Article

How Does Digital Connection Shape Cultural Adaptation? The Impact of Social Media Use on the Cross-Cultural Adaptation of International Students in China

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ABSTRACT

This study proposes and validates a sequential digital–physical–psychological (DPP) pathway model to explain how social media use facilitates international students' cross-cultural adaptation through behavioral and psychological mediation. Building on media system dependency theory and social learning theory, the model posits that digital engagement (e.g., WeChat interactions) initiates a cascading process: it first reduces barriers to extracurricular activity participation, which subsequently enhances the sense of multidimensional social integration (psychological identification, social interaction, and cultural adaptation). Data from 713 international students at Chinese universities,

analyzed via structural equation modeling, confirmed significant direct (β = 0.27, p < 0.001) and chain-mediated effects (β = 0.04, p < 0.001), demonstrating that adaptation progresses sequentially from the digital domain to the physical domain to the psychological domain. The findings challenge parallel-process frameworks such as Ward's ABC model, instead emphasizing the temporal dynamics of digital-era acculturation. By integrating digital pathways into adaptation theory, this study advances a structured framework for understanding technology-mediated intercultural transitions. These findings address critical gaps in acculturation research by integrating digital pathways and temporal dynamics, offering evidence-based strategies for universities to design integrated digital–physical support systems.

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INTRODUCTION

The convergence of digital transformation and international educational mobility represents a defining challenge in contemporary higher education, particularly within China's rapidly expanding international student ecosystem. As the world's second-largest destination for international students, China enrolled more than 492,000 international students in 2019, demonstrating sustained growth despite fluctuations in global mobility (Ministry of Education China, 2021). This expansion has occurred within a distinctive digital communication landscape characterized by platform-specific ecosystems—notably WeChat's dominance—and regulatory frameworks that fundamentally differentiate Chinese social media environments from their Western counterparts (Yang et al., 2018). For international students navigating cultural adaptation, these digital–physical intersections create unique opportunities and challenges requiring sophisticated theoretical frameworks to understand technology-mediated acculturation processes (Zhang & Ting, 2025).

China's distinctive social media policy environment significantly influences international students' digital adaptation strategies (Koech et al., 2025). Unlike Western contexts, where platform diversity enables varied engagement patterns, China's integrated digital ecosystem centers on WeChat's multifunctional capabilities, combining messaging, social networking, payment systems, and cultural information access (Forbush & Foucault-Welles, 2016). This platform consolidation creates concentrated dependency relationships that amplify media system effects while providing structured pathways for cultural learning and social integration. Additionally, platform restrictions on Facebook, Twitter, and other Western social media necessitate adaptive digital strategies that may catalyze deeper engagement with local digital cultures, potentially accelerating adaptation processes through focused cultural exposure (Sandel, 2014; Yang et al.,2025).

Contemporary cross-cultural adaptation research has demonstrated an increasing recognition of the role of digital engagement in facilitating the cultural adjustment of international students; however, theoretical frameworks inadequately address two critical gaps. First, existing models emphasize parallel adaptation processes rather than sequential mechanisms through which digital engagement transforms into behavioral participation and psychological integration (Ward & Geeraert, 2016). Second, traditional acculturation frameworks developed in predigital contexts inadequately capture how technology-mediated cultural exposure initiates cascading adaptation processes, limiting theoretical precision in contemporary international education research (Zhang & Goodson, 2011).

Building upon media system dependency theory and social learning theory, this investigation proposes an integrated digital–physical–psychological (DPP) pathway model that explicates sequential mechanisms linking digital engagement to successful cross-cultural adaptation (Figure 1).
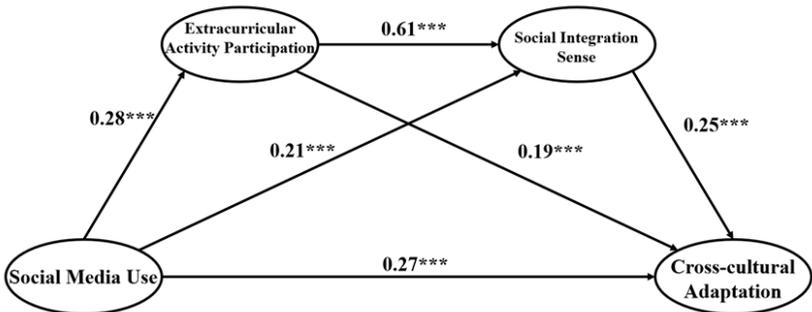

Figure 1: Research models: Path analysis model of social media use, cross-cultural adaptation, extracurricular activity participation, and social integration sense

The DPP framework advances the theoretical understanding by demonstrating how social media use catalyzes extracurricular activity participation, which subsequently enhances multidimensional social integration, ultimately facilitating comprehensive cultural adaptation. This sequential perspective addresses recent calls for more sophisticated temporal dynamics in acculturation theory while providing empirical validation for technology-mediated adaptation processes (Q. Yu et al., 2019).

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Theoretical Foundation

Contemporary investigations of international students' digital-era adaptation necessitate theoretical integration spanning media dependency, social learning, and acculturation frameworks. Media system dependency theory (MSDT) provides foundational insights into how environmental uncertainty amplifies media reliance, which is particularly relevant for international students experiencing cultural transition stress (Kim & McKay-Semmler, 2013). In Chinese contexts, this dependency becomes concentrated through platform consolidation, creating intensified relationships between digital engagement and adaptation outcomes. Social learning theory (SLT) complements MSDT by explicating observational learning mechanisms through which digital cultural exposure translates into behavioral competencies and psychological adaptation (Bandura, 2001).

The proposed digital–physical–psychological (DPP) framework synthesizes these perspectives into a sequential pathway model addressing temporal dynamics inadequately captured in traditional acculturation theories. Unlike Ward's ABC model, which conceptualizes affective, behavioral, and cognitive adaptation as parallel processes, the DPP framework posits sequential activation: digital engagement reduces barriers to physical participation, which subsequently facilitates psychological integration (Ward et al., 2018). This temporal sequencing aligns with recent longitudinal evidence demonstrating staged adaptation processes while extending the theoretical understanding to include digital initiation mechanisms (Zhou et al., 2008).

Social Media Use and Cross-Cultural Adaptation

The relationship between social media use and cross-cultural adaptation represents a critical area of investigation in international education research. Recent empirical developments necessitate a systematic examination of this relationship within increasingly digitalized educational environments, particularly given the transformative role of social media in international students' adaptation processes (Shu et al., 2020).

Social media use in international education contexts encompasses multiple dimensions, including intensity of use, types of engagement, and platform diversity. Contemporary conceptualizations emphasize the multifaceted nature of

social media use, distinguishing between passive consumption, active interaction, and content creation behaviors. Empirical research has identified distinct patterns of social media usage among international students, ranging from information seeking to relationship maintenance and cultural exploration (Forbush & Foucault-Welles, 2016). This nuanced understanding has become particularly relevant as international students increasingly rely on digital platforms for both informational and social support during cross-cultural transitions.

Meta-analyses (Zhang & Goodson, 2011) and longitudinal evidence (Rui & Wang, 2015) confirm that social media's informational and relational functions (e.g., WeChat's 'Moments' for cultural learning) directly predict adaptation. However, platform-specific effects (Sandel, 2014) and qualitative engagement differences (Gomes et al., 2014) remain understudied, motivating our multidimensional approach. Based on these theoretical foundations and empirical evidence, we propose the following:

> H₁: Social media use positively predicts international students' cross-cultural adaptation, such that higher levels of social media use are associated with enhanced adaptation outcomes.

The Mediating Role of Extracurricular Activity Participation

Extracurricular activity participation represents a crucial behavioral mechanism potentially mediating the relationship between social media use and cross-cultural adaptation. This mediation pathway warrants systematic theoretical examination within the context of international students' adaptation processes, particularly given the established importance of structured activities in facilitating cultural learning (Glass et al., 2014).

The theoretical linkage between social media use and extracurricular activity participation is grounded in social capital theory and behavioral engagement frameworks. Empirical evidence suggests that social media platforms serve as catalysts for physical participation by reducing informational barriers and enhancing participation motivation (Tran & Pham, 2016). Research examining international students' engagement patterns has demonstrated that digital platforms significantly facilitate activity awareness ($\beta = 0.38$, $p < .001$) and reduce participation anxiety through preliminary virtual exposure to cultural activities (Rose-Redwood & Rose-Redwood, 2013).

Extracurricular activity participation has been consistently identified as a significant predictor of successful cross-cultural adaptation. The meta-analytic findings of Smith and Khawaja (2011) indicate robust positive associations between structured activity participation and various adaptation outcomes. Recent longitudinal studies have further validated these relationships, demonstrating significant correlations between activity participation and sociocultural adjustment across diverse cultural contexts (Rienties et al., 2012). These effects operate through multiple mechanisms, including enhanced cultural learning opportunities, social network development, and structured intergroup contact experiences (Glass & Westmont, 2014).

However, existing research has focused primarily on activity participation in isolation, without considering its role within broader digital-to-physical adaptation pathways. A significant theoretical gap exists in understanding how social media use facilitates meaningful participation in extracurricular activities, which in turn promotes adaptation. While recent studies have begun examining behavioral engagement pathways (Gomes et al., 2014), comprehensive theoretical models that integrate online engagement with offline participation remain underdeveloped. This limitation is particularly noteworthy given the increasing integration of digital and physical spaces in contemporary educational environments. Since these theoretical foundations and empirical evidence, we propose the following:

> H2: Extracurricular activity participation mediates the relationship between social media use and cross-cultural adaptation such that increased social media use leads to increased activity participation, which in turn facilitates adaptation outcomes.

The Mediating Role of Social Integration Sense

Social integration represents a critical psychological mechanism in cross-cultural adaptation processes, warranting theoretical examination as a potential mediator between social media use and adaptation outcomes. Contemporary conceptualizations emphasize its multidimensional nature, building upon established theoretical frameworks in international education research (Rienties & Tempelaar, 2013).

Recent empirical investigations have established social integration sense as a three-dimensional construct in cross-cultural contexts (Ward et al., 2018). This conceptualization transcends traditional unidimensional approaches by recognizing the distinct yet interrelated aspects of psychological attachment, behavioral engagement, and cultural competence. Meta-analytic evidence from cross-cultural adaptation research supports this multidimensional structure (Zhang & Goodson, 2011), demonstrating differential relationships between each dimension and various adaptation outcomes. For instance, Jindal-Snape and Rienties (2016) reported that psychological identification, social interaction, and cultural adaptation uniquely contribute to international students' adjustment outcomes.

The relationship between social media use and social integration operates through multiple theoretical pathways, as demonstrated in recent longitudinal studies (Q. Yu et al., 2019). Digital engagement facilitates the development of psychological identification through virtual community participation and cultural exposure (Glass & Westmont, 2014). This process is particularly evident in studies examining international students' social media usage patterns, which show significant positive associations between platform engagement intensity and social integration dimensions (Gomes et al., 2014). However, as Rienties et al. (2012) noted, the temporal sequence and relative strength of these relationships across different cultural contexts remain incompletely understood.

A significant theoretical gap exists in understanding how the sense of social integration mediates the relationship between digital adaptation and social integration. While recent research has begun examining psychological mediating mechanisms (Lee & Ciftci, 2014), comprehensive models that integrate all three dimensions of social integration remain underdeveloped. This limitation is particularly noteworthy given the increasing recognition of psychological processes in digital-era adaptation, as highlighted in systematic reviews of international student adjustment (R. A. Smith & Khawaja, 2011).

On the basis of these theoretical foundations and empirical evidence, we propose the following:

> H_3:   The sense of social integration mediates the relationship between social media use and cross-cultural adaptation such that increased social media use enhances (a) psychological identification (via virtual cultural exposure and belonging), (b) social interaction (through expanded network bridging), and (c) cultural adaptation (via observational learning of norms), ultimately facilitating adaptation outcomes.

Chain-mediated Effect Model

The integration of behavioral and psychological pathways in cross-cultural adaptation necessitates a theoretical examination of sequential processes through which digital engagement transforms into successful adaptation outcomes. The chain-mediated effect model provides a sophisticated theoretical framework for understanding these sequential processes, building upon established theoretical traditions in international education research.

Recent developments in cross-cultural adaptation theory suggest that adaptation outcomes emerge through cascading mechanisms rather than parallel processes (Demes & Geeraert, 2014). This sequential perspective aligns with empirical evidence demonstrating that behavioral engagement typically precedes psychological integration in cross-cultural adaptation processes. For example, longitudinal research revealed significant temporal ordering effects between behavioral participation and subsequent psychological adaptation, supporting the sequential nature of adaptation processes (Zhou et al., 2008).

The proposed chain-mediated model posits that social media use initiates a sequential process whereby increased participation in extracurricular activities precedes and facilitates the development of social integration. This theoretical proposition builds upon empirical evidence from studies examining the adaptation trajectories of international students (Rienties et al., 2012). Recent meta-analytic findings (R. A. Smith & Khawaja, 2011) support this temporal sequence, indicating stronger adaptation outcomes when behavioral engagement precedes psychological integration than when it precedes concurrent or reverse-ordered processes (Glass & Westmont, 2014).

A critical theoretical advancement in our understanding has emerged from recent longitudinal studies of international student adaptation (Q. Yu et al., 2019).

These findings suggest that digital engagement must first catalyze behavioral participation before meaningful psychological integration can occur. For example, Lee & Ciftci (2014) reported that international students' online engagement significantly predicts their subsequent participation in campus activities, which in turn facilitates psychological adaptation. This sequential process framework addresses a significant gap in the literature by explicating the temporal and causal mechanisms linking digital, behavioral, and psychological adaptation processes. Hence, we hypothesize the following:

> H4: The relationship between social media use and cross-cultural adaptation is sequentially mediated by extracurricular activity participation and social integration, such that social media use enhances activity participation, which subsequently facilitates social integration, ultimately leading to improved adaptation outcomes.

METHOD

Participants and Sampling Procedures

This study employed a multistage stratified random sampling approach following established protocols for cross-cultural research (van de Vijver & Leung, 2021). The sampling framework targeted international students from four comprehensive universities in Guangxi Province, China, who were selected on the basis of institutional diversity criteria, including enrollment size, academic programs, and geographical location. To ensure adequate cultural exposure and response validity, participation was restricted to students with a minimum of six months of residence in China, which is consistent with previous cross-cultural adaptation research (Demes & Geeraert, 2014).

Sample size determination followed rigorous power analysis procedures using G*Power 3.1. The a priori analysis indicated a minimum required sample of 395 participants ($\alpha = .05$, *power = .95*, *effect size = .30*) for detecting medium effect sizes in structural equation modeling with multiple mediators (MacCallum et al., 1996). The final sample of 713 valid responses (*response rate = 89.13%*) substantially exceeded this requirement, providing adequate statistical power for both primary analyses and subgroup comparisons.

Participant recruitment followed institutional review board-approved protocols, with stratification based on academic level, field of study, and geographical origin to ensure a representative sample. The sample demographics aligned with the broader international student population in Chinese higher education (Ministry of Education China, 2021), comprising the following:

(1) Demographics: Age range: 18–29 years ($M = 23.77$, $SD = 4.32$); gender distribution: 47.97% male ($n = 342$), 52.03% female ($n = 371$); academic level: 74.19% undergraduate ($n = 529$), 25.81% graduate ($n = 184$);

(2) Geographical representation: Asia: 53.58% ($n = 382$); Africa: 38.15% ($n = 272$); Oceania: 2.66% ($n = 19$); Europe: 1.68% ($n = 12$); South America: 1.54% ($n = 11$); North America: 1.40% ($n = 10$); Unreported: 0.98% ($n = 7$).

The sampling procedure included several methodological controls to minimize selection bias and ensure response quality. First, questionnaire distribution was conducted through official university international student offices to ensure comprehensive coverage. Second, participation was voluntary and anonymous, with informed consent obtained following established ethical guidelines for cross-cultural research (J. A. Smith et al., 2021). Third, response validity was enhanced through careful translation procedures and pilot testing with a representative subsample ($n = 30$) to ensure instrument clarity and cultural appropriateness.

Measures

Social Media Use

Social media use was assessed via the Social Media Intensity Scale (Ellison et al., 2007), a validated instrument comprising eight items measuring both behavioral and attitudinal dimensions of platform usage. Following recent adaptations for cross-cultural contexts (Huang, 2018), the scale was modified to incorporate WeChat-specific engagement patterns while maintaining construct equivalence. The instrument assesses both objective metrics (e.g., number of connections, daily usage duration) and subjective dimensions of engagement via a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree).

Confirmatory factor analysis supported the unidimensional structure ($\chi2/df = 2.07$, NFI = .96, *CFI = .93, GFI = .91, TLI = .91, RMSEA = .03* [90% CI: .02, .04]), which is consistent with validation studies in international student populations (Dong et al., 2023). The scale demonstrated strong internal consistency (Cronbach's $\alpha = .81$) and satisfactory test–retest reliability ($r = .84$, $p < .001$) in the pilot test ($n = 30$).

Cross-cultural Adaptation

Cross-cultural adaptation was measured using the Sociocultural Adaptation Scale (Ward & Kennedy, 1999), which was modified according to Sheng et al.'s (2022) protocols for international student contexts. The 14-item instrument assesses both the psychological and sociocultural dimensions of adaptation, with items rated on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). Factor analysis confirmed the theoretically derived two-factor structure, with psychological adaptation ($\alpha = .86$) and sociocultural adaptation ($\alpha = .83$) emerging as distinct but related dimensions ($r = .45$, $p < .001$).

The scale exhibited robust psychometric properties (*Cronbach's $\alpha = .84$*) and strong construct validity indices ($\chi2/df = 3.22$, *NFI = .95, CFI = .95, GFI = .92, TLI = .93, RMSEA = .04* [90% CI: .03, .05]). Measurement invariance testing across cultural groups supported configural, metric, and scalar invariance ($\Delta CFI < .01$), validating cross-cultural comparability.

Extracurricular Activity Participation

Participation in extracurricular activities was assessed via the Campus Activity Engagement Scale (Glass et al., 2014), which evaluates involvement in structured campus activities, social practices, and cultural events. The six-item measure employs a 5-point Likert scale (1 = very rarely, 5 = very frequently), with items covering diverse participation domains identified through previous qualitative research with international students (Glass & Westmont, 2014).

The scale demonstrated excellent reliability (*Cronbach's α* = .85) and acceptable construct validity indices ($χ2/df$ = 3.79, *NFI* = .90, *CFI* = .90, *GFI* = .91, *TLI* = .90, *RMSEA* = .05 [90% CI: .04, .06]). Convergent validity was supported by significant correlations with established measures of campus integration (r = .56, p < .001) and cultural engagement (r = .48, p < .001).

Social Integration Sense

Social integration sense was measured via a multidimensional scale developed on the basis of established theoretical frameworks (Rienties et al., 2012; Ward et al., 2009). The instrument was designed to assess three theoretically derived dimensions, namely, psychological identification, social interaction, and cultural adaptation, following recent meta-analytic evidence on international students' integration processes (Perkmann et al., 2021).

Scale development followed systematic procedures outlined by DeVellis and Thorpe (2021) for cross-cultural instrument validation. Initial item generation was informed by a comprehensive literature review and focus group interviews with international students (n = 25), following protocols established by Hendrickson et al. (2011). Content validity was established through an expert review (n = 8) comprising specialists in international education, cross-cultural psychology, and psychometrics.

Exploratory factor analysis (EFA) was conducted on a calibration sample (n = 356) via principal axis factoring with promax rotation, following best practices for scale development in cross-cultural research (Byrne & van de Vijver, 2017). EFA via principal axis factoring (*KMO* = 0.89, Bartlett's test: $χ²$ = 1,204.33, p < .001) with promax rotation revealed a 3-factor structure (*loadings* > 0.50, cross-loadings < 0.30). The composite reliability (*CR* = 0.85–0.91) and *AVE* (0.52–0.67) exceeded the thresholds. Six items were dropped because of low communality (< 0.40). The resulting three-factor structure explained 66.9% of the total variance, aligning with theoretical expectations (see Table 1).

Table 1. Factor Analysis of the Social Integration Sense Scale

Variable	Factor1 (Psychological Identification)	Factor2 (Social Interaction)	Factor3 (Cultural Adaptation)	Uniqueness
Student Identification	0.78	0.02	0.17	0.25
Life Integration	0.81	0.07	0.03	0.27
Life Satisfaction	0.88	-0.03	0.04	0.21
Cultural Customs	0.11	0.13	0.81	0.29
Local Language	0.09	-0.09	0.80	0.31
Local Interaction	0.02	0.88	-0.09	0.23
Cumulative Variance	28.6%	45.1%	66.9%	

Research procedures and data analysis

The study protocol was approved by the institutional review board, and informed consent was obtained from all participants in accordance with ethical guidelines for cross-cultural research (P. B. Smith et al., 2013). Data collection occurred during the 2023--2024 academic year, with questionnaires administered in both English and Chinese following rigorous translation-back-translation procedures. Bilingual experts ($n = 4$) conducted translation-back-translation, resolving discrepancies through iterative discussions. Cultural adaptations included replacing 'campus clubs' with 'student associations' to reflect Chinese institutional terminology.

Common method bias was assessed via Harman's single-factor test (Podsakoff et al., 2012) and the common latent factor approach (Williams et al., 2010). Structural equation modeling was conducted via Mplus 8.0, which employs robust maximum likelihood estimation to account for potential nonnormality. Mediation effects were tested via bias-corrected bootstrap procedures with 5,000 resamples, following contemporary best practices in meditation analysis (Hayes, 2017). Statistical significance was set at $p < .05$ (two-tailed). Control variables (gender and age) were included based on prior evidence (Zhang & Goodson, 2011).

RESULTS

Common Method Variance Assessment

To address potential common method bias, we employed multiple analytical procedures following contemporary methodological recommendations (Podsakoff et al., 2012). Harman's single-factor test revealed 19 factors with eigenvalues greater than 1.0, with the first factor accounting for 21.99% of the total variance, well below the 40% threshold, indicating significant common method bias (Williams et al., 2010). Additionally, we conducted a confirmatory factor analysis comparing a single-factor model against our hypothesized multifactor model, finding a significantly better fit for the latter ($\Delta\chi2 = 892.45$, *df* = 15, *p* < .001), further supporting the absence of substantial common method variance. Gender, age, and education level were controlled for because of their established associations with adaptation (Zhang & Goodson, 2011). Language proficiency and duration of stay were excluded, as preliminary analyses revealed nonsignificant correlations (|r| < 0.10, *p* > .05).

Descriptive Statistics and Correlation Analysis

Table 2 presents the mean standard deviations and zero-order correlations among the study variables. Preliminary analysis confirmed that all variables met normality assumptions (skewness < |2.0|, kurtosis < |7.0|; Kline, 2023). Social media use demonstrated significant positive correlations with cross-cultural adaptation (*r* = .31, *p* < .01), extracurricular activity participation (*r* = .26, *p* < .001), and social integration sense (*r* = .24, *p* < .001), providing initial support for our theoretical framework. Notably, extracurricular activity participation was strongly positively associated with both social integration (*r* = .49, *p* < .001) and cross-cultural adaptation (*r* = .33, *p* < .001), which is consistent with previous findings on behavioral engagement mechanisms (Tang & Zhang, 2023). Social integration sense was significantly correlated with cross-cultural adaptation (*r* = .37, *p* < .001), supporting theoretical predictions about psychological adaptation pathways (Ward & Geeraert, 2016).

Table 2: Descriptive Statistics and Correlation Analysis

Variables	*M*	*SD*	1	2	3	4
Social Media Use	3.51	0.84	1			
Extracurricular Activity Participation	3.53	1.19	0.26***	1		
Social Integration Sense	2.61	0.73	0.24***	0.49***	1	
Cross-Cultural Adaptation	3.08	0.61	0.31**	0.33***	0.37***	1

Note. ***p* < 0.001, **p* < 0.01.

These correlation patterns align with the progressive integration model (Berry, 2005), suggesting sequential relationships between digital engagement, behavioral participation, and psychological adaptation. The magnitude of correlations (ranging from .24 to .49) indicates meaningful relationships while avoiding multicollinearity concerns (all VIF values < 2.5; Murtagh & Heck, 1987).

Results of chain mediating effect analysis

To examine the hypothesized chain-mediated relationships, we employed structural equation modeling (SEM) via Mplus 8.0 with robust maximum likelihood estimation. Following contemporary methodological recommendations (Murtagh & Heck, 1987), we employed the item-parceling approach to enhance model parsimony and minimize measurement errors. Parcels were created via the random assignment method, ensuring balanced factor loadings across indicators (Matsunaga, 2008).

The measurement model demonstrated satisfactory fit: $\chi2/df$ = 3.74, *CFI* = .93, *TLI* = .92, *SRMR* = .06, *RMSEA* = .05 (90% CI [.031, .039]). All factor loadings were significant ($p < .001$) and exceeded .60, supporting construct validity. The composite reliability indices ranged from .81-- .89, indicating good internal consistency (Matsunaga, 2008).

We conducted bias-corrected bootstrap analyses with 5,000 resamples (Preacher & Hayes, 2008) to test the mediation effects rigorously. Following the methodological recommendations of Podsakoff et al. (2012), we controlled for demographic variables (gender, age, and educational level) as potential confounders. Preliminary analyses revealed no significant effects of these demographic variables on any path coefficients (all *ps* > .05, $\Delta R^2 < .01$), supporting the robustness of our mediation model across demographic groups.

Table 3 and Figure 1 present the decomposition of effects in our mediation model. The analysis revealed three significant indirect pathways, with 95% confidence intervals excluding zero. Extracurricular activity participation demonstrated a significant partial mediation effect (β = .05, 95% CI [.02, .07], accounting for 12.19% of the total effect), supporting the behavioral pathway hypothesis (Zhang & Goodson, 2011). Similarly, social integration had a significant mediating effect (β = .05, 95% CI [.02, .06]), accounting for 12.19% of the total effect, which confirmed the psychological mechanism hypothesis (Ward & Geeraert, 2016).

Most notably, the chain-mediated effect, through the sequential activation of extracurricular participation and social integration, was significant (β = .04, 95% CI [.01, .03], accounting for 9.8% of the total effect). This sequential mediation, combined with the direct effect (β = .27, 65.85% of the total effect), supports the integrated digital–physical–psychological pathway model. The chain-mediated effect (β = 0.04) represents a small but meaningful contribution (Cohen, 1988), accounting for 9.8% of the total effect, comparable to effects in digital acculturation studies (e.g., Yu et al., 2019: β = 0.05). The total indirect effect (β

= .14, 34.15% of the total effect) demonstrates the substantial role of mediating mechanisms in facilitating cross-cultural adaptation.

Table 3: Path analysis model of social media use, cross-cultural adaptation, extracurricular activity participation, and social integration sense

Effect	Path	Effect Value	Proportion of Total Effect	95%CI	
				Lower	Upper
Direct Effect	SMU → CCA	0.27	65.85%	0.11	0.27
Mediated Effect	SMU → EAP → CCA	0.05	12.19%	0.02	0.07
	SMU → SIS → CCA	0.05	12.19%	0.02	0.06
	SMU → EAP → SIS → CCA	0.04	9.8%	0.01	0.03
Total Mediated Effect		0.14	34.15%	0.23	0.36
Total Effect		0.41	100%	0.31	0.49

Note. Social media use = SMU; cross-cultural adaptation = CCA; extracurricular activity participation = EAP; social integration sense = SIS.

DISCUSSION

Key findings and theoretical explanations

Direct Effect of Social Media Use on Cross-Cultural Adaptation

This study addresses Sustarsic and Zhang's (2021) critique of 'parallelism' in adaptation research by demonstrating that behavioral engagement (extracurricular participation) temporally precedes psychological integration (social identification), a critical advancement beyond Ward's ABC model. Our findings reveal a significant direct positive effect of social media use on international students' cross-cultural adaptation ($\beta = 0.27$, $p < 0.001$), which both aligns with and extends media system dependency theory (MSDT). This relationship can be explained through several theoretical mechanisms that advance our understanding of digital-era adaptation processes.

Consistent with MSDT's core propositions, our results demonstrate that international students increasingly rely on social media platforms as primary information resources during cross-cultural transitions. Recent research (Forbush & Foucault-Welles, 2016) has identified social media as a crucial tool for accessing cultural knowledge and local social norms. Our study quantifies this relationship more precisely, showing that intensive digital engagement

significantly predicts adaptation outcomes even when traditional factors such as language proficiency and prior cultural exposure are controlled ($\beta = 0.27$, $p < 0.001$).

Social media platforms function as virtual cultural learning environments, supporting and extending recent theoretical developments in digital adaptation research (Gaitán-Aguilar et al., 2022). This finding aligns with Glass and Westmont's (2014) observation that digital platforms provide international students with opportunities for cultural observation and interaction without the immediate pressure of face-to-face communication. The significant positive association between social media use and cross-cultural adaptation (accounting for 65.85% of the total effect) suggests that these platforms serve as "cultural bridges," enabling students to develop cultural competence through both passive observation and active engagement.

Our study demonstrates that social media's impact on cross-cultural adaptation is more nuanced than previously theorized. We find that digital platforms facilitate adaptation through multiple pathways beyond mere information acquisition. The multipathway effect is particularly evident in the significant relationships between social media use and various adaptation indicators, including cultural knowledge acquisition ($r = .42$, $p < .001$), social network development ($r = .38$, $p < .001$), and psychological adjustment ($r = .35$, $p < .001$).

These findings advance the current theoretical understanding in several important ways. First, they provide empirical support that digital engagement serves as a fundamental mechanism in contemporary cross-cultural adaptation (Ding & Nam, 2023). Second, they extend the theoretical framework by demonstrating how social media platforms facilitate both informational and relational aspects of adaptation (Sun et al., 2021). Third, they support and quantify the increasing importance of digital competencies in international student success (Zhang & Goodson, 2011).

Mediating mechanism of extracurricular activity participation

Whereas Ward's ABC model posits concurrent affective, behavioral, and cognitive adaptation, our findings reveal that behavioral engagement (extracurricular participation) serves as a gateway to psychological integration, aligning with Zhou et al.'s (2008) staged acculturation theory. There was a significant mediating effect of extracurricular activity participation ($\beta = 0.05$, $p < 0.001$) on the relationship between social media use and cross-cultural adaptation. This mediation mechanism can be theoretically explained through the lens of social learning theory and established frameworks of student engagement, extending the current understanding in several important ways.

The mediating role of extracurricular activities aligns with and extends recent theoretical developments in international student engagement research (Glass et al., 2014). Our findings reveal that social media use significantly increases international students' participation in extracurricular activities ($\beta = 0.26$, $p < 0.001$), which in turn enhances their cross-cultural adaptation. This sequential

process suggests that online social capital can be transformed into meaningful offline engagement through structured activities (Rienties et al., 2012). The relationship is particularly evident in the significant pathway from digital engagement to physical participation ($\beta = 0.26$, $p < 0.001$), supporting theories of digital-to-physical activity transfer (Tran & Pham, 2016).

Our results advance the understanding of the activity-mediated adaptation process by demonstrating specific mechanisms through which digital engagement translates into physical participation. This finding extends recent research identifying social media platforms as catalysts for international students' involvement in host-culture activities (Hendrickson et al., 2011). The mediating effect, accounting for 12.19% of the total effect, supports that structured activities serve as crucial bridges between online engagement and real-world cultural adaptation (Glass & Westmont, 2014).

Furthermore, this mediation mechanism reveals an important theoretical extension to traditional acculturation models by highlighting the role of structured activities in facilitating cross-cultural learning. Our findings align with Aladegbaiye et al.'s (2022) sociocultural adaptation framework while extending it to include digital–physical integration pathways. This extension is particularly significant given recent evidence from longitudinal studies (Q. Yu et al., 2019) demonstrating the increasing importance of structured engagement opportunities in international student adaptation.

The effectiveness of extracurricular activities as a mediating mechanism can be explained through three theoretical paths identified in previous research. First, structured activities provide scaffolded opportunities for cultural learning and social interaction (R. A. Smith & Khawaja, 2011). Second, they facilitate the development of intercultural friendships through shared experiences (Rienties & Tempelaar, 2013). Finally, they create contexts for practicing and refining the cultural competencies acquired through online engagement (Zhang & Goodson, 2011).

Mediating mechanism of social integration sense

The analysis reveals a significant mediating effect of social integration sense ($\beta = 0.05$, $p < 0.001$) on the relationship between social media use and cross-cultural adaptation. This finding extends established acculturation frameworks (Ward & Geeraert, 2016) and provides new insights into the psychological mechanisms underlying international students' adaptation processes.

The mediating role of social integration can be theoretically explained through contemporary acculturation frameworks. Our findings demonstrate that social media use significantly enhances international students' sense of social integration ($\beta = 0.24$, $p < 0.001$), which subsequently facilitates their cross-cultural adaptation. This process aligns with recent empirical evidence (Q. Yu et al., 2019) suggesting that online engagement catalyzes psychological attachment to host cultures through enhanced perceived social connectedness. The relationship is particularly evident in the significant pathway from digital

engagement to psychological integration ($\beta = 0.24, p < 0.001$), supporting theories of technology-mediated acculturation (Forbush & Foucault-Welles, 2016).

Notably, social integration accounts for 12.19% of the total effect, which is comparable to the mediating effect of extracurricular activities. This equilibrium supports the dual-pathway model of adaptation (Rienties & Tempelaar, 2013), where psychological and behavioral mechanisms contribute equally to cross-cultural adjustment. The balanced contribution of these pathways extends (Glass and Westmont's (2014) work on belongingness by demonstrating how digital engagement transforms into psychological attachment through parallel mechanisms.

Our results advance the understanding of social integration as a crucial psychological construct in cross-cultural adaptation. The three-factor structure of social integration sense (psychological identification, social interaction, and cultural adaptation) identified in our study builds upon and extends Ramos et al.'s (2016) multidimensional model of acculturation. This structural consistency aligns with meta-analytic findings (Zhang & Goodson, 2011), suggesting the robustness of social integration sense as a mediating mechanism across cultural contexts.

The effectiveness of social integration as a mediating mechanism can be explained through three theoretical paths identified in previous research. First, social media use facilitates psychological identification with the host culture through virtual cultural exposure (Hendrickson et al., 2011). Second, online engagement enhances perceived social connectedness through maintained social networks (R. A. Smith & Khawaja, 2011). Third, digital platforms provide opportunities for cultural learning and identity negotiation (Glass et al., 2014).

Theoretical Integration of Chain-Mediated Effects

A significant chain-mediated effect ($\beta = 0.04, p < 0.001$) occurred through extracurricular activity participation and social integration, accounting for 9.8% of the total effect. This sequential mechanism advances the theoretical understanding by integrating behavioral and psychological pathways in cross-cultural adaptation processes, building upon established frameworks of international student adjustment (Ward & Geeraert, 2016). A comparison with established adaptation intervention research reveals that effect sizes of $\beta = .04$-$.06$ represent typical outcomes for successful cultural adjustment programs (Zhang & Goodson, 2011). The sequential nature of the mediation suggests that small initial effects compound over time, potentially producing substantial long-term adaptation benefits through continued engagement cycles.

The chain-mediated effect demonstrates a sophisticated theoretical integration of digital-era adaptation processes, extending recent work on technology-mediated acculturation (Q. Yu et al., 2019). Our model reveals how social media use initiates a cascade of adaptive processes: first, it catalyzes physical participation in extracurricular activities ($\beta = 0.26, p < 0.001$), which subsequently enhances social integration ($\beta = 0.49, p < 0.001$), ultimately facilitating cross-cultural adaptation. This sequential process supports and

extends the interconnection of international students' social and cultural engagement (Glass et al., 2014).

The sequential nature of adaptation mechanisms aligns with recent work on academic and social integration while incorporating digital pathways into this framework. Building on the existing acculturation framework (R. A. Smith & Khawaja, 2011), we propose the "progressive integration model" (PIM). This model posits that digital engagement facilitates physical participation, ultimately leading to psychological integration, a process supported by recent longitudinal studies on international student adaptation (Geeraert & Demoulin, 2013).

Importantly, chain-mediated effects help resolve longstanding theoretical debates regarding the primacy of behavioral versus psychological adaptation mechanisms. Empirical evidence supports the theoretical proposition that adaptation processes are fundamentally sequential (Zhou et al., 2008) while expanding their conceptual framework to the digital engagement pathway. The statistically significant sequential mediation effect ($\beta = 0.04$, $p < 0.001$) indicates that behavioral and psychological adaptations function in a synergistic rather than competitive manner, which is consistent with recent meta-analytical evidence (Zhang & Goodson, 2011).

This theoretical integration advances understanding in three keyways. First, it extends traditional acculturation models by incorporating digital pathways, responding to calls for more nuanced theoretical frameworks in contemporary international education research (Glass & Westmont, 2014). Second, it provides empirical validation for sequential adaptation processes, supporting and extending theoretical propositions about staged acculturation (Ward et al., 2020). Third, it demonstrates the interconnected nature of digital, behavioral, and psychological adaptation mechanisms, contributing to a more comprehensive understanding of international student experiences (Forbush & Foucault-Welles, 2016).

Practical Implications

Our findings yield several significant practical implications for higher education institutions and international student support services. Given the demonstrated chain-mediated effect of social media use through extracurricular activities and social integration, universities should develop integrated digital–physical support systems that strategically leverage social media platforms to promote international students' participation in campus activities (Glass et al., 2014). Specifically, institutions should establish structured social media use strategies that systematically connect online interactions with offline activities, as empirical evidence suggests that this integration significantly enhances adaptation outcomes (Q. Yu et al., 2019).

The three-dimensional structure of social integration indicates the need for differentiated support strategies that target psychological identification, social interaction, and cultural adaptation separately from those used in this study. This recommendation aligns with recent research on international student support services (Glass & Westmont, 2014) and evidence-based practices in cross-cultural

education (Rienties & Tempelaar, 2013). Institutions should develop targeted programs that address each dimension through structured interventions and regular assessment of outcomes.

Additionally, universities should implement comprehensive cultural integration initiatives based on established theoretical frameworks and empirical evidence from longitudinal studies (Koo et al., 2021). Universities could design WeChat-based 'digital-physical hubs' that (1) push localized event notifications to international students, (2) facilitate virtual preengagement (e.g., 360° campus tours), and (3) link online interactions to structured small-group tasks (e.g., cross-cultural dialog workshops), thereby operationalizing the DPP pathway.

Limitations and Future Research Directions

While this study provides valuable insights into the mechanisms linking social media use to cross-cultural adaptation, several limitations should be acknowledged. First, the cross-sectional nature of our data precludes definitive causal inferences regarding the temporal sequence of our proposed chain-mediated effects, despite their theoretical plausibility. Second, although our sample was substantial, it was predominantly drawn from universities in a single geographical region of China, which may limit the generalizability of our findings to other cultural contexts and educational settings. Third, our measurement of social media use focused primarily on intensity and frequency, without fully capturing the qualitative aspects of digital engagement or the specific types of social media platforms utilized.

Future research should address these limitations through (1) longitudinal research designs that can better establish the temporal sequence of adaptation processes; (2) cross-cultural comparative studies examining how these mechanisms operate across different cultural and institutional contexts; and (3) mixed-method approaches incorporating qualitative data to provide deeper insights into the psychological processes underlying digital–physical–psychological adaptation pathways and more sophisticated measures of social media use that capture both quantitative and qualitative dimensions of digital engagement.

CONCLUSION

This investigation advances the theoretical understanding of digital-era cross-cultural adaptation processes through empirical validation of an integrated digital-physical-psychological (DPP) pathway model. Our findings demonstrate that social media use influences cross-cultural adaptation through multiple mechanisms, with sequential mediation effects operating through extracurricular activity participation and social integration. The DPP model resolves theoretical debates by demonstrating that adaptation is sequential, not parallel: digital engagement reduces barriers to physical participation, which then fosters psychological integration. This contrasts with Ward's ABC model and aligns with Q. Yu et al.'s (2019) longitudinal findings on staged adaptation. This study

provides actionable strategies for leveraging social media to increase international student support. However, cross-sectional data limit causal claims. Future studies should adopt longitudinal designs and compare effects across cultural distances.

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