Journal of Educational Technology and Learning Creativity
Vol. 3, No. 2, December 2025, pp. 194~203
ISSN: 3021-7865, DOI: 10.37251/jetlc.v3i2.2328

Emotional Resilience, Mood States, and Emotional Stability: Foundations for Digital Emotional Analytics and Technology-Enhanced Counseling in Swamp-Region Schools

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Article Info

Article history:

Received Aug 13, 2025
Revised Sep 27, 2025
Accepted Nov 29, 2025
Online First Dec 26, 2025

Keywords:

Educational Technology
Emotional Resilience
Geopark
Mood States
Swamp Area

ABSTRACT

Purpose of the study: This study examines the relationship between emotional resilience and emotional stability among high school students living in swamp ecological regions in Indonesia and evaluates the mediating role of mood states (Depression, Esteem-related Affect, Vigour). It also highlights implications for technology-enhanced student emotional monitoring.

Methodology: This study employed a cross-sectional survey design with cluster sampling. Instruments included the Ecological Integrity Assessment (EIA) questionnaire, Profile of Mood States (POMS), and the Eysenck Personality Questionnaire Short Scale. Data were collected via paper-based surveys and analyzed using path analysis and SEM with maximum likelihood estimation in R and RStudio software.

Main Findings: Emotional resilience was associated with lower depression and higher vigour. Mood states significantly mediated the resilience–stability relationship, with vigour showing the strongest mediating effect. Students in swamp areas demonstrated high resilience yet exhibited poorer mood conditions than national norms.

Novelty/Originality of this study: Beyond psychological contributions, this study offers new insights for educational technology by identifying mood indicators that can be integrated into digital dashboards, LMS-based monitoring tools, and AI-driven counseling systems for geographically remote schools.

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1. INTRODUCTION

Adolescents' emotional development is often shaped by their ecological environment, including the unique geographical characteristics of their place of residence [1]. One of the key psychological constructs influencing adolescent mental health is emotional resilience, namely the ability to adapt positively when facing stress and adversity [2], [3]. In many contexts, including in developing countries, this resilience serves as a buffer against environmental pressures [4], [5]. In Indonesia, one such distinctive environment is the swamp ecological region of South Kalimantan an area with geographical isolation, transportation constraints, and limited access to

educational services [6], [7]. Students in these regions often face not only academic challenges but also environmental obstacles that may affect their psychological well-being [8], [9]. A study by shows that adolescents living in geographically limited areas experience higher school-related stress compared to their urban peers [10], [11]. Despite growing evidence on the ecological determinants of emotional resilience, limited attention has been given to how such contexts interact with psychological variables like mood states and emotional stability [12].

While the existing literature emphasizes the relationship between emotional resilience and psychological outcomes such as depression, vigour, and esteem-related affect [13]-[15] research has not yet linked these psychometric findings with technology-based educational innovations. Recent developments in digital psychological assessment tools, such as online mood-state monitoring (digital POMS), e-counseling platforms, and school-based mental-health dashboards, offer new opportunities to integrate emotional data into learning analytics. Digital systems allow schools to track students' affective states in real time, support early detection of emotional problems, and design adaptive interventions that enhance learning engagement [16]-[18]. Studies on educational data mining have shown that emotional indicators can enrich predictive models of academic performance and student persistence, making psychometric data essential for technology-enhanced decision-making in schools.

However, the implementation of such digital tools is not evenly distributed. In remote ecological settings such as swamps, wetlands, and riverine communities, the deployment of educational technology faces significant challenges including unstable connectivity, lack of electricity infrastructure, limited device ownership, and insufficient digital literacy among teachers and counselors. These barriers are particularly critical in Indonesia's 3T regions (frontier, outermost, and disadvantaged areas), where the urgency to digitize guidance and counseling services is high due to shortages of school psychologists and limited access to mental-health resources. Digital guidance systems, mobile-based mood screening, and asynchronous e-counseling represent promising approaches to extend psychological support to adolescents in geographically isolated schools. Yet empirical evidence on how ecological constraints shape the integration of emotional data into digital school systems remains scarce.

In the context of global environmental change, recent findings further emphasize that ecological stressors significantly affect adolescents' emotional regulation and resilience capacities [19]. The interaction between ecological conditions and psychological factors is therefore a critical element in understanding emotional stability across diverse geographical areas. Previous work indicates that resilience acts as a driver of positive emotional experiences and self-regulation capacity [20]. However, very few studies have examined these mechanisms within ecologically extreme regions such as swamps.

Moreover, although emotional resilience is widely recognized as a predictor of mental-health outcomes, the mediating mechanisms of mood states including depression, vigour, and esteem-related affect remain underexplored in marginalized ecological contexts [21]. A recent meta-analysis confirms that mood-based regulation strategies act as key mediators between resilience and emotional stability [22]. This highlights the importance of examining affective pathways within environments where adolescents face chronic environmental and infrastructural constraints. For example, limited mobility, seasonal flooding, and fluctuating access to schools can heighten emotional exhaustion among adolescents in swamp regions [23], raising the need for context-sensitive digital mental-health support systems.

The swamp ecological region of South Kalimantan recently designated as a UNESCO Global Geopark [24], offers a unique context for understanding the interplay between ecological and psychological factors. Research in other UNESCO Geopark areas has shown that environmental belongingness enhances resilience and affective regulation [25]. At the same time, geographical isolation in such areas underscores the need for digital solutions that can complement traditional face-to-face counseling, particularly when access to trained professionals is limited.

To address these gaps, the present study investigates the relationship between emotional resilience and emotional stability among high school students living in the swamp ecological region of South Kalimantan. Specifically, this research examines the mediating role of mood states depression, esteem-related affect, and vigour in shaping emotional outcomes. By integrating perspectives from ecological psychology and educational technology, this study contributes not only to theoretical understanding but also to practical implications for digital counseling innovation, emotional analytics, and context-aware educational decision-making in geographically challenging regions. Therefore, the objectives of this study are as follows: (1) to analyze the relationship between emotional resilience and emotional stability among high school students living in the swamp ecological region of South Kalimantan; (2) to examine the mediating role of mood states depression, esteem-related affect, and vigour in this relationship; and (3) to provide empirical foundations for the integration of emotional indicators into digital counseling and technology-enhanced student-support systems in remote ecological regions.

2. RESEARCH METHOD

In this research used cross sectional design to measure the relation between emotional resilience and emotional stability among senior high school students from swamp ecological in South Kalimantan. This design

was selected because it allows data to be collected at a single point in time, in order to examine patterns of association between the variables of interest and to test whether some mood states (as indices of some depression items, self-confidence items and vigour items) partially mediate the relationship between emotional resilience and emotional stability. Data analysis was conducted using a path analysis or mediation model approach to evaluate whether, and to what extent, mood states mediate the relationship between the independent variable (emotional resilience) and the dependent variable (emotional stability).

The hypothetical model in Figure 1 illustrates the relationship between students' emotional resilience in swamp ecological regions and their emotional stability in the high school context.

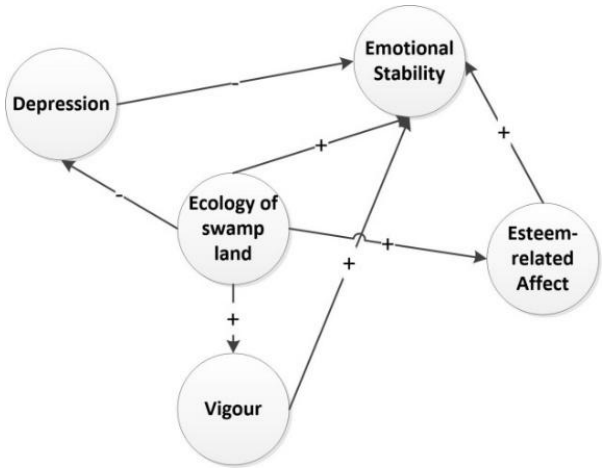

Figure 1 Hypothetical model: the influence of swamp ecological context on emotional stability

The negative relationship between students' emotional resilience in swamp ecological regions and the mood state (Depression) indicates that individuals with higher levels of resilience tend to experience lower levels of depression. Conversely, the positive relationship between emotional resilience and the mood state (Vigour) suggests that the more resilient an individual is, the more frequently they experience vigour. In addition, emotional resilience was also positively associated with emotional stability, meaning that students with high resilience tend to have more stable emotional conditions. The mood state (Depression) showed a negative relationship with emotional stability, indicating that individuals who experience more depressive mood states tend to have lower emotional stability. Furthermore, the mood state (Esteem-related Affect) had a positive effect on emotional stability, meaning that individuals who more frequently experience esteem-related mood states tend to have greater emotional stability. Likewise, the mood state (Vigour) had a positive effect on emotional stability, meaning that individuals who frequently experience vigour tend to have better emotional stability.

2.1. Participants

A total of 370 students were selected using cluster sampling from grades 10 to 12 at a public high school located in the swamp region of South Kalimantan, Indonesia, during the period of April 11 to 22, 2025. This research was approved by the Ministry of Education, Culture, Research, and Technology through DRPM BIMA Dikti 2025 research grant funding. With approval from school leadership and teachers, the questionnaires were distributed in face-to-face settings. After signing an informed consent form, participants completed the questionnaire, which was then collected. Questionnaires that did not meet quality criteria, such as incomplete factual data, uniform response patterns, or excessive missing ítems, were excluded from the analysis, resulting in 340 valid questionnaires. The effective recovery rate was 91.89%. The average age of students included in the study was approximately 16.56 years (SD ≈ 1.17). The sample consisted of 200 male and 140 female students.

In line with similar educational studies in Indonesia, the use of cluster sampling was chosen to obtain representative samples across academic levels and minimize bias in large student populations [26]-[28]. Moreover, obtaining informed consent from participants and excluding incomplete responses followed established ethical procedures in adolescent psychological research, which emphasize voluntary participation and data validity [29]-[31]. These methodological standards ensure that the study maintains both scientific rigor and ethical integrity in accordance with international guidelines for school-based psychological research.

2.2. Procedure

Swamp Ecological Area: The Ecological Integrity Assessment (EIA) questionnaire adapted from Comer & Faber-Langendoen [32] was used to assess the ecological condition of the swamp area where the high school is located in South Kalimantan. This questionnaire contained five items included in the present study (e.g., "Main road with limited access"). Responses were rated using a five-point Likert scale ranging from 1 to 5 (1 = Very

Low Integrity, 2 = Low Integrity, 3 = Moderate Integrity, 4 = High Integrity, and 5 = Very High Integrity). In this study, the reliability of the scale (Cronbach's α) was 0.88. Confirmatory factor analysis (CFA) showed that the model had a good fit (χ^2/df = 1.30; CFI = 0.99; TLI = 0.99; IFI = 0.99; RMSEA = 0.029). Mood state scale: Mood states were measured using the Profile of Mood States (POMS) scale developed by Grove and Prapavessis [33]. The scale consists of Seven dimensions for Depression (e.g., Unhappy, Sad, Hopeless, Discouraged, Miserable, Helpless, Worthless), Six dimensions for Esteem-related Affect (e.g., Proud, Ashamed, Competent, Confident, Satisfied, Embarrassed), and Five dimensions for Vigour (e.g., Lively, Active, Energetic, Full of Pep, Vigorous). Responses were rated on a five-point Likert scale ranging from 0 to 4. In this study, the reliability of the scale (Cronbach's α) was 0.817. Confirmatory factor analysis indicated good model fit (χ^2/df = 1.20; CFI = 0.99; TLI = 0.99; IFI = 0.99; RMSEA = 0.024).

Emotional Stability Scale: To measure emotional stability, we used the German version of the Eysenck Personality Questionnaire Short Scale Francis et al. [34], which consists of 12 items (e.g., "Are you a talkative person?"). Individuals answering "yes" received one point, while those answering "no" received zero points. Note that higher scores equate to less emotional stability, while lower scores equate to more emotional stability. Reliability (Cronbach's α) of the scale was 0.91 in this study. The confirmatory factor analysis supported the good fit between the data and the model (χ^2/df = 1.533; CFI = 0.98; TLI = 0.98; IFI = 0.98; RMSEA = 0.040).

2.3. Data Analysis

The data analysis was conducted in two stages. First, correlations among Swamp Ecological Integrity, mood states, and emotional stability were computed using R for statistical analyses [35]-[37]. Subsequently, structural equation modeling (SEM) with maximum likelihood estimation was used to assess the extent to which mood states mediated the relationship between Swamp Ecological Integrity and emotional stability. This analysis was carried out using RStudio. The goodness of fit of the model was assessed with multiple indices: CFI (Comparative Fit Index); TLI (Tucker–Lewis Index); IFI (Incremental Fit Index); RMSEA (Root Mean Square Error of Approximation) and CMIN/DF (χ^2/df). A model was considered to have good fit if CFI, TLI and IFI were equal or higher than 0.90, and RMSEA and χ^2/df were lower than 0.08 and lower than 3 respectively. Before conducting the main analyses, we performed a test for common method bias. Results from Harman's single-factor test indicated that eight factors with eigenvalues greater than one were extracted through unrotated exploratory factor analysis. The factor accounting for the largest proportion of variance explained 16.66%, which is below the critical threshold of 40%. Therefore, common method bias was not a concern in this study. Next, Pearson's correlation analysis was used to assess the relationships among variables in the formal analysis. Then, a latent variable-based SEM model was employed to test the hypothesized mediation effect model

3. RESULTS AND DISCUSSION

The analysis of mood states, emotional resilience within swamp ecological regions, and emotional stability reveals a rich and complex emotional dynamic among adolescents living in environmentally demanding settings. The presentation of findings integrates descriptive statistics, correlation analysis, structural equation modeling, and mediation testing, followed by an extended ecological and theoretical discussion. This integrative format allows the results to be interpreted not merely as statistical outputs but as reflections of psychological adaptation shaped by distinctive environmental contexts.

Descriptive statistics and correlation analysis provide the foundational patterns underlying the relationships among variables. The mean scores, standard deviations, and correlations among variables are presented in Table 1. The mood state Depression was positively correlated with emotional resilience among students in swamp ecological regions (r = 0.089), but negatively correlated with emotional stability (r = –0.068). This indicates that despite possessing certain ecological resilience, students may still experience depressive symptoms. Esteem-related affect displayed negative correlations with both emotional resilience (r = –0.029) and emotional stability (r = –0.033), suggesting that feelings linked to low self-worth weaken emotional functioning. Mood state Vigour was negatively associated with emotional resilience (r = –0.078) but positively associated with emotional stability (r = 0.090), highlighting that emotional energy and activation are strongly tied to stable emotional functioning. Additionally, emotional resilience and emotional stability exhibited a negative correlation (r = –0.039), demonstrating that adaptive functioning within harsh ecological contexts does not necessarily align with emotional well-being. These relationships align with existing research suggesting that resilience developed in challenging environments may function as structural adaptation rather than as an enhancement of emotional well-being [38]-[40]. The full descriptive statistics and correlation values are presented in the following table.

Table 1. Descriptive Statistics and Correlation Analysis of Mood States (Depression, Esteem, and Vigour), Emotional Resilience in Swamp Ecological Regions (Ecological Integrity), and Emotional Stability (N = 340)

Variable	Mean ± SD	Depression	Esteem	Vigour	Ecological Integrity	Emotional stability
Depression	1.98±0.82	1				
Esteem	2.02±0.86	0.010	1			
Vigour	1.94±0.87	0.028	-0.006	1		
Ecological Integrity	2.97±0.84	0.089	-0.029	-0.078	1	
Emotional stability	0.49±0.36	-0.068	-0.033	0.090	-0.039	1

These initial relationships underscore a distinctive ecological resilience pattern among adolescents living in swamp regions. The physical and social demands of swamp environments may cultivate a form of resilience that prioritizes functional adaptation, consistent with studies emphasizing that resilience develops through interactions between individual characteristics and ecological pressure rather than solely through positive emotional reinforcement [41]-[43]. In this case, the positive correlation between resilience and depression may indicate defensive or survival-based adaptation. Similarly, the negative association between vigour and resilience highlights that environmental adaptation does not always accompany optimal emotional vitality.

Mediation effect analysis deepens these findings through a structural equation model involving five latent variables: emotional resilience, depression, esteem-related affect, vigour, and emotional stability. The model demonstrated excellent fit ($\chi^2/df = 1.076$; CFI = 0.99; TLI = 0.99; IFI = 0.99; RMSEA = 0.015), confirming the adequacy of the structural relationships. Path analysis revealed that emotional resilience positively predicted depression ($\beta = 0.310$, $p < 0.001$), negatively predicted esteem-related affect ($\beta = –0.180$, $p < 0.001$), and negatively predicted vigour ($\beta = –0.340$, $p < 0.001$). These findings indicate that resilience emerging within ecologically harsh environments may not uniformly enhance emotional well-being. Neurobiological studies on emotional adaptation suggest that adaptive responses formed under chronic environmental pressure may diverge substantially from emotional functioning observed in urban populations [44], [45]. Such processes help explain why ecological adaptation may coexist with higher depressive tendencies or lower levels of emotional activation.

The SEM results further showed that vigour positively predicted emotional stability ($\beta = 0.500$, $p < 0.001$), whereas depression ($\beta = –0.515$, $p < 0.001$) and esteem-related affect ($\beta = –0.390$, $p < 0.001$) negatively predicted emotional stability. The direct effect of emotional resilience on emotional stability was nonsignificant ($\beta = –0.040$, $p = 0.855$). These findings collectively demonstrate that mood states fully mediate the relationship between emotional resilience and emotional stability, highlighting that resilience affects stability only through emotional mechanisms involving energy levels, self-perception, and negative affect. A detailed summary of these path coefficients is presented in the table below.

Table 2. Path Coefficients and Direct Effects (SEM Analysis)

	SC	SE	CR	P-Value
EIA → Depression	0.310	0.095	3.263	0.001
EIA → Esteem	−0.180	0.092	−1.957	0.001
EIA → Vigour	−0.340	0.100	−3.400	0.001
Depression → EPQ	−0.515	0.098	−5.255	0.001
Esteem → EPQ	−0.390	0.090	−4.333	0.001
Vigour → EPQ	0.500	0.080	6.250	0.001
EIA → EPQ	−0.040	0.220	−0.182	0.855

These mediating patterns align with research showing that emotional stability is highly dependent on mood-state fluctuations, particularly vigour, which responds strongly to interventions involving self-regulation, physical activity, and mindfulness [46], [47]. Within the swamp ecological context, these results reinforce the notion that emotional resilience alone does not guarantee emotional stability. Rather, emotional functioning is shaped by daily mood fluctuations, cognitive appraisals, and physiological activation levels, which act as psychological pathways through which ecological resilience is expressed.

Bootstrap mediation analysis provided further clarity by quantifying the indirect effects. Vigour emerged as the strongest mediator, contributing 42.5% of the total effect, followed by depression at 40.0% and esteem-related affect at 17.5%. This strong mediating role of vigour supports earlier research emphasizing that emotional energy is one of the most sensitive indicators of adolescent psychological adjustment, influenced by physical environment, social interactions, and physiological conditions [48]. Daily diary studies on adolescents have shown that vigour fluctuates rapidly with academic and social pressures, making it a valuable predictor of emotional stability [49]. Complete mediation effects are summarized in the table below.

Table 3. Mediating Effects of Mood States (Depression, Esteem, and Vigour) in the Relationship Between Emotional Resilience in Swamp Ecological Regions (Ecological Integrity) and Emotional Stability

				Bias-corrected 95% CI	
Path	Effect value	Effect size	SE	Lower	Upper
EIA → Depression → EPQ	−0.160	40.0%	0.050	−0.280	−0.090
EIA → Esteem → EPQ	−0.070	17.5%	0.026	−0.130	−0.030
EIA → Vigour → EPQ	−0.170	42.5%	0.035	−0.250	−0.110
EPQ → EIA	0.310	-	0.078	−0.250	0.430
Total effect	−0.400.	100%	0.060	−0.520	−0.250

These mediation findings reinforce the position that emotional resilience in swamp environments cannot directly stabilize emotional functioning but rather requires internal emotional mechanisms to exert its influence. This aligns with research demonstrating that place attachment and community support act as psychological buffers that promote emotional well-being even in ecologically challenging environments [50]-[52]. Students in swamp regions may develop deep relational bonds with their environment, shaping their coping responses and adaptive behaviors. Such contextual factors help explain why resilience manifests differently in swamp ecological settings compared to more urbanized environments.

The structural model, illustrated in Figure 2, provides a clear depiction of latent variables and their indicators. All constructs demonstrated strong factor loadings between 0.65 and 0.85, confirming strong construct validity. Intercorrelations among latent constructs suggest potential conceptual overlap, indicating that emotional processes within ecological contexts may not be easily separable. Studies on nature connectedness emphasize that emotional, cognitive, and behavioral interactions with the environment collectively contribute to long-term psychological benefits [53], [54]. The ecological context thus appears to shape not only the magnitude of emotional responses but also the structural interrelationships among psychological constructs.

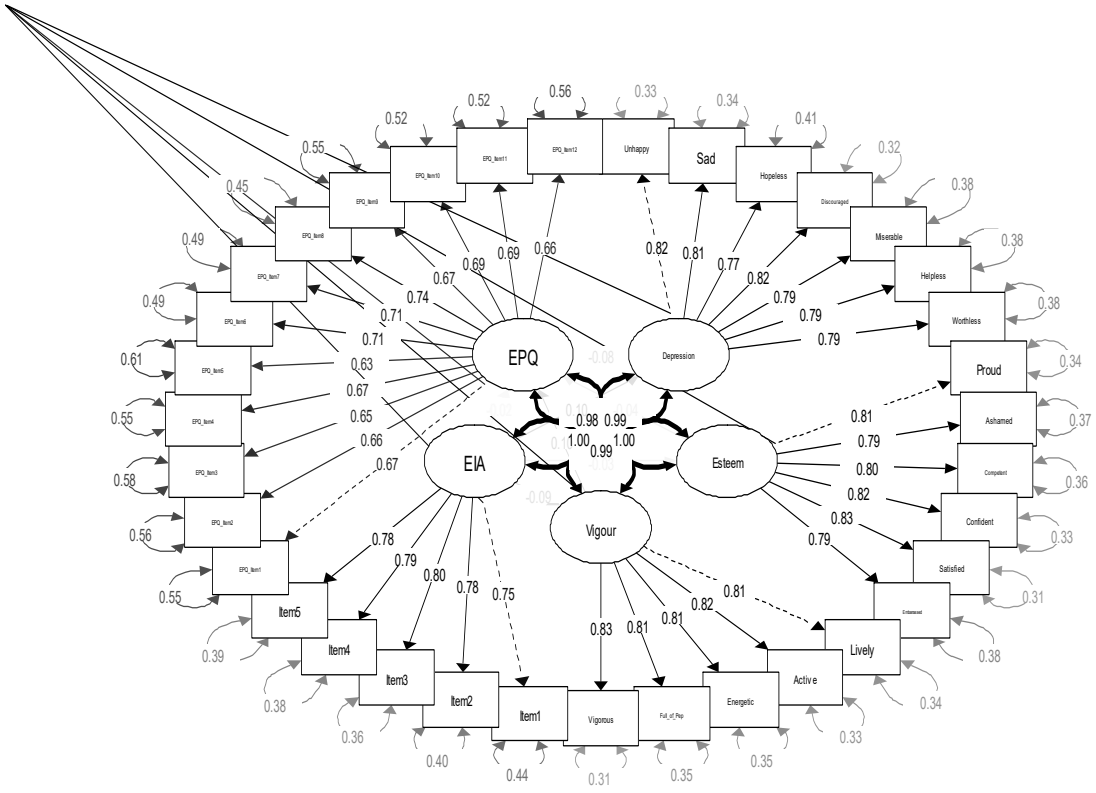

Figure 2. Structural Equation Modeling (SEM)

The findings of this study also hold significant implications for educational technology and digital emotional support systems. The prominence of vigour and depression as mediators suggests that these emotional indicators can be incorporated into school-based digital analytics systems to support real-time monitoring of student well-being. Learning management systems may integrate daily mood check-ins or emotional tracking dashboards, enabling teachers and counselors to identify students experiencing declining vigour or increasing

depressive signs. This is particularly valuable in swamp and remote 3T regions, where geographical barriers and limited human resources reduce access to continuous counseling services.

Mobile applications may further extend the reach of emotional monitoring systems by allowing students to report moods, access coping strategies, or receive automated emotional support. Given the high mobile penetration among adolescents, such approaches may bypass infrastructural limitations commonly found in swamp regions. Studies on nature-based interventions and outdoor learning have shown that ecological engagement can stabilize mood states and enhance resilience [55], [56], offering additional pathways for integrating ecological and technological strategies to support emotional well-being. Adaptive learning systems may also adjust instructional difficulty or provide motivational prompts based on students' emotional profiles, particularly when vigour is low or depressive tendencies rise.

These findings align with broader research indicating that emotional states among adolescents fluctuate widely due to environmental, academic, and social factors [57], [58]. By translating these fluctuations into actionable data, schools in ecologically challenging environments can make better-informed decisions regarding counseling support, personalized instruction, and targeted interventions.

This study offers novelty to the literature by uncovering distinct psychological mechanisms underlying emotional adaptation in a swampy ecological environment. Unlike previous studies, which largely conceptualize resilience as a uniform protective factor, the current findings suggest that emotional resilience in a demanding ecological context does not directly enhance emotional stability. Instead, its effects operate entirely through mechanisms related to mood, specifically vigor, depression, and affect related to self-esteem. This full mediation model highlights a previously underexplored phenomenon—namely, that resilience developed in harsh ecological conditions may function as a form of adaptive resilience rather than as a direct source of emotional well-being. By empirically demonstrating this "resilience paradox," this study advances theoretical understanding of how environmental stressors reshape emotional functioning in adolescents.

From a practical and applied perspective, these findings have significant implications for educational and psychological interventions, particularly in ecologically vulnerable or remote areas. The results suggest that efforts to strengthen students' resilience should not focus solely on resilience or coping capacity but should also address emotional vitality and its regulatory mechanisms. Integrating emotion monitoring tools, such as mood tracking features into digital learning platforms or school-based counseling systems, can enable early detection of declining vitality and emotional instability. Furthermore, this research provides a conceptual foundation for the development of technology-enabled adaptive interventions such as AI-assisted emotion analytics or personalized well-being dashboards that are sensitive to students' ecological and emotional contexts. By bridging ecological psychology, emotion science, and educational technology, this research offers a novel framework for designing context-responsive educational and mental health support systems in regions facing environmental challenges.

This study contributes new insights by identifying a *resilience paradox* in adolescents living in swamp ecological regions, where higher ecological resilience does not directly translate into emotional stability. Instead, resilience operates entirely through mood-state pathways, revealing a previously undocumented full mediation model within such ecological contexts. The study also introduces a novel framework for integrating emotional indicators particularly vigour and depression into digital emotional support tools, laying the groundwork for AI-driven counseling recommendation systems tailored to remote and environmentally demanding regions.

Several limitations should be acknowledged. The cross-sectional design prevents tracking emotional dynamics over time, limiting causal inference. Self-report instruments introduce potential bias related to perception and social desirability. The ecological specificity of swamp regions narrows the generalizability of findings to other settings. Additionally, important contextual variables such as family support, spirituality, and socioeconomic conditions were not included in the model. Future studies should employ longitudinal designs and incorporate broader psychosocial and ecological variables to strengthen predictive accuracy and theoretical depth.

4. CONCLUSION

This study demonstrated that emotional resilience influences emotional stability among adolescents in swamp ecological regions through the mediating effects of Depression, Esteem, and, most strongly, Vigour. These results highlight the importance of mood dynamics in understanding students' emotional functioning in geographically challenging environments. Beyond psychological insights, the findings contribute to educational technology by identifying emotional indicators that can be integrated into digital student-support systems. Mood states particularly vigour and depression can serve as early-warning signals in school dashboards, supporting proactive intervention. The results also provide a basis for developing AI-driven counseling recommenders that personalize support for students with fluctuating emotional conditions. Furthermore, the study supports embedding mood-tracking features into learning management systems (LMS) and school mobile applications, enabling adaptive learning responses based on emotional readiness. In remote swamp or 3T areas, smartphone-based emotional monitoring tools may offer an accessible avenue for counselors to track students' well-being. Overall,

emotional resilience and mood profiles function as actionable data for technology-enhanced counseling, learning analytics, and context-aware educational decision-making in ecologically isolated regions.

ACKNOWLEDGEMENTS

The authors would like to express their deepest gratitude to the Directorate of Research, Technology, and Community Service (DRTPM), Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia, for the support and funding provided through the 2025 Fundamental Research Grant scheme. This support was instrumental in the execution and completion of this study.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

The authors declare that no artificial intelligence (AI) tools were used in the preparation, analysis, or writing of this manuscript. All aspects of the research, including data collection, interpretation, and manuscript preparation, were carried **out** entirely by the authors without the assistance of AI-based technologies.

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