A longitudinal examination of WeChat usage intensity, behavioral engagement, and cross-cultural adjustment among international students in China

Chun Cao[1] · Qian Meng[2] · Huijuan Zhang[1]

Abstract

WeChat is a highly popular social media in China and many other Asian countries, but little is known about its effectiveness in facilitating international students' academic and social functioning. Hence, the present study aimed to examine causal or reciprocal relationships among WeChat usage intensity, behavioral engagement in academic learning (BE-academic) and in local social activities (BE-social), and academic and social adjustment. To this end, we employed a three-wave longitudinal design among international students in China with data collected at three times (i.e., Time 1 data collected in December of 2020, Time 2 data collected in March of 2021, and Time 3 data collected in June of 2021). Results based on the cross-lagged panel analyses indicated that in academic domains, WeChat usage intensity positively predicted longitudinal changes in BE-academic and academic adjustment positively predicted longitudinal changes in WeChat usage intensity across Time 1 and Time 3. In social domains, WeChat usage intensity positively predicted longitudinal changes in BE-social and social adjustment, and BE-social positively predicted longitudinal changes in social adjustment from Time 1 to Time 2. Additionally, the reverse effects of social adjustment on WeChat usage intensity were revealed across Time 1 and Time 3.

✉ Qian Meng
mengqianlucky@aliyun.com

Chun Cao
caogecheng@aliyun.com

Huijuan Zhang
zhanghj066@nenu.edu.cn

[1] Northeast Normal University, Renmin Street, Changfchun 5268, China

[2] Changchun University of Science and Technology, Weixing Road, Changchun 7186, China

Introduction

Sojourning in an unfamiliar environment, international students usually struggle with the acculturation process (Billedo et al., 2019; Ding, 2016; Wen et al., 2018), which is defined as "the dual process of cultural and psychological change that takes place as a result of contact between two or more cultural groups and their individual members" (Berry, 2005). Therefore, easing and facilitating the acculturation process, though a challenging task, can be essential for acculturating individuals to achieve a successful "fit" with the new environment (Berry, 1997). Like other acculturating groups (e.g., immigrants and refugees), international students need also to strive for social functional fitness. However, they have to additionally strive for academic functional fitness. Hence, our study explores factors that may contribute to international students' both academic and social outcomes.

In this regard, we aim to investigate whether the intensity of using social media can make such contributions. Indeed, social media has been utilized by minority members as a channel to ease their acculturation process (e.g., Li & Tsai, 2015). Our research aim can be guided by Pang & Wang's, (2020) theoretical framework which depicts how social media usage influences international students' acculturation experiences. The framework is developed based on a review of 40 articles related to this topic, and we select it as the theoretical guidance for two reasons. First, although there are other theories that shed light on the acculturation process, for example, Berry's, (1997) acculturation framework and Kim's, (2001) integrative theory of cross-cultural adjustment, these theories do not take social media usage into account. Thus, one obvious advantage of Pang & Wang's, (2020) framework for the current study is its explicit focuses on social media and its impact. Second, Pang & Wang's, (2020) framework explicitly targets international students and all 40 reviewed articles contain international students as the sample, which may offer our study clearer guidance. From a systematic synthesis, the framework proposes the associations between social media usage, acculturation experiences (e.g., behavioral engagement and participation in the host settings), coping resources (e.g., social support and social capital), and cross-cultural adjustment which means the extent of perceived comfort minority members have with various aspects of a host culture (Black & Gregersen, 1991) and is viewed as the ultimate goal of and the utmost performance in the acculturation process (Berry, 1997). Specifically, in the framework, social media usage is argued to be the positive and proximal influential factor for behavioral engagement (i.e., participation in the host settings), as well as the positive and distal influential factor for psychosocial adjustment. Pang & Wang, (2020) explained the underlying mechanisms of the framework by stating that social media, particularly the host social media, acts as contextual resources providing international students with abundant knowledge (e.g., knowledge about host traditions, values, norms, and behavioral features), information (e.g., information of host academic/social events), and relatedness (e.g., contacting with and receiving social support from culturally diverse individuals through online platforms). The resources stemming from social media potentially assist international students in learning host communities, participating in host activities, and cultivating intercultural ties (Pang, 2020).

Guided by the framework, we mainly test whether the intensity of social media usage can enhance international students' behavioral engagement and adjustment in academic/social domains. Regarding behavioral engagement, we simultaneously consider academic behavioral engagement (abbreviated as BE-academic referring to students' participation in academic learning and school tasks; Reeve, 2012) and social behavioral engagement (abbreviated as BE-social referring to minority members' participation in local social

events or activities with local members; Kim et al., 2016). We also simultaneously consider two main types of cross-cultural adjustment: academic adjustment (i.e., how well international students adjust to host universities' academic demands and approaches, for example, instructional methods, learning strategies, classroom interactions, and management styles; Gong & Fan, 2006) and social adjustment (i.e., "ability to 'fit in', to acquire culturally appropriate skills and to negotiate interactive aspects of the host environment"; Ward & Kennedy, 1999).

Meanwhile, our study may expand Pang & Wang's, (2020) framework in two important aspects. First, since the framework is mainly situated within the psychosocial domains, we can extend it by examining to what extent it is applicable in the academic domains. Second, the framework only proposes the uni-directional links from social media usage to engagement and adjustment. Consistent with the framework, most prior studies simply treated social media usage as the predictor of acculturation experiences, as noted by Billedo et al., (2019). However, researchers also articulate that students' resources, engagement, and performance may be reciprocally related with each other (Chen et al., 2020; Xu et al., 2021). Thus, we intend to further expand the existing literature and enrich the framework by employing a three-wave longitudinal design which can determine the directionality of relationships and improve the causality inference by testing the bi-directional links, thereby generating better theoretical and practical implications.

Literature review

Research contexts

The present study targets international students sojourning in China for two reasons. First, China has become one of the major study abroad destinations worldwide (Cao & Meng, 2022; Ma & Zhao, 2018). In the ten-year timeframe (2009–2018), the number of international students enrolled at Chinese universities more than doubled, soaring from 238,184 in 2009 to 492,185 in 2018 (Tian & Liu, 2021). Despite its increasing attractiveness, the recent review by Cao & Meng, (2022) noted the paucity of empirical evidence on how international students acculturate and adjust in Chinese academic/social contexts. Second, though being limited, both qualitative and quantitative studies have shown that international students encounter daunting challenges undermining their adjustment in China, such as acculturative stress, a lack of knowledge of the mainstream society, and academic/social disintegration (e.g., Ding, 2016; Wen et al., 2018; Yang et al., 2018). Taken together, the abovementioned reasons indicate that there is a need of more empirical studies investigating international students' adjustment in China.

Additionally, the present study targets the Chinese popular social media of WeChat. Notably, previous studies in this field primarily focused on social media (e.g., Facebook, Twitter, and WhatsApp) developed in America and used frequently in many countries (e.g., Billedo et al., 2019; Dragseth, 2020; Junco et al., 2011; Li & Chen, 2014). Therefore, our examination of WeChat may make unique contributions in the following aspects. First, initially released in late 2011, WeChat has become a highly popular social media in China and many other Asian countries with more than one billion monthly active users since 2018 (Hou et al., 2021). After arriving in China, almost all international students begin to use WeChat for building connections in new academic/social communities. Second, like some other social media (e.g., WhatsApp), WeChat integrates multi-purpose functions, such as

sending messages in various forms (e.g., text, picture, voice, and video) and making free phone calls, which can facilitate international students' intercultural communication. Like Facebook, WeChat can also share personal emotion and life events through moments. In addition, WeChat offers distinctive functions, for example, online payment, e-commerce, and local public services (e.g., city transportation, local utilities, and municipal services) (Wang et al., 2019). These functions can be helpful to familiarize international students with local lifestyles, thereby potentially facilitating their acculturation process. Third, some social media outlets that are popular elsewhere (e.g., Facebook, Twitter, and WhatsApp) are banned in China due to the internet restriction (Zhang-Wu, 2018). Hence, many international students in China have to rely on WeChat to communicate with local and other international students and experience more hardships to keep in touch with family members and friends in home countries. However, the central role of WeChat in their academic and social communities can be further highlighted. Taken together, despite its high popularity and importance, the evidence of how WeChat can help navigate international students' adjustment in China is rather scarce. As such, our study can add insights into the usefulness and effectiveness of this social media in international education.

Social media usage and behavioral engagement

Academic engagement is a multifaceted construct including behavioral, cognitive, and emotional engagement (Reeve, 2012). Compared to the other facets, behavioral engagement is more easily observed and perceived since it is reflected in the presence of positive academic behaviors (e.g., completing academic work on time, following rules, asking frequently, and discussing actively) and in the absence of disruptive academic behaviors (e.g., making noises in class and pretending to pay attention) (Damian et al., 2017). Therefore, BE-academic has alone attracted extensive attention in the literature (Chen et al., 2020). In academic communities, social media has been extensively employed as academic resources for fostering active and collaborative learning (sharing information and resources, discussing in groups, receiving support, and handling academic issues) (Al-Rahmi et al., 2022; Hou et al., 2021), thereby potentially increasing BE-academic. For instance, Dragseth, (2020) utilized the Facebook- and Twitter-based environment to have strengthened BE-academic of American college students. For another instance, Junco et al., (2011) confirmed in an experimental study that Twitter usage improved American college students' engagement in research training. More relevant to our research aims was the study by Rasheed et al., (2020) revealing that Chinese postgraduates' social media usage positively predicted BE-academic and research creativity.

In social communities, BE-social is conceptualized as international students' participation in local social events and activities with local members (Kim et al., 2016). Based on the conceptualization, BE-social incorporates the two components of dynamic interactions with the host society and its members in the physical environment, both of which can be intensified by social media usage since online relationships are likely to be transferred to offline relationships (Lev-On & Lissitsa, 2015). According to Cao & Meng, (2022) and Pang & Wang, (2020), information and knowledge of host social events and activities embedded in social media usage, as well as emotional support and encouragement received from local and other peers, may activate international students' motivation to initiate BE-social to explore the unfamiliar host society. Echoing these arguments, empirical evidence showed that using the host social media positively predicted social support from host members among international students in America (Li & Peng, 2019). Additionally,

Lin et al., (2012) revealed that Facebook usage of international students in America was a positive predictor of online bridging social capital (i.e., weak ties in online communities). As revealed by Yu et al., (2019), social media usage was a significant correlate of BE-social (e.g., language learning and social contact) among international students. Hence, it is assumed that expanded local social networks resulting from intensity of social media usage may positively predict BE-social.

Social media usage and cross-cultural adjustment

Pang & Wang's, (2020) theoretical framework argues that social media contains a resourceful environment which may be helpful for international student adjustment mainly achieved through learning the host cultures and building positive relationships with the host society (Berry, 2005; Cao et al., 2018). In this respect, the intensified usage of social media can help obtain wide access to information, knowledge, relatedness, and coping resources related to the host society (Billedo et al., 2019; Pang, 2020; Yu et al., 2019). Empirically supporting these arguments, Croucher & Rahmani, (2015) revealed that the host knowledge and information gained through Facebook can enhance immigrants' adjustment in America. In addition, weak ties fostered by social media usage and strong ties maintained by social media usage can expand international students' relatedness and enrich their coping resources (i.e., social support and social capital) (Li & Peng, 2019; Pang, 2020), thus promoting cross-cultural adjustment (Shu et al., 2020).

During the past two decades, some researchers have explored the relationships of social media usage with adjustment and related constructs among minority members. For instance, roles of social media in facilitating the acculturation process were reported in McKelvy & Chatterjee's, (2017) qualitative study of Muslim women in America and Li & Tsai's, (2015) quantitative study of Hispanics in America. Some research more explicitly focused on cross-cultural adjustment. Empirical support can be found in Lin et al., (2012) who revealed that Facebook usage was a positive predictor of international students' social adjustment in America. More recently, Forbush & Foucault-Welles, (2016) found the direct associations of early and later social media diversity with academic and social adjustment among Chinese students in America. In addition, Pang, (2020) revealed that the indirect associations of active social media usage with academic and social adjustment were mediated by social support from local members. There seemed only one study (i.e., Jin & Zhang, 2017) that explicitly examined the relationship between WeChat usage and international student adjustment in China. The authors conducted a mixed-method study: the quantitative method revealed that different types of WeChat usage (i.e., the number of Chinese friends on WeChat, information sharing, social interactions, and WeChat dependency) positively predicted social adjustment; the qualitative method revealed that social networks formed through WeChat enhanced their social competence, relieved them from loneliness, and shaped their new cultural identity.

Behavioral engagement and cross-cultural adjustment

In academic communities, prior studies have evidenced that compared to disengaged peers, students who are actively engaged in learning activities tend to display more positive attitudes toward academic achievement and adjustment (e.g., van Rooij et al., 2017). Actively engaged students are also more likely to avoid various problematic behaviors, such as sitting passively in class, school dropout, and substance use (Henry et al., 2012). Via active

BE-academic (e.g., regularly attending classes, raising questions, and interactions with teachers and peers), marginalized or disadvantageous students are also likely to increase their academic self-efficacy and better comprehend teachers' instructional strategies and teaching styles (Taylor et al., 2019). This learning phenomenon was noted in international students as well in Wang & Hannes's, (2014) qualitative study revealing that Asian international students' engagement in academic activities was one of the four broad domains of challenges but can contribute much to academic adjustment.

In social communities, international students have to more or less engage in local social activities and interact with local members. Since international students in China originate from different countries with diverse cultures, some of them whose cultures are similar to those of China may be motivated for BE-social by cultural proximity, whereas others whose cultures differ enormously with those of China may be motivated by interest and curiosity. No matter what the motivational factors might be, examining predictors and outcomes of BE-social can be vital for international students because building local networks can be beneficial for functional fitness (Cao et al., 2018), but tends to be the most arduous task as compared to building co-ethnic and international networks (Cao, et al., 2021; Wang & Hannes, 2014). Moreover, unlike culture learning through social media, BE-social allows international students to observe and learn local cultural norms and behavioral features in close distance and in the real world. Such face-to-face communication and engagement may further optimize international students' adjustment. As posited by the integrative theory of cross-cultural adaptation (Kim, 2001), minority members' social engagement in the host environment can help achieve adjustment by acquiring insights and culture-specific skills. To support the theory, Kim & McKay-Semmler, (2013) conducted a study among foreign-born individuals in America and revealed that their engagement in social activities with locals was associated with psychological well-being and adjustment. Additionally, Yu & Moskal, (2019) interviewed Chinese international students in the UK and found that participation in church activities with locals was beneficial for social adjustment.

Potential reverse effects and research hypotheses

The literature review indicates that previous research overwhelmingly used cross-sectional data in researching international students' social media usage, with rather few exceptions (e.g., Billedo et al., 2019). Using longitudinal data, Billedo et al., (2019) revealed that international students' usage of Facebook was both the antecedent and the consequence of perceived social support in the long term. Although the prior studies based on cross-sectional data have provided insightful knowledge, the present study based on longitudinal data can provide better educational implications because it moves beyond the traditional unidirectional links from social media usage to academic and social outcomes by enabling possibilities of testing reverse effects. The causal or reciprocal links originating from the bi-directional examination can update the current knowledge of operationalizing mechanisms underlying social media usage and student outcomes. It is possible that international students who are actively engaged and optimally adjusted may reversely intensify their usage of WeChat for diverse academic and social purposes (e.g., contact with significant others and information sharing). The underlying reason may be that individuals achieving academic or social performance with benefits of WeChat usage may perceive this social media as useful, thus fostering positive emotions and attitudes toward WeChat (e.g., stickiness and satisfaction) (Lien et al.,

2017). The reshaped emotions and attitudes have the potential to reversely reinforce WeChat users' intention for continuance usage (Gong et al., 2018).

Despite being limited, evidence indeed suggests that there may be reverse effects of personal performance on student engagement. Theoretically, Schartner & Young, (2016) developed an integrative model for international student adjustment in which cross-cultural adjustment and social interactions with locals may have a reciprocal relationship. Empirically, Yuan et al., (2013) longitudinal study focused on migrant children in China and found the reciprocal relationships between social adjustment and identification with Chinese cultures (i.e., interest and engagement in the mainstream society). Plus, superior academic adjustment outcomes may also reversely stimulate subsequent investment of time and energy in academic activities. For instance, Chen et al., (2020) longitudinal study revealed that earlier academic achievement positively predicted later BE-academic in adolescent students.

Therefore, guided by Pang & Wang's, (2020) theoretical framework and prior empirical evidence, our study aims to investigate causal or reciprocal relationships among WeChat usage intensity, behavioral engagement, and cross-cultural adjustment, by employing a three-wave longitudinal design among international students in China. Accordingly, we propose the following hypotheses:

> In academic domains:
> **H1:** WeChat usage intensity positively predicts longitudinal changes in BE-academic (H1a). Reversely, BE-academic positively predicts longitudinal changes in WeChat usage intensity (H1b).
> **H2:** WeChat usage intensity positively predicts longitudinal changes in academic adjustment (H2a). Reversely, academic adjustment positively predicts longitudinal changes in WeChat usage intensity (H2b).
> **H3:** BE-academic positively predicts longitudinal changes in academic adjustment (H3a). Reversely, academic adjustment positively predicts longitudinal changes in BE-academic (H3b).
> In social domains:
> **H4:** WeChat usage intensity positively predicts longitudinal changes in BE-social (H4a). Reversely, BE-social positively predicts longitudinal changes in WeChat usage intensity (H4b).
> **H5:** WeChat usage intensity positively predicts longitudinal changes in social adjustment (H5a). Reversely, social adjustment positively predicts longitudinal changes in WeChat usage intensity (H5b).
> **H6:** BE-social positively predicts longitudinal changes in social adjustment (H6a). Reversely, social adjustment positively predicts longitudinal changes in BE-social (H6b).

Method

Participants and procedure

The participants of our three-wave longitudinal study were international students currently sojourning in China. Data collection at Time 1 began in December of 2020, at the end of the autumn academic semester. We recruited the participants through two social

media (i.e., WeChat and Facebook) on which there were friend groups designed specifically for international students in China for them to discuss topics, seek advice, and share knowledge and information. Once the potential participants were identified, they were contacted online to ensure that they were (1) currently international students in China and (2) currently living in China. The mandatory selection criteria can guarantee that they had adequate sojourn experiences in Chinese academic/social contexts. The students who met these criteria were informed of research aims, voluntary participation, anonymity, and participation rewards (15 RMB, approximately 2 dollars, for completing each wave of survey). If they agreed to participate, they were sent the link to the online survey and then invited as friends on WeChat to facilitate tracking them subsequently. Both student ID numbers and phone numbers were used as unique tracking codes. Altogether, 1013 students completed the online survey, but 11 of them who reported to have no WeChat accounts were removed. Of the final sample ($N = 1002$), there were 472 males and 530 females, with ages ranging from 18 to 30 years old ($M = 23.2$; $SD = 2.98$) and length of stay in China ranging from 1 to 72 months ($M = 20.08$; $SD = 10.10$). They were enrolled in different educational programs: bachelor programs ($N = 345$; 34.4%), master programs ($N = 169$; 16.9%), doctoral programs ($N = 62$; 6.2%), language programs ($N = 376$; 37.5%), and *other* programs ($N = 50$; 5.0%). They originated from nearly 100 countries and six continents: Asia ($N = 531$; 53%), Africa ($N = 183$; 18.3%), Europe ($N = 123$; 12.3%), North America ($N = 69$; 6.9%), Oceania ($N = 65$; 6.5%), and South America ($N = 31$; 3.1%). They mainly sojourned in large Chinese cities, such as Beijing ($N = 181$; 18.1%), Shanghai ($N = 154$; 15.4%), and Guangzhou ($N = 112$; 11.2%).

We collected Time 2 data in March of 2021, one month after the next semester began. Online invitations were sent to all previous Time 1 participants, and recruitment of Time 2 was capped at $N = 542$. Time 3 data collection was conducted in June of 2021 before this semester ended. Online invitations were sent to all previous Time 2 participants, and recruitment of Time 3 was capped at $N = 327$. The online surveys at the three waves were identical. We used a filter question (i.e., Are you currently sojourning in China?). The survey would be automatically halted for those who answered "no." The six-month duration was selected since in July when a whole academic year ends, many international students complete their academic learning in China and return to home countries.

This longitudinal design can allow us to test bi-directional links, thus moving much beyond the prior cross-sectional studies offering the unidirectional evidence. Therefore, we can delve deeper into the academic and social phenomena by determining the directionality of the relationships. Additionally, the three-wave longitudinal design can allow us to assess and determine the stability or changes in the investigated relationships. Despite these unique contributions, the recent review article (Cao & Meng, 2022) revealed that there were merely three studies that employed the longitudinal data to research international student adjustment in China. Moreover, none of these three studies tested the bi-directional relationships.

Measures

The questionnaire including the following measures and the demographics was administered in English since proficiency in English is the basic requirement for international students applying to study in China.

WeChat usage intensity

Ellison et al., (2007) developed this scale for Facebook. Recently, Wang et al., (2019) extended this scale to WeChat by replacing "Facebook" with "WeChat," and acquired good psychometric properties. It contained six items, but one item (WeChat has become part of your daily routine) was dropped because it is almost semantically identical to another item (WeChat is part of your everyday activity). Examples of the remaining five items were "You feel out of touch when you haven't logged onto WeChat for a while" and "You feel you are part of the WeChat community." Responses categories ranged from 1 (strongly disagree) to 5 (strongly agree). Cronbach's alphas were 0.81 for Time 1, 0.73 for Time 2, and 0.75 for Time 3.

BE-academic

We measured behavioral engagement in academic learning using five items from Qureshi et al., (2016). Examples included "You work as hard as you can during your academic learning/research in China" and "In China, you complete all assignments and academic/research activities to the best of your ability." Response categories ranged from 1 (strongly disagree) to 5 (strongly agree). Cronbach's alphas were 0.84 for Time 1, 0.74 for Time 2, and 0.79 for Time 3.

BE-social

We measured international students' behavioral engagement in social activities with local members using six items from Kim et al., (2016). Examples included "How often do you attend social gatherings with Chinese locals?" and "How often do you chat with Chinese locals about social events?". Response categories ranged from 1 (not at all) to 5 (very often). Cronbach's alphas were 0.84 for Time 1, 0.81 for Time 2, and 0.81 for Time 3.

Cross-cultural adjustment

Academic and social adjustment were measured with the scales from Gong & Fan, (2006). They developed the two scales specifically for international students. Each of them had five items. Examples for academic adjustment included "To what extent are you adjusted to your academic work at the host university?" and "To what extent are you adjusted to the instructional methods in China?". Examples for social adjustment included "To what extent are you adjusted to interpersonal relationships with Chinese locals?" and "To what extent are you adjusted to social gatherings with Chinese locals?". Response categories ranged from 1 (not at all) to 5 (extremely well). For academic adjustment, Cronbach's alphas were 0.89 for Time 1, 0.85 for Time 2, and 0.88 for Time 3; for social adjustment, Cronbach's alphas were 0.88 for Time 1, 0.84 for Time 2, and 0.86 for Time 3.

Statistical analyses

Since the measures were used among international students in China for the first time, their validity should be examined. Exploratory factor analyses with principal component approach were conducted respectively for the variables across the three time points. The results showed that at each time point, the extracted factors completely matched the

measures described above, demonstrating their good validity. Factor loadings ranged from 0.63 to 0.80 for Time 1, from 0.56 to 0.74 for Time 2, and from 0.55 to 0.79 for Time 3 (see Table 1).

For the main analyses, we test two cross-lagged models respectively for academic (see Fig. 1 for the academic model: WeChat usage intensity, BE-academic, and academic adjustment) and social domains (see Fig. 2 for the social model: WeChat usage intensity, BE-social, and social adjustment) in AMOS 25. They are examined separately because the

Table 1 Results of exploratory factor analyses for the study variables across the three time points

	Time 1					Time 2					Time 3				
	F1	F2	F3	F4	F5	F1	F2	F3	F4	F5	F1	F2	F3	F4	F5
WeChat usage intensity															
Item 1	*0.75*	—	—	—	—	*0.70*	—	—	—	—	*0.71*	—	—	—	—
Item 2	*0.71*	—	—	—	—	*0.58*	—	—	—	—	*0.55*	—	—	—	—
Item 3	*0.65*	—	—	—	—	*0.56*	—	—	—	—	*0.66*	—	—	—	—
Item 4	*0.68*	—	—	0.33	—	*0.68*	—	—	—	—	*0.64*	—	—	—	—
Item 5	*0.73*	—	—	—	—	*0.66*	—	—	—	—	*0.71*	—	—	—	—
BE-academic															
Item 1	—	*0.77*	—	—	—	—	*0.71*	—	—	—	—	*0.75*	—	—	—
Item 2	—	*0.75*	—	—	—	—	*0.59*	—	—	—	—	*0.60*	—	—	—
Item 3	—	*0.73*	—	—	—	—	*0.69*	—	—	—	—	*0.71*	—	—	—
Item 4	—	*0.71*	—	—	—	—	*0.63*	—	—	—	—	*0.68*	—	—	—
Item 5	—	*0.80*	—	—	—	—	*0.74*	—	—	—	—	*0.79*	—	—	—
BE-social															
Item 1	—	—	*0.69*	—	—	—	—	*0.67*	—	—	—	—	*0.68*	—	—
Item 2	—	—	*0.70*	—	—	—	—	*0.69*	—	—	—	—	*0.66*	—	—
Item 3	—	—	*0.74*	0.34	—	—	—	*0.64*	—	—	—	—	*0.63*	—	—
Item 4	—	—	*0.64*	0.31	—	—	—	*0.58*	—	—	—	—	*0.61*	—	—
Item 5	—	—	*0.71*	—	—	—	—	*0.69*	—	—	—	—	*0.68*	—	—
Item 6	—	—	*0.67*	—	—	—	—	*0.65*	—	—	—	—	*0.63*	—	—
Academic adjustment															
Item 1	—	—	—	*0.70*	—	—	—	—	*0.74*	—	—	—	—	*0.69*	—
Item 2	—	—	—	*0.68*	0.33	—	—	—	*0.63*	—	—	—	—	*0.77*	0.33
Item 3	—	—	—	*0.63*	—	—	—	—	*0.68*	—	—	—	—	*0.63*	—
Item 4	—	—	—	*0.69*	0.32	—	—	—	*0.67*	—	—	—	—	*0.64*	—
Item 5	—	—	—	*0.74*	—	—	—	—	*0.68*	—	—	—	—	*0.71*	—
Social adjustment															
Item 1	—	—	—	—	*0.76*	—	—	—	—	*0.72*	—	—	—	—	*0.74*
Item 2	—	—	—	—	*0.79*	—	—	—	—	*0.74*	—	—	—	—	*0.77*
Item 3	—	—	—	—	*0.73*	—	—	—	—	*0.70*	—	—	—	—	*0.72*
Item 4	—	—	—	—	*0.72*	—	—	—	0.34	*0.66*	—	—	—	0.38	*0.65*
Item 5	—	—	—	—	*0.74*	—	—	—	—	*0.70*	—	—	—	—	*0.74*

Factor loadings of the items affiliated with corresponding scales are shown in bold and italic type; "—" represents factor loadings that are smaller than 0.30

F, factor

Time 1   Time 2   Time 3
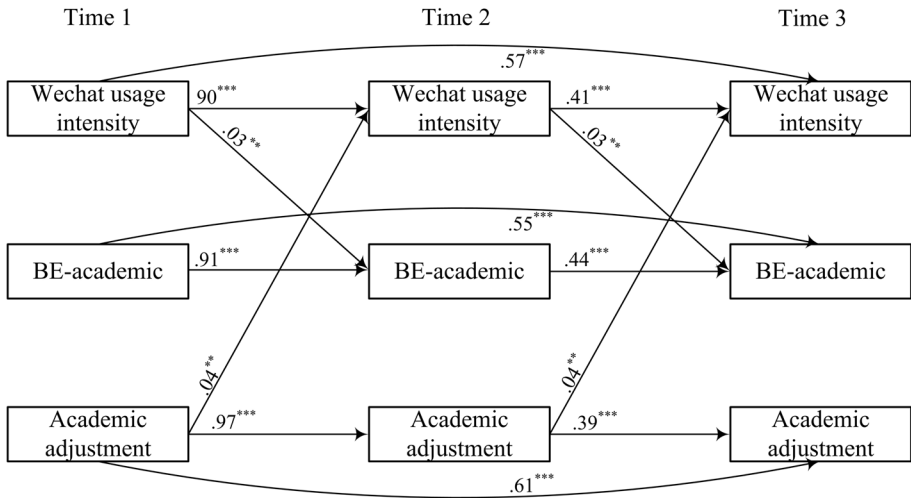
Fig. 1 Results of testing the academic model: two asterisks (**) $p < .01$, three asterisks (***) $p < .001$. Non-significant cross-lagged paths and within-time covariances are not shown for the parsimony of the model

Time 1   Time 2   Time 3
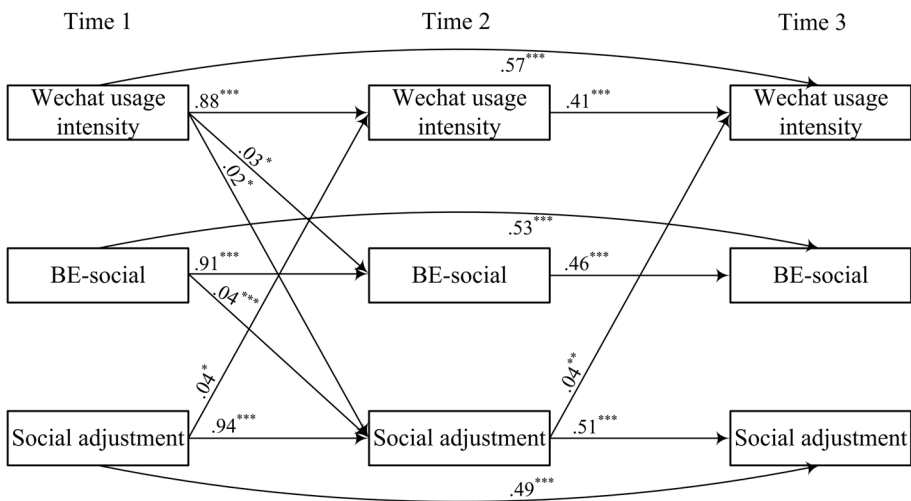
Fig. 2 Results of testing the social model: one asterisk (*) $p < .05$, two asterisks (**) $p < .01$, three asterisks (***) $p < .001$. Non-significant cross-lagged paths and within-time covariances are not shown for the parsimony of the model

former primarily centers around on-campus learning phenomena (e.g., engagement in academic learning and adaptation to learning and teaching styles), whereas the latter primarily centers around off-campus social phenomena (e.g., engagement in local social activities and functional fitness with the host society). These two types of phenomena are distinct but not completely independent, and thus corresponding collinearity between them may attenuate specific effects and cause misleading conclusions. Cross-lagged panel analyses with observed variables are performed for the two hypothesized models. Each model has

the following paths: (a) stability paths (autoregressive effects of the predictor variables on themselves across Time 1 and Time 3) and (b) time cross-lagged paths (reciprocal effects among WeChat usage intensity, behavioral engagement, and cross-cultural adjustment from Time 1 to Time 2 and from Time 2 to Time 3). Within-time correlations among the variables are also included in the models. The models are evaluated using these model-data fit indices: χ^2/df ratio (criterion: < 3), comparative fit index (CFI; criterion: > .95), Tucker-Lewis index (TLI; criterion: > .90), and root mean square error of approximation (RMSEA; criterion: < .08) (Byrne, 2013).

Results

Descriptive statistics, bivariate correlations, and missing data

We present in Table 2 the means, standard deviations, and bivariate correlations of the variables. As shown in the table, all the variables were positively correlated with each other within each time and across times. Since some students dropped out of the study at Time 2 and Time 3, we utilized the full information maximum likelihood (FIML) estimation, which has been widely proved to be a reliable method to handle missing data in longitudinal studies because it does not directly replace missing values, but rather yields unbiased parameter estimates through all data information available (Graham, 2009).

Model testing

Our research models followed the propositions of Pang & Wang's, (2020) framework in which social media usage may be the proximal influential factor for behavioral engagement (i.e., participation in the host settings) and the distal influential factor for cross-cultural adjustment. Expanding this framework, we tested the reciprocal links among the three variables in each of the academic and social models. Then, we investigated if the cross-lagged relationships were time-invariant. In details, two competing models (M1 and M2) for each of the academic and social models were respectively compared. Specifically, in M1, cross-lagged effects were constrained to be equal across times; in M2, cross-lagged effects were unconstrained for them to vary freely. We evaluated which between M1 and M2 could be a better fit with the data. According to Chen, (2007) and Cheung & Rensvold, (2002), significant differences between M1 and M2 can be determined when at least two of the three criterions are met: $\Delta\chi^2$ significant at $p < .05$, ΔCFI ≥ 0.010, and ΔRMSEA $\geq .015$. For the academic model, M1 and M2 were not significantly different (see Table 3): $\Delta\chi^2(6) = 9.050$; $p = .171$; ΔCFI $= 0.000$; ΔRMSEA $= .002$. Hence, the time-invariant model (M1) was chosen as the final academic model since it was more parsimonious. For the social model, M1 and M2 were significantly different (see Table 3): $\Delta\chi^2(6) = 24.120$; $p < .001$; ΔCFI $= 0.002$; ΔRMSEA $= 0.027$. Hence, the free-to-vary model (M2) was chosen as the final social model because it achieved the better fit.

The final academic model fitted the data satisfactorily: $\chi^2 (12) = 19.306$, $p = .081$, $\chi^2/df = 1.609$, CFI $= 0.999$, TLI $= 0.996$, and RMSEA $= .025$ (90% confidence intervals [0.044, 0.987]). Figure 1 presents standardized path coefficients of the significant cross-lagged effects. Results revealed causal effects of WeChat usage on BE-academic both from Time 1 to Time 2 ($\beta = .03$, $p = .004$) and from Time 2 to Time 3 ($\beta = .03$, $p = .004$).

Table 2 Means, standard deviations, and bivariate correlations of the study variables across the three time points

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Time 1															
1. WeChat usage intensity	—														
2. BE-academic	.31**	—													
3. BE-social	.35**	.19**	—												
4. Academic adjustment	.41**	.30**	.44**	—											
5. Social adjustment	.26**	.18**	.36**	.46**	—										
Time 2															
6. WeChat usage intensity	.76**	.27**	.35**	.42**	.29**	—									
7. BE-academic	.33**	.81**	.22**	.32**	.20**	.29**	—								
8. BE-social	.37**	.21**	.83**	.47**	.38**	.36**	.23**	—							
9. Academic adjustment	.45**	.28**	.45**	.89**	.44**	.42**	.31**	.46**	—						
10. Social adjustment	.30**	.22**	.39**	.45**	.89**	.29**	.21**	.40**	.44**	—					
Time 3															
11. WeChat usage intensity	.87**	.29**	.37**	.44**	.29**	.85**	.32**	.37**	.42**	.30**	—				
12. BE-academic	.34**	.90**	.28**	.31**	.23**	.30**	.88**	.28**	.29**	.24**	.33**	—			
13. BE-social	.37**	.26**	.91**	.48**	.37**	.35**	.29**	.90**	.46**	.39**	.38**	.29**	—		
14. Academic adjustment	.41**	.26**	.45**	.91**	.46**	.39**	.28**	.45**	.90**	.46**	.42**	.29**	.46**	—	
15. Social adjustment	.28**	.22**	.37**	.47**	.94**	.27**	.22**	.38**	.46**	.95**	.30**	.24**	.39**	.47**	—
M	4.04	3.96	3.55	3.72	2.93	4.05	4.04	3.58	3.81	2.98	4.10	4.06	3.59	3.80	3.03
SD	.53	.60	.63	.67	.72	.49	.52	.59	.64	.68	.48	.55	.58	.63	.73

$**p < .01$

Table 3 Cross-lagged model fit indices and model comparisons for the academic and social models

The academic model

	Model fit indices						Model comparisons				
	χ^2	df	χ^2/df	CFI	TLI	RMSEA (90% confidence intervals)	$\Delta\chi^2$	Δdf	ΔCFI	ΔRMSEA	p
M1 (constrained)	19.306	12	1.609	0.999	0.996	.025 (0.044, 0.987)	9.050	6	0.000	.002	.171
M2 (unconstrained)	10.256	6	1.709	0.999	0.995	.027 (0.054, 0.918)					

The social model

	Model fit indices						Model comparisons				
	χ^2	df	χ^2/df	CFI	TLI	RMSEA (90% confidence intervals)	$\Delta\chi^2$	Δdf	ΔCFI	ΔRMSEA	p
M1 (constrained)	31.119	12	2.593	0.998	0.991	.040 (0.057, 0.816)	24.120	6	0.002	.027	.000
M2 (unconstrained)	6.999	6	1.167	1.000	0.999	.013 (0.045, 0.978)					

Additionally, results showed causal effects of academic adjustment on WeChat usage both from Time 1 to Time 2 ($\beta = .04$, $p = .001$) and from Time 2 to Time 3 ($\beta = .04$, $p = .001$).

The final social model also fitted the data well: $\chi^2(6) = 6.999$, $p = .321$, $\chi^2/df = 1.167$, CFI $= 1.000$, TLI $= 0.999$, and RMSEA $= .013$ (90% confidence intervals [0.045, 0.978]). Figure 2 presents standardized coefficients of the significant cross-lagged effects. Results showed causal effects of WeChat usage (Time 1) on both BE-social (Time 2) ($\beta = .03$, $p = .038$) and social adjustment (Time 2) ($\beta = .02$, $p = .046$). Causal effects of BE-social (Time 1) on social adjustment (Time 2) ($\beta = .04$, $p < .001$) were also found. Finally, it was revealed that social adjustment had reverse effects on WeChat usage both from Time 1 to Time 2 ($\beta = .04$, $p = .031$) and from Time 2 to Time 3 ($\beta = .04$, $p = .008$). Within the two models, all autoregressive path coefficients were high, indicating stability of the constructs over time. Note that although the cross-lagged effect sizes were not very large, they are valuable since in longitudinal research autoregressive effects and within-time covariances usually take away a substantial amount of the variance in the predicted variable (Adachi & Willoughby, 2015). Finally, Table 4 displays all cross-lagged paths across times, while Table 5 displays all covariances of the constructs within times.

Additional multi-group analyses

We tested whether the cross-lagged effects were moderated by the demographic variables of gender, Asian vs. non-Asian students, and academic programs, using the multi-group analyses. For gender, the multi-group analyses showed no significant differences between females and males for the academic model ($\Delta\chi^2[11] = 3.578$; $p = .981$; ΔCFI $= 0.001$;

Table 4 Standardized cross-lagged path coefficients across times for the academic and social models

The academic model

Paths	From Time 1 to Time 2			From Time 2 to Time 3		
	β	SE	p	β	SE	p
WeChat usage → BE-academic	.03**	.011	.004	.03**	.011	.004
WeChat usage → Academic adjustment	.00	.011	.596	.00	.011	.596
BE-academic → Academic adjustment	.00	.009	.894	.00	.009	.894
BE-academic → WeChat usage	−.01	.010	.416	−.01	.010	.416
Academic adjustment → WeChat usage	.04**	.009	.001	.04**	.009	.001
Academic adjustment → BE-academic	.02	.008	.121	.02	.008	.121

The social model

Paths	From Time 1 to Time 2			From Time 2 to Time 3		
	β	SE	p	β	SE	p
WeChat usage → BE-social	.03*	.020	.038	−.01	.012	.225
WeChat usage → Social adjustment	.02*	.016	.046	.00	.010	.552
BE-social → Social adjustment	.04***	.014	< .001	.00	.009	.904
BE-social → WeChat usage	.04	.017	.065	.00	.013	.781
Social adjustment → WeChat usage	.04*	.014	.031	.04**	.011	.008
Social adjustment → BE-social	.02	.015	.217	.02	.009	.091

$*p < .05$, $**p < .01$, $***p < .001$

Table 5 Covariances among the constructs within times for the academic and social models

The academic model

Covariances	Time 1			Time 2			Time 3		
	β	SE	p	β	SE	p	β	SE	p
WeChat usage ↔ BE-academic	.38***	.011	< .001	.09*	.002	.046	.09	.001	.125
WeChat usage ↔ Academic adjustment	.48***	.012	< .001	.17***	.002	< .001	.07	.001	.182
BE-academic ↔ Academic adjustment	.38***	.014	< .001	.12**	.001	.005	.13*	.001	.017

The social model

Covariances	Time 1			Time 2			Time 3		
	β	SE	p	β	SE	p	β	SE	p
WeChat usage ↔ BE-social	.45***	.011	< .001	.13**	.002	.002	.13*	.001	.023
WeChat usage ↔ Social adjustment	.37***	.013	< .001	−.07	.002	.082	.11*	.000	.048
BE-social ↔ Social adjustment	.50***	.016	< .001	.11*	.002	.010	−.03	.000	.615

*p < .05, **p < .01, ***p < .001

ΔRMSEA = .021) and the social model ($\Delta\chi^2$[11] = 14.046; p = .230; ΔCFI = 0.000; ΔRMSEA = .000) (Chen, 2007; Cheung & Rensvold, 2002). We examined the moderating role of Asians vs. non-Asians because Cao & Meng, (2022) indicated that Asian international students had different levels of adjustment in China, compared to peers from other regions. Hence, we created a categorical variable in which there were 531 Asians and 471 non-Asians. The multi-group analyses showed no significant differences between Asians and non-Asians for the academic model ($\Delta\chi^2$[11] = 11.348; p = .415; ΔCFI = 0.000; ΔRMSEA = .000) and the social model ($\Delta\chi^2$[11] = 7.353; p = .770; ΔCFI = 0.001; ΔRMSEA = .014). For academic programs, we divided the sample into two groups: degree-seeking (i.e., those enrolled in bachelor, master, and doctoral programs; N = 576) and non-degree-seeking students (i.e., those enrolled in language and *other* programs; N = 426). We tested this factor as a moderator because Wen et al., (2018) found that the two types of international students in China had distinctive academic experiences. The multi-group analyses showed no significant differences between the two groups for the academic model ($\Delta\chi^2$[11] = 15.603; p = .157; ΔCFI = 0.001; ΔRMSEA = .010) and the social model ($\Delta\chi^2$[11] = 10.533; p = .483; ΔCFI = 0.000; ΔRMSEA = .000). These results revealed that the two models fitted equally well between males vs. females, Asians vs. non-Asians, and degree-seeking vs. non-degree-seeking students.

Discussion and implications

Theoretically seeking guidance from Pang & Wang's, (2020) theoretical framework and methodologically using a longitudinal design, the current study examined the three-wave cross-lagged models among international students sojourning in China and revealed causal or reciprocal links among intensity of WeChat usage, behavioral engagement, and cross-cultural adjustment. The findings advanced prior cross-sectional studies by adding new insights into the research on social media technologies in international education.

Interpretation of the main findings

Consistent with our hypotheses of H1a and H4a, WeChat usage intensity positively predicted longitudinal changes in BE-academic (congruent with Junco et al., 2011 focusing on Twitter) and BE-social (congruent with Kim et al., 2016 focusing on social media non-specified). These results revealed WeChat's functional role as instrumental resources that were motivational in nature to stimulate international students' academic/social engaging behaviors. For instance, via the intensified usage of WeChat, international students were enabled to be more actively engaged in online academic behaviors (e.g., discussion, collaboration, and knowledge sharing). These teamwork behaviors occurring on online platforms can promote and reinforce goal-oriented motivation for and engagement in academic learning (Rasheed et al., 2020). BE-social is also challenging for international students since it often involves intergroup anxiety and uncertainty (Stephan, 2014). And such negative yet enduring emotional (i.e., anxiety) and cognitive (i.e., uncertainty) factors can in turn cause avoidance in contact with cultural others (social disengagement) (Duronto et al., 2005). However, social media (e.g., WeChat) can provide a useful platform for international students to acquire cultural knowledge (e.g., norms, values, and traditions) of the host society and its members (Pang, 2020). More knowledge of mainstream cultures can alleviate minority members' intergroup anxiety and uncertainty (Stephan, 2014), thus reducing avoidance intentions and improving engagement levels. Besides, one key function of social media usage is to build and maintain interpersonal relationships, which can be especially essential for international students characterized by leaving family members and friends back in home countries. Therefore, international students who utilize local social media to interact and socialize with locals more actively may gain more social support from locals because social support is usually embedded in social relationships (Li & Peng, 2019). Such support resulting from social media usage can be functional in informational, emotional, and motivational aspects to stimulate international students' inner interest and actual engagement in local social activities. The above arguments may be the causal mechanisms underlying the WeChat usage → BE-academic and WeChat usage → BE-social relationships, thereby offering strong evidence that WeChat usage can be the antecedent of behavioral engagement, rather than its consequence.

In line with H5, we found the reciprocal effects between WeChat usage and social adjustment. The effects of social media usage on social adjustment were empirically consistent with Forbush & Foucault-Welles, (2016) and Pang, (2020). The result lends support for the argument that social media is of particular usefulness for international students' transition into the new society via acquiring intercultural and linguistic competence (Li & Peng, 2019). To sum up, our findings implied that the functional roles of WeChat can be more salient in social communities than in academic communities. Of interest, our study revealed the reverse effects of social adjustment on WeChat usage both from Time 1 to Time 2 and from Time 2 to Time 3 (see Fig. 2), a novel finding that has not been examined in the previous literature. It may inform that WeChat usage was likely to be intensified as social adjustment was achieved or accumulated, echoing the notion that ongoing successes reinforce previous behaviors or beliefs that have contributed to such successes (Chen et al., 2020; Yuan et al., 2013). Alternatively, socially well-adjusted international students may have formed various social networks in China, and thus may rely more on WeChat to maintain and strengthen these interpersonal relationships. The findings provided evidence that WeChat usage can be both the antecedent

and the consequence of social adjustment. We also revealed reverse effects from academic adjustment to WeChat usage from Time 1 to Time 2 and from Time 2 to Time 3, a novel finding as well, which supported H2b. Like socially well-adjusted students, academically well-adjusted students may also rely more on WeChat for specific academic purposes.

A bit surprisingly, neither WeChat usage intensity nor BE-academic predicted longitudinal changes in academic adjustment, which may show that international students still faced problems with Chinese styles of teaching, learning, or management regardless of how intensively they used WeChat and how actively they engaged in academic learning. The lack of effects also informs that there can be alternative factors influencing academic adjustment but are not examined in the current study. Anyway, it must be recognized that achieving academic adjustment is highly demanding for international students. Unlike social outcomes that are often add-on benefits for overseas study, academic outcomes have to be pursued and achieved by international students in order to graduate. Wang & Hannes, (2014) qualitatively revealed that international students faced more hardships in academic adjustment than those in social adjustment. Furthermore, teaching and learning practices in China are deeply rooted in its collectivist cultures (Cao & Meng, 2020; Cao et al., 2020), which may cause more difficulties for academic adjustment, particularly for students from Western individualist cultures. In a similar vein, Cao et al., (2021) targeted Chinese students in a Western country (i.e., Belgium) and found that their collectivist cultures mattered much more than the host individualist cultures in affecting academic adjustment.

Theoretical and practical implications

Our study guided by Pang & Wang's, (2020) framework can be among the first examining how WeChat usage can generate social and academic outcomes for international students in China. From the theoretical perspective, the findings derived from the social model corresponded to the propositions of the framework by revealing that WeChat usage intensity was a longitudinal predictor of both BE-social and social adjustment and BE-social was a longitudinal predictor of social adjustment. Extending the framework, we also examined its applications in the academic domains. The findings derived from the academic model did not fully conform to the framework. More specifically, while WeChat usage intensity was a longitudinal predictor of BE-academic, there were no relations of WeChat usage intensity and BE-academic with academic adjustment. In this regard, we revealed that within the framework, WeChat usage intensity seemed to yield relatively more positive social outcomes than academic ones. It is suggested that future studies need to outline a more suitable and integrative framework that synergistically depicts how social media usage may impact international students' academic learning in various domains (e.g., academic support, knowledge sharing, academic self-efficacy, goal progress, academic engagement, academic adjustment, and academic performance). More importantly, our study can be the first examining the relationships with a longitudinal design. Hence, we contributed to the existing literature, as well as the framework which merely proposes the unidirectional links, by testing the dynamic and reciprocal process. Indeed, we found the reciprocity between WeChat usage intensity and social adjustment and a reverse link from academic adjustment to WeChat usage intensity. The revealed directionality of these relationships can be important findings that were lacking in prior investigations but challenged the prevalent belief that social media usage simply acts as the antecedent of international students' cross-cultural adjustment (e.g., Forbush & Foucault-Welles, 2016; Li & Peng, 2019; Lin et al.,

2012; Pang, 2020; Yu et al., 2019). Therefore, our findings have delved deeper into the nature of social media effectiveness for international students.

Practically, our study highlighted the importance for host universities to integrate social media (WeChat in this case) in facilitating international students' academic/social adjustment. The integration needs to be designed more wisely to maximize the usefulness and effectiveness of WeChat by implementing several strategies. First, one important service available on WeChat is the creation of public accounts wherein texts, pictures, and videos concerning specialized information, knowledge, or current events can be provided, and users who are interested can follow the public accounts. It is necessary that at university/faculty levels, public accounts in English can be created for international students regarding host management policies, faculty profiles, pedagogical application, academic resources, and host cultural traditions and customs. The strategy can increase chances for acquiring knowledge of the host university and society necessary for academic/social engagement and adjustment. Second, host trainings on WeChat usage can be offered to newly arrived international students and how it is integrated into daily academic activities needs to be displayed. Thus, the new students can recognize the importance of learning with the usage of WeChat at the initial phase. Third, to intensify the usage of WeChat for academic/social purposes, topics with common interest (e.g., innovative teaching in multicultural classrooms, learning-related confusion, mainstream traditions, and world affairs) should be designed for international students in WeChat friend groups. In doing so, students may be more actively engaged in discussion, collaboration, and knowledge sharing (Rasheed et al., 2020). Finally, Chinese domestic students need to be invited to join the WeChat friend groups and participate in the online discussion. As online relationships are likely to be transferred to offline relationships (Lev-On & Lissitsa, 2015), this strategy is vital because it expands international students' chances to interact with local peers in both virtual and physical contexts. Accordingly, international students may have more chances for BE-social. Of note, when our study was conducted, the Covid-19 pandemic was still a global crisis and brought challenges to academic and social involvement of international students. For instance, international students have to undergo the course shift from traditional in-person classes to online virtual classes and abide by the social distancing or occasional lock-down policies in many host countries (Van de Velde et al., 2021). To handle the dramatic changes, host universities can fully utilize social media as a channel to improve international students' engagement and adjustment, thereby compensating the loss caused by the pandemic.

Limitations and conclusion

Several limitations need to be acknowledged. First, although we collected the three-wave longitudinal data, the three-month intervals were relatively short. Tracking international students is difficult because their study abroad durations are various (e.g., a few months of exchange programs). Therefore, future longitudinal studies can address this issue by focusing on a fixed group of international students enrolled in a one-year or longer program. Second, our study merely examined the social media of WeChat. Although these social media (e.g., Facebook, Twitter, and WhatsApp) are banned in China, some international students may still be able to use them through Virtual Private Network (VPN). Therefore, future research can capture more nuances in international students' engagement and adjustment in China if the roles of WeChat and other social

media can be differentiated. Third, as for BE-social, we merely investigated international students' behavioral engagement in the host community. It is recommended that future research additionally examine engagement in co-ethnic and international communities. Finally, since our participants were WeChat users at Chinese universities, cautions may be required to generalize the results to other academic/social contexts or social media platforms before future longitudinal studies can validate our results.

Despite these limitations, the current study can be among the first that longitudinally tested social media usage and its relationships with academic and social outcomes among international students. Due to the revealed causal or reciprocal relationships among the study variables, new knowledge has been contributed to the literature on web-based technologies in the educational community. Specifically, we revealed the causal effects from WeChat usage intensity to BE-academic and BE-social, and from BE-social to social adjustment. The causal pathways confirmed and extended the previous knowledge gained from the correlational evidence based on cross-sectional data. More importantly, we revealed the reverse causal effects from academic adjustment to WeChat usage intensity, as well as the reciprocal effects between WeChat usage intensity and social adjustment. The reverse and reciprocal effects contributed new knowledge by informing that adjustment outcomes may also be antecedents of intensity of social media usage. Theoretically, although the suitability of Pang & Wang's, (2020) framework for the research on international student adjustment was generally confirmed, our results indicated that the framework may still have space for advancement by taking into account reverse effects from cross-cultural adjustment to social media usage. This idea of acting in cycles echoes that the intensified social media usage may help international students achieve better adjustment, and later, achieved adjustment may in turn stimulate more intensified usage. Practically, our results can provide implications for host universities to make integrated efforts to design programs on social media platforms for generating better academic/social outcomes for international students.

Data availability Data will be made available on request to the first author.

Declarations

Conflict of interest The authors declare no competing interests.

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