Motivation and Self-Regulation as Mediators between Learning Environment and Engagement in Online Learning among Chinese University Students

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ABSTRACT

Drawing on self-regulated learning theory and self-determination theory, this study examines the mediating roles of motivation and learning environment in the relationship between self-regulation and student engagement, while accounting for the influence of the online learning environment. Data were collected from 1521 Chinese university students enrolled in online courses and analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). Results from the structural model indicate that the online learning environment strongly predicts self-regulation ($\beta = 0.829$, $p < .001$) and motivation ($\beta = 0.301$, $p < .001$). Self-regulation significantly influences motivation ($\beta = 0.529$, $p < .001$) and engagement ($\beta = 0.299$, $p < .001$), while motivation also exerts a significant effect on engagement ($\beta = 0.330$, $p < .001$). Engagement is substantially explained by the model ($R^2 = 0.823$), demonstrating high predictive power. Mediation analyses reveal significant indirect effects of self-regulation on engagement through motivation ($\beta = 0.174$, $p < .001$), as well as multiple indirect pathways linking the online learning environment to engagement via self-regulation and motivation (total indirect effect $\beta = 0.492$, $p < .001$). Predictive relevance was further supported by strong Q^2 values for engagement ($Q^2 = 0.712$). Overall, the findings confirm that motivation and engagement act as key psychological mechanisms through which self-regulation and learning environment quality translate into engagement in online learning. The study contributes to online learning research by empirically validating an integrated, mechanism-based model and offers practical implications for designing learning environments that foster self-regulation, motivation, and sustained student engagement.

Keywords: Self-Regulated Learning; Motivation; Student Engagement; Learning Environment; Online Learning; PLS-SEM; China.

INTRODUCTION

The rapid institutionalization of online learning in higher education has transformed the dynamics of teaching and learning, reshaping how students interact with content, instructors, and peers. Although online environments provide flexibility and broaden access, they also place greater responsibility on students to actively manage their own learning processes. In such contexts, engagement is no longer driven solely by instructional delivery but increasingly depends on learners' internal psychological resources, particularly motivation and self-regulation (Broadbent & Lodge, 2021; Martin et al., 2020). Empirical evidence indicates that students in online courses often struggle with maintaining focus, managing time effectively, and sustaining effort compared to those in traditional face-to-face settings (Bond et al., 2020). These challenges are especially pronounced in large-scale digital systems such as those implemented across Chinese higher education, where rapid technological expansion has not always been accompanied by equivalent development in learner-support mechanisms.

Within this landscape, the quality of the online learning environment has emerged as a central factor influencing student outcomes. Research demonstrates that elements such as course structure, instructor support, interaction opportunities, and feedback significantly shape students' perceptions of the learning experience and their willingness to participate actively (Martin et al., 2020; Bond et al., 2020). However, environmental quality alone does not automatically translate into meaningful engagement. Students exposed to similar platforms and instructional designs frequently display varying levels of behavioral, emotional, and cognitive engagement. This variability suggests that internal learner-level mechanisms mediate the relationship between environmental conditions and engagement outcomes.

Self-regulated learning has been widely recognized as a foundational process in online education. According to social cognitive perspectives, self-regulation involves goal setting, strategic planning, monitoring, and self-reflection, enabling learners to adapt to complex learning environments (Zimmerman & Schunk, 2011; Panadero, 2017). In technology-mediated settings where external monitoring is limited, self-regulation becomes particularly critical. Yet, prior research has often conceptualized self-regulation as a direct predictor of engagement, overlooking the motivational processes through which regulatory behaviors exert their influence. Motivation, especially when understood through contemporary theoretical perspectives emphasizing autonomy, competence, and value, plays a key role in energizing and sustaining engagement in online contexts (Panadero, 2017; Broadbent & Lodge, 2021).

Despite growing acknowledgment of these relationships, relatively few empirical studies have simultaneously examined motivation and self-regulation as mediating mechanisms between the online learning environment and student engagement. Existing models frequently test bivariate associations—such as environment-to-engagement or self-regulation-to-performance—without integrating these constructs into a unified explanatory framework. This limitation is particularly evident in research conducted within Chinese higher education, where much attention has focused on technology adoption and system implementation rather than on learner-level psychological processes that sustain engagement. To address this gap, the present study proposes and tests an integrated structural model in which motivation and self-regulation function as mediators between online learning environment quality and student engagement among Chinese university students. By employing a PLS-SEM approach, the study aims to move beyond simple correlation-based explanations and provide a mechanism-driven understanding of how environmental factors translate into active engagement through internal psychological processes. Such an approach contributes to both theory and practice by clarifying the pathways through which online learning environments can effectively foster sustained student engagement in the context of Chinese higher education.

Problem Statement

Despite sustained global investment in digital education, student engagement in online learning environments remains uneven and inconsistent. Large-scale syntheses indicate that online instruction can achieve outcomes comparable to face-to-face formats when pedagogical conditions are carefully designed (Means et al., 2013), yet substantial variability persists in students' persistence, participation intensity, and behavioral involvement in online courses (Broadbent & Poon, 2015). These disparities suggest that technological infrastructure and instructional design alone are insufficient to explain differences in how actively students engage in digital learning contexts. Emerging research increasingly highlights learner-level psychological processes as central determinants of engagement in online settings. Self-regulated learning (SRL), defined as learners' active regulation of cognition, motivation, and behavior (Zimmerman, 2002), has been consistently associated with adaptive learning behaviors in virtual environments (Barnard-Brak et al., 2010; Broadbent & Poon, 2015); however, much of the literature conceptualizes SRL as a direct predictor of outcomes without fully clarifying how it operates within motivational processes to sustain behavioral, emotional, and cognitive engagement. Likewise, motivation is frequently modeled as an independent variable rather than as a mediating mechanism through which environmental characteristics shape students' active involvement in learning activities (Schunk & DiBenedetto, 2020; Jansen et al., 2019). Accordingly, understanding engagement in online learning requires a process-oriented perspective in which features of the learning environment—such as autonomy support, interaction opportunities, feedback, and structural clarity—first influence students' motivation and self-

regulatory capacities, which in turn foster sustained and meaningful engagement among Chinese university students.

Moreover, although the perceived quality of the online learning environment has been shown to influence students' motivation and engagement (Martin & Bolliger, 2018; Kahu & Nelson, 2018), its indirect effect through self-regulation remains insufficiently examined. Existing research often focuses on the direct associations between environmental features and engagement, while overlooking the regulatory mechanisms that may translate environmental support into sustained behavioral, emotional, and cognitive involvement. Without empirically testing these mediated pathways, institutional interventions may overemphasize platform design and technological enhancements while neglecting the deeper motivational and self-regulatory processes that underpin meaningful engagement. Therefore, an empirically validated structural model integrating online learning environment quality, self-regulation, motivation, and engagement is necessary to clarify how engagement is fostered in digital contexts. This need is particularly salient within the Chinese university context, where rapid digital transformation calls for evidence-based explanatory models that move beyond technology adoption and instead illuminate the psychological processes that sustain student engagement in online learning.

LITERATURE REVIEW

Self-Regulated Learning in Online Education

Self-regulated learning refers to learners' active control over cognitive, motivational, and behavioral aspects of learning, including goal setting, strategy use, time management, self-monitoring, and reflection (Zimmerman, 2000). In online learning environments, self-regulation is particularly critical due to reduced external structure and limited real-time instructor oversight.

Meta-analytic and systematic review evidence indicates that self-regulation is strongly associated with academic achievement in online and blended learning contexts (Broadbent & Poon, 2015; Wong et al., 2019). Students who demonstrate higher levels of self-regulation are more likely to persist in online courses, manage competing demands, and effectively utilize digital learning resources. This perspective suggests that self-regulation may function as an enabling condition whose impact depends on downstream psychological processes.

Motivation as a Psychological Mechanism

Motivation plays a central role in determining the intensity, direction, and persistence of learning behavior. According to self-determination theory, motivated learners are more likely to exert effort, persist in the face of difficulty, and experience higher-quality engagement (Ryan & Deci, 2020). In online learning, motivation is particularly sensitive to perceptions of autonomy, competence, and instructional support. Empirical studies have consistently linked motivation to engagement in online learning environments (Howard et al., 2021; Xie et al., 2023). Importantly, motivation has been shown to mediate the effects of instructional design and learner characteristics on engagement, suggesting its role as a transmission mechanism rather than a simple antecedent. Building on this literature, the present study conceptualizes motivation as a mediator that translates self-regulatory capacity and environmental affordances into observable academic engagement.

Conceptual Framework and Hypotheses

Based on self-regulated learning theory and self-determination theory, this study proposes a conceptual model in which the online learning environment influences self-regulation and motivation, which in turn affect engagement.

Specifically, the model assumes that:

- A supportive online learning environment enhances students' self-regulatory capacity and motivation.
- Self-regulation increases engagement.

- Motivation enhances engagement.
- Learning environment serves as a proximal predictor of Engagement.
- Motivation and self-regulation mediate the relationships between learning environment and engagement.

Accordingly, the following hypotheses were tested:

- H1: Online learning environment positively influences self-regulation.
- H2: Online learning environment positively influences motivation.
- H3: Self-regulation positively influences engagement.
- H4: Motivation positively influences engagement.
- H5: Online learning environment positively influences engagement.
- H6: Motivation and self-regulation mediate the relationship between Online learning environment and engagement.

METHODOLOGY

Research design and approach

The study applies a positivist paradigm and a quantitative, cross-sectional survey design, suitable for testing theoretically specified relationships among latent constructs using statistical modeling (Creswell & Creswell, 2018; Neuman, 2014). Cross-sectional designs are common in online learning research because they allow simultaneous measurement of multiple constructs and efficient sampling of large student populations.

Population and sampling

The study involved undergraduate students enrolled in online learning courses within Chinese higher education institutions. A multistage sampling approach was employed to select 1,521 participants, as complete student lists were not readily available. However, cluster frames, such as faculties, were accessible and served as the sampling units.

Instrumentation and measures

Data were collected using a structured questionnaire comprising validated subscales measuring the online learning environment, self-regulation, motivation, and engagement using 82 items. Constructs were measured using a structured questionnaire with Likert-type responses. The measurement model demonstrated excellent reliability and validity, with Cronbach's alpha values ranging from 0.924 to 0.968 and AVE values above 0.59 for all constructs. SRL items reflected goal setting, time management, strategy use, monitoring, and help seeking; motivation assessed intrinsic and extrinsic drivers; engagement assessed behavioral, emotional, and cognitive engagement. Measurement development should reference validated scales and online learning research syntheses. This approach aligns with established practice in SRL and online learning measurement (Broadbent & Poon, 2015).

Data analysis method (PLS-SEM)

PLS-SEM was used due to its suitability for prediction-oriented modeling and complex mediation testing. The analysis followed standard two-stage evaluation: (1) measurement model assessment (indicator reliability, internal consistency, convergent validity, discriminant validity), followed by (2) structural model assessment (collinearity, path significance via bootstrapping, explained variance R^2, predictive relevance Q^2predict, and

model fit indicators such as SRMR). This reporting aligns with widely used PLS-SEM guidelines (Hair et al., 2021) and predictive evaluation recommendations (Shmueli et al., 2019).

RESULTS

Measurement Model Assessment

The measurement model was first evaluated to ensure the reliability and validity of the latent constructs. Indicator reliability was confirmed, as all outer loadings exceeded the recommended threshold of 0.70 (Hair et al., 2017), ranging from 0.717 to 0.873 across constructs. These results indicate that the observed indicators adequately represented their respective latent variables. Internal consistency reliability was supported, with Cronbach's alpha values ranging from 0.931 to 0.945, and composite reliability (rho_c) values ranging from 0.941 to 0.954, exceeding the minimum acceptable value of 0.70. Convergent validity was also established, as all Average Variance Extracted (AVE) values exceeded 0.50, indicating that each construct explained more than half of the variance in its indicators.

Table 1. Reliability and Convergent Validity

Construct	Cronbach's α	rho_a	rho_c	AVE
Engagement	0.945	0.945	0.954	0.721
Self-Regulation	0.944	0.944	0.953	0.718
Learning Environment	0.934	0.934	0.946	0.716
Motivation	0.931	0.933	0.941	0.570

Discriminant validity was assessed using both the Fornell–Larcker criterion and the Heterotrait–Monotrait (HTMT) ratio. The square roots of AVE for each construct exceeded the inter-construct correlations, satisfying the Fornell–Larcker criterion. In addition, all HTMT values were below the conservative threshold of 0.90, confirming adequate discriminant validity (Henseler et al., 2015).

Structural Model Evaluation

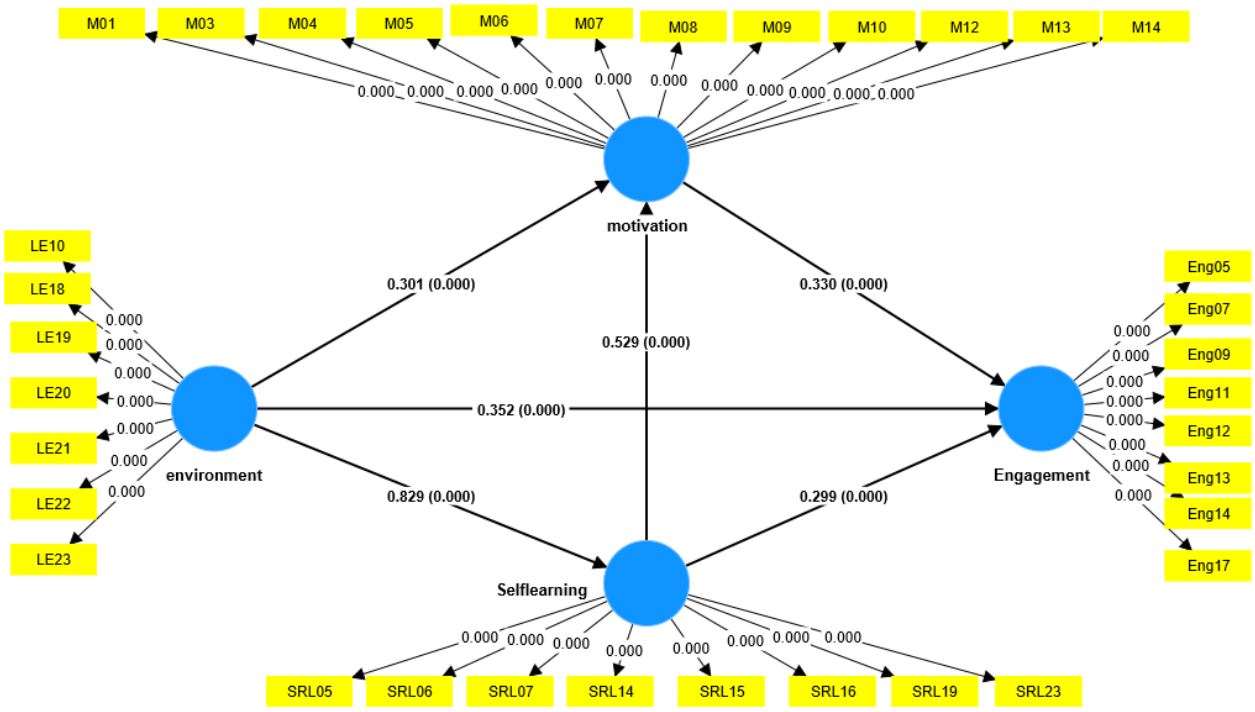
Prior to hypothesis testing, collinearity diagnostics were examined. All Variance Inflation Factor (VIF) values were below 5, indicating that multicollinearity did not threaten the stability of the structural estimates (Hair et al., 2017). The model demonstrated strong explanatory power. The R^2 value for engagement was 0.823, indicating that 82.3% of the variance in engagement was explained by self-regulation, motivation, and the learning environment. The R^2 values for self-regulation (0.688) and motivation (0.634) also indicate substantial predictive power.

Table 2. Coefficient of Determination (R^2)

Endogenous Construct	R^2	Adjusted R^2
Engagement	0.823	0.822
Self-Regulation	0.688	0.687
Motivation	0.634	0.634

Model fit was further supported by the Standardized Root Mean Square Residual (SRMR = 0.054), which is below the recommended threshold of 0.08, indicating a satisfactory model fit (Hair et al., 2017).

Path Coefficients and Hypothesis Testing



Bootstrapping results revealed that all hypothesized direct relationships were statistically significant.

- Self-regulation positively influenced engagement (β = 0.299, $p < .001$) and motivation (β = 0.529, $p < .001$).
- The learning environment had strong direct effects on self-regulation (β = 0.829, $p < .001$), motivation (β = 0.301, $p < .001$), and engagement (β = 0.352, $p < .001$).
- Motivation also positively influenced engagement (β = 0.330, $p < .001$).

Table 3. Direct Effects

Path	β	t-value	p-value
Self-Regulation → Engagement	0.299	8.045	0.000
Self-Regulation → Motivation	0.529	13.461	0.000
Learning Environment → Engagement	0.352	11.748	0.000
Learning Environment → Self-Regulation	0.829	67.760	0.000
Learning Environment → Motivation	0.301	7.543	0.000
Motivation → Engagement	0.330	10.348	0.000

Mediation Analysis

Mediation effects were examined using bootstrapped indirect effects. Results showed that motivation significantly mediated the relationship between self-regulation and engagement (β = 0.174, $p < .001$). In addition, the learning environment exerted significant indirect effects on engagement through self-regulation and motivation, both independently and sequentially.

The total indirect effect of the learning environment on engagement was substantial (β = 0.492, $p < .001$), confirming the presence of partial mediation. These findings indicate that environmental influences on engagement are largely transmitted through students' self-regulatory capacity and motivational processes.

Table 4. Specific Indirect Effects

Indirect Path	β	t-value	p-value
Self-Regulation → Motivation → Engagement	0.174	8.904	0.000
Environment → Self-Regulation → Engagement	0.248	7.893	0.000
Environment → Motivation → Engagement	0.099	5.689	0.000
Environment → Self-Regulation → Motivation → Engagement	0.145	8.879	0.000

DISCUSSION

This study examined the structural relationships among the online learning environment, self-regulation, motivation, and engagement using PLS-SEM. The findings provide strong empirical support for a process-oriented explanation of engagement in online learning, rather than a purely trait-based or technology-driven account. Consistent with prior meta-analytic evidence indicating that contextual and learner-level factors jointly shape online learning experiences (Means et al., 2013; Broadbent & Poon, 2015), the results demonstrate that engagement emerges from the dynamic interplay between environmental quality, regulatory capacity, and motivational processes.

The results confirm that the learning environment plays a foundational role in fostering engagement. It exerted a very strong positive effect on self-regulation (β = 0.829, $p < .001$), alongside significant direct effects on motivation (β = 0.301, $p < .001$) and engagement (β = 0.352, $p < .001$). These findings align with ecological and systems-based perspectives suggesting that learner behaviors are shaped by affordances embedded in instructional design (Dede et al., 2020). Structured course organization, accessible resources, and meaningful interaction reduce cognitive uncertainty and enable students to regulate their learning more effectively. The substantial total indirect effect of the learning environment on engagement (β = 0.492, $p < .001$) further supports the view that environmental influences are largely transmitted through psychological processes rather than operating solely through direct pathways, addressing gaps identified in recent reviews of online learning research (Martin et al., 2020; Bond et al., 2020).

Self-regulation emerged as a central psychological mechanism in the model. It significantly predicted motivation (β = 0.529, $p < .001$) and engagement (β = 0.299, $p < .001$), indicating that students who actively manage goals, strategies, and time are more likely to develop motivational resources and sustain active involvement in learning activities. This finding is consistent with self-regulated learning theory, which conceptualizes regulation as a meta-process enabling learners to mobilize cognitive and motivational resources effectively (Zimmerman, 2000; Panadero, 2017). It also aligns with evidence suggesting that self-regulation exerts its strongest impact in online contexts when it supports sustained effort and task persistence (Broadbent & Lodge, 2021). Importantly, the significant indirect effect of self-regulation on engagement through motivation (β = 0.174, $p < .001$) indicates that motivation partially explains why self-regulated learners remain engaged. This pattern is consistent with self-determination theory, which emphasizes competence, autonomy, and task value as key drivers of sustained engagement (Ryan & Deci, 2020).

Motivation also functioned as a critical transmission mechanism within the structural model. Beyond its direct effect on engagement (β = 0.330, $p < .001$), motivation mediated the effects of both self-regulation and the learning environment on engagement. The specific indirect effects—Environment → Motivation → Engagement (β = 0.099, $p < .001$) and Environment → Self-Regulation → Motivation → Engagement (β = 0.145, $p < .001$)—demonstrate that motivational processes translate both contextual support and regulatory capacity into

observable involvement. This extends prior research that treated motivation primarily as a direct antecedent of engagement by empirically confirming its mediating role in online learning contexts (Howard et al., 2021; Xie et al., 2023). Furthermore, although motivation significantly predicted engagement, the stronger direct and indirect effects of the learning environment underscore that motivation operates most effectively within supportive contextual conditions, reinforcing calls to examine how instructional environments cultivate motivational processes rather than attributing engagement solely to individual differences (Bond et al., 2020; Kahu & Nelson, 2018).

Overall, the model demonstrates that engagement in online learning is the result of coordinated environmental, regulatory, and motivational influences. By empirically specifying both direct and mediated pathways, the study advances a comprehensive structural explanation of engagement among Chinese university students, showing that high-quality online environments enhance engagement primarily by strengthening students' self-regulatory capacity and motivational resources.

Contributions

This study addresses a clear gap in the online learning literature: while prior research has established that the learning environment, motivation, and self-regulation are all associated with engagement, limited empirical work has examined how these variables operate together within a mediated structural process—particularly in the context of Chinese university students. Existing studies have often treated motivation and self-regulation as parallel predictors of engagement or as isolated individual traits, without specifying the mechanisms through which environmental quality translates into sustained behavioral, emotional, and cognitive involvement. By explicitly modeling motivation and self-regulation as mediators between the online learning environment and engagement, this study fills that conceptual and empirical gap.

First, this research offers a theoretical contribution by proposing and empirically validating a process-based structural model of engagement in online learning. Rather than conceptualizing engagement as a direct outcome of environmental design or as a simple function of individual traits, the study demonstrates that engagement emerges through interconnected regulatory and motivational pathways. This extends self-regulated learning theory (Zimmerman, 2000; Panadero, 2017) by situating regulation within a broader motivational transmission system and clarifies that regulatory capacity translates into engagement partly through its influence on students' motivational resources. In doing so, the study moves beyond static, trait-based interpretations and supports a dynamic understanding of engagement as a psychologically mediated process.

Second, the study contributes to motivational theory in online learning by clarifying the functional role of motivation as a mediating mechanism rather than merely an antecedent variable. While self-determination theory emphasizes the importance of autonomy, competence, and intrinsic motivation (Ryan & Deci, 2020), empirical research in online contexts has often modeled motivation as a direct predictor of engagement. This study demonstrates that motivation operates as a transmission pathway through which both environmental quality and self-regulatory capacity are converted into active involvement. By empirically specifying these indirect relationships, the study refines how motivational processes function within digitally mediated learning environments and integrates self-determination theory more coherently into online engagement research.

Third, the study advances the literature by repositioning the online learning environment as a powerful upstream determinant of engagement. Prior research has frequently emphasized learner-level characteristics while under-theorizing environmental influences (Bond et al., 2020; Martin et al., 2020; Kahu & Nelson, 2018). The present findings demonstrate that environmental quality does not merely influence engagement directly; rather, it shapes students' capacity to self-regulate and sustain motivation, which in turn drives engagement. This context-sensitive model responds directly to critiques that online learning research has overemphasized individual differences and insufficiently accounted for instructional design and systemic factors.

From a practical perspective, the study provides actionable insights for higher education institutions undergoing digital transformation. The findings indicate that enhancing engagement requires more than technological upgrades; it requires intentionally designed learning environments that cultivate regulatory skills and motivational strength. Course designers should prioritize clarity, structured guidance, interactive opportunities,

and meaningful feedback to support students' regulatory processes. Universities should embed structured self-regulation scaffolds—such as guided goal setting, reflective checkpoints, and time-management supports—within online courses. Importantly, these supports should be framed in ways that enhance students' sense of autonomy and competence, thereby strengthening the motivational foundations of engagement.

Collectively, these contributions provide a theoretically integrated and empirically validated explanation of how engagement is fostered in online learning among Chinese university students. By identifying the mechanisms through which environmental conditions are translated into active involvement, this study offers both a refined conceptual framework and a practical roadmap for designing engagement-oriented digital learning systems.

CONCLUSION

This study demonstrates that engagement in online learning is best understood as a mediated psychological process shaped by the interaction between the learning environment, self-regulation, and motivation. Rather than functioning as an automatic outcome of digital access or platform quality, engagement emerges when supportive environmental conditions strengthen students' regulatory capacity and motivational resources. The findings clarify that environmental design alone is insufficient unless it actively cultivates students' ability to manage their learning and sustain meaningful involvement in academic tasks.

By empirically validating an integrated structural model in the context of Chinese university students, this research advances a mechanism-based explanation of online engagement. It moves beyond fragmented or variable-centered approaches and offers a coherent framework that explains how contextual and psychological factors jointly produce sustained behavioral, emotional, and cognitive engagement. In doing so, the study provides both theoretical refinement and practical direction for institutions seeking to enhance engagement within digitally mediated higher education environments.

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