findings were interpreted as evidence of plausible statistical mechanisms rather than causal pathways.

Qualitative reflective journal data were analyzed using thematic analysis. This involved repeated reading, inductive coding, and iterative theme development to identify patterns related to emotional safety, reflective engagement, coping, and perceived changes in well-being. The qualitative data consisted of weekly reflective journal entries rather than interviews, and these entries were used to capture students' ongoing emotional experiences during the 10-week program. A purposive subset of entries was selected to ensure variation in gender, academic background, baseline perceived stress, and patterns of pre–post psychological change. To enhance qualitative rigor, two researchers independently coded an initial subset of reflective entries, compared coding decisions, and refined the coding framework through discussion. Coding was then applied to the remaining selected entries. Thematic saturation was considered reached when additional entries no longer generated new codes or substantially altered the existing themes. To reduce confirmation bias, the analysis included not only highly positive reflections but also entries expressing hesitation, uncertainty, or limited perceived benefit from AI-supported reflective writing. Coding discrepancies were resolved through discussion. Quantitative and qualitative findings were integrated at the interpretation stage using an explanatory mixed-methods logic. Specifically, the quantitative analyses identified within-group changes and statistical associations among perceived stress, digital emotional safety, emotion regulation, and psychological well-being, while the qualitative analysis was used to contextualize how students experienced emotional safety, reflection, and coping processes during the program. This integration provided a more comprehensive understanding of participants' experiences

Table 2. Descriptive statistics and Pearson correlations among primary study variables at pre-intervention

Variable	M (SD)	1	2	3	4
Perceived stress	3.48 (0.74)	—			
Digital emotional safety	3.10 (0.70)	−0.26**	—		
Emotion regulation (reappraisal)	3.09 (0.66)	−0.41**	0.38**	—	
Psychological well-being	3.21 (0.68)	−0.46**	0.35**	0.48**	—

Note. Values below the diagonal are Pearson correlation coefficients. ** $p < 0.01$, two-tailed.

and the psychological changes associated with the AI-supported reflective writing program.

Results

Preliminary analyses and descriptive statistics

A total of 120 university students completed the baseline assessment, and 114 students completed both baseline and post-intervention assessments, yielding a retention rate of 95%. Analyses were conducted on the final sample after listwise deletion for minimal missing data. Participants had a mean age of 20.4 years, and 68% identified as female. Because this study employed a single-group pre-post design without a randomized control or comparison group, the following analyses were interpreted as evidence of within-group change over time rather than definitive evidence of causal intervention effects.

Descriptive statistics and Pearson correlations among the primary variables at baseline are presented in Table 2. At pre-intervention, perceived stress was moderate, while emotion regulation and psychological well-being were at mid-range levels. The baseline correlation pattern was generally consistent with the proposed conceptual model: perceived stress was negatively associated with emotion regulation and psychological well-being, whereas digital emotional safety was positively associated with emotion regulation and well-being. Reporting these baseline associations provides greater transparency regarding the relationships among study variables before the intervention period.

Paired-sample t -tests indicated significant pre-post changes from Tables 2 and 3. Participants reported lower perceived stress at post-intervention ($M = 3.02$, $SD = 0.79$) than at baseline ($M = 3.48$, $SD = 0.74$), $t(113) = 8.71$, $p < 0.001$, Cohen's $d = 0.80$. Emotion regulation also increased from baseline ($M = 3.09$, $SD = 0.66$) to post-intervention ($M = 3.56$, $SD = 0.65$), $t(113) = -9.24$, $p < 0.001$, $d = 0.88$. Psychological well-being increased from baseline ($M = 3.21$, $SD = 0.68$) to post-intervention ($M = 3.65$, $SD = 0.71$), $t(113) = -7.45$, $p < 0.001$, $d = 0.70$. These results indicate significant within-group improvements following participation in the AI-supported reflective writing program. However, given the absence of a control group, these changes should be interpreted cautiously and not as definitive evidence that the observed improvements were caused by the intervention.

Descriptive statistics and Pearson correlations among the primary variables at post-intervention are presented in Table 3. Compared with the pre-intervention pattern, post-intervention correlations remained in the expected

directions and showed stronger associations between digital emotional safety, emotion regulation, and psychological well-being. Although the observed effect sizes were medium to large, they should be interpreted cautiously because they were derived from a single-group pre-post self-report design. Without a comparison group, these changes may partly reflect time-related influences, expectancy effects, repeated measurement, course-related experiences, or increased familiarity with reflective writing. These findings indicate significant within-group improvements following participation in the AI-supported reflective writing program. However, given the absence of a control group and the reliance on self-report measures, the magnitude of these changes should be interpreted cautiously. The observed medium-to-large effect sizes may partly reflect time-related influences, repeated measurement, expectancy effects, social desirability, course-related experiences, or increased familiarity with reflective writing.

Longitudinal trends across the 10-week intervention are illustrated in Figure 2. Perceived stress exhibited a steady decline across the 10-week intervention period, whereas emotion regulation (cognitive reappraisal) and psychological well-being showed progressive increases. These patterns visually support the observed within-group changes over time, although they should not be interpreted as causal effects in the absence of a comparison group.

Measurement model validation

Confirmatory factor analysis (CFA) was conducted to examine the distinctiveness of perceived stress, digital emotional safety, emotion regulation, and psychological well-being. The four-factor measurement model demonstrated good fit to the data, $\chi^2(146) = 259.30$, $p < 0.001$, CFI = 0.946, TLI = 0.931, RMSEA = 0.052. All standardized factor loadings were substantial (0.72–0.89, $p < 0.001$), with composite reliabilities ranging from 0.84 to 0.92 and AVE values exceeding 0.60. These results support adequate convergent and discriminant validity. Model fit indices for both the measurement and structural models are summarized in Table 4. Although the four-factor model demonstrated acceptable fit and discriminant validity at the construct level, the results should be interpreted with caution because all latent variables were measured using self-report indicators collected from the same participants.

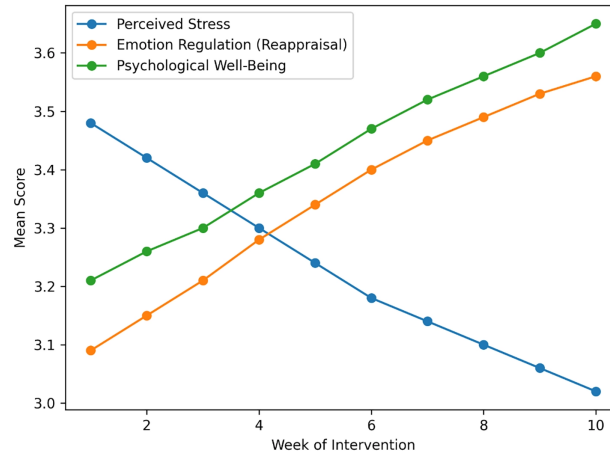
Structural equation modeling and mediation tests (H3–H4)

The hypothesized structural equation model demonstrated acceptable fit, $\chi^2(148) = 267.50$, $p < 0.001$, CFI = 0.939,

Table 3. Descriptive statistics and Pearson correlations among primary study variables (post-intervention)

Variable	M (SD)	1	2	3	4
Perceived stress	3.02 (0.79)	—	−0.31**	−0.47**	−0.44**
Digital emotional safety	3.42 (0.68)	−0.31**	—	0.51**	0.42**
Emotion regulation (reappraisal)	3.56 (0.65)	−0.47**	0.51**	—	0.54**
Psychological well-being	3.65 (0.71)	−0.44**	0.42**	0.54**	—

Note. Values are Pearson correlation coefficients. ** $p < 0.01$, two-tailed.

**Figure 2.** Trajectories of perceived stress, emotion regulation (cognitive reappraisal), and psychological well-being**Table 4.** Confirmatory factor analysis (CFA) and structural equation model (SEM) fit indices

Model	χ^2	df	χ^2/df	CFI	TLI	RMSEA	SRMR
Measurement model (CFA)	259.30	146	1.78	0.946	0.931	0.052	0.048
Structural model (SEM)	267.50	148	1.81	0.939	0.925	0.055	0.052

Note. CFA = confirmatory factor analysis; SEM = structural equation modeling; CFI = comparative fit index; TLI = Tucker–Lewis index; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual.

TLI = 0.925, RMSEA = 0.055. The structural relationships among perceived stress, digital emotional safety, emotion regulation, and psychological well-being are depicted in Figure 3, with standardized path coefficients reported in Table 5.

Perceived stress exerted a significant negative effect on emotion regulation ($\beta = -0.51, p < 0.001$), whereas digital emotional safety exerted a significant positive effect ($\beta = 0.47, p < 0.001$). Together, these predictors explained 52% of the variance in emotion regulation. Emotion regulation, in turn, significantly predicted psychological well-being ($\beta = 0.56, p < 0.001$).

When emotion regulation was included, the direct effect of perceived stress on well-being was no longer significant ($\beta = -0.10, p = 0.21$), suggesting a full statistical mediation pattern and supporting H3. Digital emotional safety retained a significant direct effect on well-being ($\beta = 0.20, p = 0.028$), suggesting partial statistical mediation and supporting H4. The final model accounted for 59% of the variance in psychological well-being.

Bias-corrected bootstrap analyses with 5000 resamples were then conducted to examine indirect associations

through emotion regulation. As shown in Table 6, perceived stress exerted a significant negative indirect effect on well-being via emotion regulation ($\beta = -0.28, 95\% \text{ CI } [-0.40, -0.18]$), whereas digital emotional safety exerted a significant positive indirect effect ($\beta = 0.26, 95\% \text{ CI } [0.15, 0.38]$). Confidence intervals did not include zero, confirming robust mediation effects. These findings support the proposed statistical mediation model. However, because the study did not include a control or comparison group, these mediation findings should be interpreted as evidence of plausible psychological mechanisms rather than causal pathways. Meanwhile, these mediation findings should be interpreted as evidence of plausible statistical mechanisms rather than causal pathways. Because all quantitative variables were self-reported and because the current model did not include formal common method bias testing, demographic covariate adjustment, or baseline-controlled structural estimates, the observed associations may partly reflect shared method variance or unmodeled confounding.

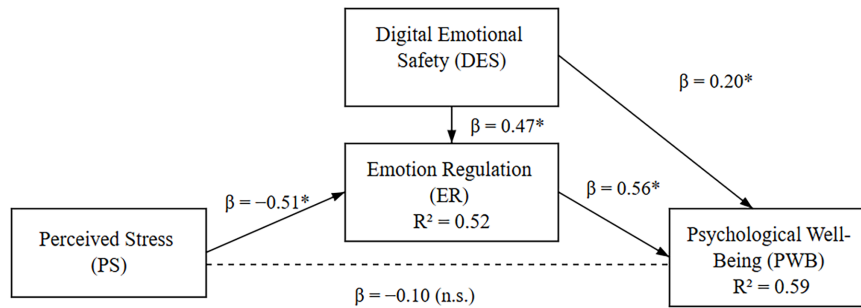


Figure 3. Structural equation model. Note: Standardized path coefficients are reported. Solid lines indicate statistically significant paths, and the dashed line indicates a non-significant path. * $p < 0.05$; n.s. = not significant. R^2 indicates the proportion of explained variance.

Table 5. Standardized path coefficients for the structural equation model

Pathway	Standardized β	SE	95% CI	p
Direct Effects				
Perceived Stress \rightarrow Emotion Regulation	-0.51	0.07	[-0.64, -0.37]	<0.001
Digital Emotional Safety \rightarrow Emotion Regulation	0.47	0.07	[0.33, 0.60]	<0.001
Emotion Regulation \rightarrow Psychological Well-Being	0.56	0.06	[0.42, 0.68]	<0.001
Perceived Stress \rightarrow Psychological Well-Being	-0.10	0.08	[-0.26, 0.06]	0.21
Digital Emotional Safety \rightarrow Psychological Well-Being	0.20	0.09	[0.02, 0.38]	0.028
Indirect (Mediated) Effects				
Perceived Stress \rightarrow Emotion Regulation \rightarrow Psychological Well-Being	-0.28	0.06	[-0.40, -0.18]	<0.001
Digital Emotional Safety \rightarrow Emotion Regulation \rightarrow Psychological Well-Being	0.26	0.06	[0.15, 0.38]	<0.001

Table 6. Bootstrapped mediation analysis summary (indirect effects via emotion regulation)

Mediation pathway	Indirect effect (β)	SE	95% bootstrap CI	p
Perceived Stress \rightarrow Emotion Regulation \rightarrow Psychological Well-Being	-0.28	0.06	[-0.40, -0.18]	<0.001
Digital Emotional Safety \rightarrow Emotion Regulation \rightarrow Psychological Well-Being	0.26	0.06	[0.15, 0.38]	<0.001

Qualitative findings

The qualitative findings provided explanatory insight into students' experiences during the AI-supported reflective writing program. Thematic analysis of weekly reflective journals identified three main themes: enhanced emotional awareness, perceived safety in the AI-facilitated environment, and growth in adaptive coping. These themes helped contextualize the quantitative patterns by illustrating how students described emotional reflection, perceived digital safety, and regulation-related changes over time.

Theme 1: Enhanced emotional awareness

Students reported that the guided prompts and AI feedback helped them recognize and articulate their emotions more clearly. Several reflections indicated a shift from simply expressing stress to identifying its sources and meanings. For example, one student wrote, "I finally understood why I felt so anxious during exams by writing it out." Another noted, "By week 5, I noticed patterns in my moods and could identify what was causing my stress." These accounts suggest that reflective writing supported emotional awareness and may have facilitated cognitive reappraisal.

Theme 2: Perceived safety and trust

Students frequently described the AI-supported writing space as private, non-judgmental, and emotionally safe. Although some initially felt hesitant, many became more willing to disclose personal feelings as the program progressed. One participant stated, "I felt secure writing things I'd never said out loud to anyone," while another noted, "Knowing this space was safe made it easier to confront my stress instead of avoiding it." These reflections suggest that perceived digital safety may have enabled deeper emotional expression and engagement with difficult experiences.

Theme 3: Growth in coping and well-being

Students also described developing more adaptive coping strategies, including reframing negative thoughts, planning actions, and managing emotional responses more deliberately. Some participants reported feeling less overwhelmed and more confident in handling academic challenges. As one student reflected, "I feel less overwhelmed and more confident that I can handle challenges now." These accounts align with the quantitative finding that emotion regulation was associated with psychological well-being, suggesting that students' perceived

improvements in coping may have supported their well-being during the program.

Integration of quantitative and qualitative findings

Quantitatively, participants reported lower perceived stress and higher psychological well-being after the program, with emotion regulation emerging as a statistical mediating mechanism linking both perceived stress and digital emotional safety to well-being outcomes. The qualitative findings extend these statistical patterns by showing how these associations may have unfolded psychologically. Students' reflective journals suggested that perceived digital emotional safety created a private and non-judgmental space in which they felt more willing to disclose emotions, examine academic stressors, and engage with AI-supported reflective prompts. This sense of safety appeared to support a movement from emotional expression toward cognitive reappraisal, as students described identifying stress triggers, reconsidering negative experiences, and developing more adaptive coping intentions. In this way, the qualitative data help explain why digital emotional safety was positively associated with emotion regulation in the structural model. Similarly, students' accounts of feeling less overwhelmed, more emotionally aware, and more capable of reframing difficulties provide experiential insight into the statistical link between emotion regulation and psychological well-being. Thus, the qualitative strand did not merely confirm the quantitative findings; it clarified the process through which emotionally safe AI-supported reflection may facilitate emotional disclosure, cognitive reappraisal, and coping development. Taken together, the findings suggest that AI-supported reflective writing may provide a salutogenic context for emotional insight and adaptive regulation, while causal conclusions remain limited by the single-group pre-post design and self-report data.

Discussion

This mixed-methods study examined the psychological processes through which an AI-supported reflective writing program was associated with changes in perceived stress, emotion regulation, and psychological well-being among university students. Consistent with the hypotheses, quantitative findings showed that perceived stress was negatively associated with well-being, whereas digital emotional safety was positively associated with well-being. Emotion regulation, specifically cognitive reappraisal, emerged as a central statistical mediating mechanism linking both stress and digital emotional safety to psychological well-being. Qualitative findings further contextualized these relationships by illustrating how students experienced increased emotional awareness, perceived safety, and coping capacity over time. However, because the study used a single-group pre-post design without a randomized control or comparison group, these findings should be interpreted as preliminary evidence of within-group psychological change rather than definitive evidence of intervention effectiveness. Alternative explanations, including maturation, time effects, expectancy effects, general reflective writing effects and course-related influences, cannot be ruled out.

Perceived stress, emotion regulation and psychological well-being

The negative association between perceived stress and psychological well-being observed in this study is consistent with extensive research across diverse cultural contexts, including African and Global South settings where academic and socio-economic stressors are pronounced (Asante & Andoh-Arthur, 2014; Bantjes et al., 2016). Extending this literature, the present findings suggest that the impact of stress on well-being operated primarily through emotion regulation processes. Higher stress was associated with reduced use of cognitive reappraisal, which in turn predicted lower well-being.

This full mediation effect aligns with transactional models of stress and coping, which emphasize that psychological outcomes depend not only on stress exposure but also on individuals' capacity to regulate emotional responses (Lazarus & Folkman, 1984). In line with Gross's emotion regulation framework, cognitive reappraisal represents an adaptive strategy that buffers the negative effects of stress by reshaping emotional meaning. Qualitative accounts of students learning to "reframe" and "step back" from distress provide experiential support for this regulatory pathway. Nevertheless, due to the absence of a comparison group, this mediation pattern should be understood as a plausible psychological explanation rather than proof of a causal mechanism.

Digital emotional safety as a psychosocial resource

A key contribution of this study lies in conceptualizing digital emotional safety as a psychosocial resource rather than a purely technological feature. Digital emotional safety, defined as perceived trust, non-judgment, and emotional comfort within the reflective space, was positively associated with psychological well-being both directly and indirectly through emotion regulation. This finding is consistent with psychological theories emphasizing the role of perceived safety in facilitating emotional disclosure and adaptive coping (Chan et al., 2017). However, the interpretation of digital emotional safety should be made cautiously because the construct was operationalized through a trust-based technology measure. In this study, digital emotional safety primarily reflected students' perceptions of the AI system's benevolence, integrity, and competence, rather than the full emotional and relational dimensions of psychological safety. Therefore, the findings should be understood as evidence concerning the trust-based component of digital emotional safety, rather than as a comprehensive assessment of emotional safety in AI-mediated reflection. This clarification is important because emotional safety may also involve perceived empathy, privacy, non-judgment, emotional comfort, and cultural sensitivity, which were not fully captured by the present measure.

Qualitative data illustrate how emotionally safe digital environments reduced fear of evaluation and encouraged honest self-expression. Importantly, digital emotional safety retained a direct association with well-being even after accounting for emotion regulation, suggesting that perceived safety contributes to well-being not only by

enhancing coping skills but also by providing psychological containment and support. This resonates with African-centered perspectives that highlight relational safety and emotional affirmation as foundations of well-being. However, the present design does not allow us to determine whether digital emotional safety resulted specifically from the AI-supported writing program or from broader factors such as repeated reflection, course engagement, or increased familiarity with the platform over time.

Integration with reflective writing and meaning-making research

The findings align with prior research on reflective and expressive writing, which has shown benefits for emotional processing and stress reduction (Mohamed et al., 2023). However, this study advances the literature by identifying emotion regulation as a key mechanism underlying these benefits. Rather than functioning solely as emotional release, reflective writing appears to support well-being by facilitating cognitive reappraisal and meaning-making.

From a meaning-centered perspective, reflective writing helps individuals organize emotional experiences into coherent narratives, enhancing psychological integration and perceived control. The qualitative themes of insight, understanding, and growth observed in this study are consistent with this interpretation and are particularly relevant during emerging adulthood, a period marked by heightened stress and identity negotiation. Because no traditional reflective-writing comparison group was included, future studies should examine whether AI-assisted reflection provides additional benefits beyond ordinary reflective writing.

Implications for student mental health promotion

The findings suggest that mental health interventions for students may benefit from prioritizing emotion regulation within emotionally safe contexts. While this study employed an AI-supported format, the underlying psychological processes, emotional awareness, reappraisal, and perceived safety are not inherently technological. Rather, the digital platform served as a consistent and private context that enabled these processes to unfold. Thus, the practical implication of this study should be framed cautiously: AI-supported reflective writing may be a promising, low-threshold approach to supporting student well-being, but its effectiveness requires further testing through controlled or comparative research designs. Interventions that emphasize emotional safety and adaptive coping may be particularly beneficial in contexts where psychological distress is common, but help-seeking is constrained by structural or cultural barriers.

The present findings also resonate with recent digital-intervention research showing that technology-supported environments can create controlled and less stigmatizing spaces for emotional engagement. For instance, Wang et al. (2025) reported that VR-based extreme sports activities were associated with reductions in stress, anxiety, and depression among men with social anxiety disorder. While their study focused on immersive VR exposure and the present study focused on AI-supported reflective

writing, both suggest that digital environments may support mental health by providing structured, private, and psychologically safe contexts for emotional processing. However, unlike the VR study, the present research did not include a comparison group; therefore, its findings should be interpreted as preliminary and associative rather than causal.

Limitations and future directions

This study has several limitations. First, the most important limitation is the absence of a randomized control or comparison group. Although significant pre–post changes were observed and supported by qualitative findings, the single-group design cannot rule out alternative explanations such as maturation, time passage, expectancy effects, general reflective-writing effects, or course-related influences. Therefore, the findings should be interpreted as preliminary evidence of psychological changes associated with AI-supported reflective writing rather than definitive evidence of intervention efficacy. Future research should employ randomized controlled trials, waitlist-control designs, or active comparison groups, such as traditional reflective writing without AI support, to determine whether the AI-supported component offers benefits beyond reflection alone. Second, the sample was drawn from a single university, which may restrict generalizability. Replication across diverse institutional and cultural contexts, particularly within African and Global South settings, is needed. Third, reliance on self-report measures may introduce response bias. Future studies could incorporate behavioral or physiological indicators of stress and emotion regulation. Another limitation concerns the operationalization of digital emotional safety. In this study, digital emotional safety was measured using a trust-based technology scale, which captures important dimensions such as benevolence, integrity, and competence. However, this measure may not fully represent the broader emotional and psychological dimensions of safety in AI-mediated reflection, such as perceived empathy, emotional comfort, non-judgment, privacy, and cultural sensitivity. Future studies should develop and validate a dedicated digital emotional safety scale for AI-supported reflective writing contexts and examine its convergent and discriminant validity across diverse student populations. Finally, longitudinal research is needed to assess the durability of intervention effects over time.

Conclusion

This study provides empirical evidence that AI-assisted reflective writing can serve as an effective mental health promotion tool for university students. By integrating a salutogenic framework, the findings demonstrate that reductions in perceived stress and improvements in psychological well-being are largely explained by enhanced emotion regulation, particularly cognitive reappraisal. Importantly, perceived digital emotional safety emerged as both a direct and indirect contributor to well-being, underscoring the importance of emotionally supportive digital environments in contemporary learning contexts. The mixed-methods findings further reveal that students experienced the AI-assisted platform as a non-judgmental

and secure space that facilitated emotional expression, self-reflection, and adaptive coping. These results extend existing literature on expressive writing and digital mental health by highlighting the role of AI as a supportive, reflective companion rather than a purely instrumental tool. Overall, the study suggests that carefully designed AI-supported interventions can complement existing student mental health resources, particularly in settings where access to traditional psychological support is limited.

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