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The relationship between specific problematic internet use and hope: academic exhaustion as mediator and mattering as moderator among Chinese university students

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Abstract

Problematic social media use (PSMU) and problematic gaming (PG) among university students as specific types of problematic internet use (PIU) have become a growing concern. PSMU and PG may lead to negative outcomes such as academic exhaustion and diminished hope. However, previous studies have not simultaneously considered the associations among these variables from the perspective of Stressor-Strain-Outcome model. Furthermore, the concept of 'mattering'—the feeling of being valued and important to others and 'fear of not mattering' in this dynamic is notably under-investigated. The present study aimed to examine the associations among these variables and evaluated whether mattering profiles moderated the associations involving PIU among university students.

A survey was conducted among 3,035 university students in China, with an average age of 19.24 years (SD = 1.83). The sample included 52% males and 48% females from 19 different universities. The Bergen Social Media Addiction Scale, the Internet Gaming Disorder Scale-Short Form, the General Mattering Scale, the Fear of Not Mattering Inventory, the Maslach Burnout Inventory–Student Survey, and the Dispositional Hope Scale were utilized to evaluate PSMU, PG, general mattering, fear of not mattering, academic exhaustion, and hope, respectively. Furthermore, latent profile analysis was used to categorize students into distinct mattering profiles based on measures of general mattering and fear of not mattering to others.

Correlational analyses indicated that PSMU and PG were associated with greater academic exhaustion, reduced hope, and higher levels of fear of not mattering. Mediation analysis identified academic exhaustion as a mediator in the relationships between PSMU and hope, as well as between PG and hope. Profile analyses identified a group of students distinguished by exceptionally low levels of general mattering. Mattering profiles acted as moderators of the associations between PG and academic exhaustion, and between academic exhaustion and hope.

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PG negatively affected students' hope through academic exhaustion, while different mattering profiles had diverse associations. Customized intervention strategies focused on boosting hope and feelings of mattering, and reducing fears of not mattering are needed to reduce vulnerability to PG and PSMU.

Keywords Problematic social media use, Problematic gaming, Academic exhaustion, Hope, Mattering, Fear of not mattering, Latent profile analysis

Introduction

With the rapid development of internet access and technology, social media and online games have gained significant popularity, particularly among young people [1]. While these activities offer benefits such as social interaction and entertainment [2], they also pose risks of problematic internet use (PIU)—unhealthy patterns characterized by loss of control and potentially hazardous outcomes [3, 4]. Research has categorized PIU into two main types: generalized PIU, encompassing a wide range of problematic online behaviors, and specific PIU, focusing on difficulties with particular online activities [5, 6]. Among university students, various forms of specific PIU have been observed, with problematic social media use and problematic gaming being particularly prevalent.

University students are especially vulnerable to PIU. Factors such as lack of adult supervision, unrestricted internet access, desire for close relationships, and the need to develop personal identities contribute to their susceptibility [7]. Moreover, as emerging adults, university students are still resolving core self and identity issues, often lacking a stable self-image and personal identity. This developmental stage may further exacerbate their vulnerability to specific forms of PIU.

Building on this understanding of PIU among university students, the present study focused on two prominent forms: problematic social media use (PSMU) and problematic gaming (PG). These behaviors share key characteristics such as compulsive engagement, mood alteration, and persistence despite negative consequences [6]. The present study aimed to investigate how PSMU and PG influence university students' psychological constructs, specifically hope and academic exhaustion. Additionally, the concept of mattering is introduced to this context. Subsequent sections elaborate on the mediating role of academic exhaustion and the potential influence of mattering in these relationships.

The relationship among problematic social media use, problematic gaming, hope, and academic exhaustion

As for students, existing research had indicated that PSMU and PG were associated with numerous negative effects, including decreased academic achievement [8, 9], academic burnout [9, 10] and poor mental health [6, 11]. Among the adverse consequences that can arise, academic burnout is particularly prevalent among students confronting high academic demands. This condition is typified by three main elements: academic exhaustion due to course demands, which is the central aspect of academic burnout, as well as growing cynicism and a sense of inadequacy in academic pursuits [12, 13]. Moreover, academic burnout, not only contributed to academic issues such as low grades and reduced engagement [14], but is also associated with psychological problems including low self-efficacy, anxiety, and depression [13, 15, 16]. Consequently, it is essential to explore the possible relationship between PSMU, PG, and academic burnout, particularly focusing on the aspect of academic exhaustion, among university students.

Furthermore, PSMU and PG may diminish dispositional hope among students when viewed through the lens of hope theory. Hope theory, as proposed by Snyder, is a motivational and cognitive framework comprising two essential and interactive components: pathways and agency thinking [17]. Hope is defined as the perceived capacity to generate pathways to desired goals (pathways thinking) and to motivate an individual to initiate and utilize these pathways (agency thinking) [18]. Extant research indicates that hope is positively correlated with university students' academic performance and well-being [19, 20].

Previous studies have confirmed a negative association between PSMU and hope. In a cross-sectional study conducted by Błachnio et al. [21] with 611 Polish Facebook users, problematic Facebook use (a form of PSMU) was found to be negatively associated with hope. To the best of the authors' knowledge, the literature lacks direct investigation into the relationship between PG and hope. However, existing research has established a positive association between PG and sleep disturbances [22, 23], which are known to adversely affect hope [24]. Based on these findings, a negative association between PG and hope was hypothesized.

In addition, PSMU and PG could lead to an experience of academic exhaustion [25, 26] which in turn may diminish hope among students by eroding sense of agency and pathways to reach their goals. The conceptualization and assessment of hope in the present study reflected Snyder's dual emphasis on agency and pathways

as facets of hope [27]. A student's sense of agency is particularly likely to be negatively affected by academic exhaustion, because the experience of mental and physical fatigue can make it challenging for them to maintain motivation and energy to pursue their academic goals. It is corroborated by empirical evidence, with one study reporting the presence of a negative association between academic burnout and hope [28].

The Resource Model of Self-Control (RMSC) [29] and Stressor-Strain-Outcome (SSO) model [30] may explain the relationship between PSMU, academic exhaustion and hope, as well as that between PG, academic exhaustion and hope. RMSC posits that the overconsumption of self-control resources can lead to ego depletion [29]. PSMU and PG can consume a significant proportion of students' time and self-control resources, potentially leading to academic exhaustion [12]. This positive association between PSMU and exhaustion has been empirically substantiated among university student populations [25], while a similar relationship between PG and exhaustion has been validated among adolescent samples [26]. Additionally, the excessive depletion of self-control resources attributed to PSMU and PG results in a scarcity of cognitive faculties required for agency and pathway thinking, consequently culminating in a reduction of hope, as postulated by hope theory.

The SSO model, as proposed by Koeske and Koeske [30], outlines the process where stressors negatively affect behavior through psychological strain, which acts as a key mediator. Stressors encompass all unfavorable actions, such as PIU, which are deemed problematic behaviors [31]. Strain refers to the negative emotional responses to stressors, including exhaustion [32]. Outcomes represent the ongoing behavioral or psychological effects of these strains, such as a reduction in hope [33]. Guided by studies [9, 25] that have recognized PSMU as a stressor, the present study extends the application of the SSO model to argue that the stress induced by PSMU and PG can transform into academic exhaustion, a strain that has profound implications for students' psychological well-being. Academic exhaustion, characterized by feelings of fatigue and depletion of energy, can impede an individual's sense of agency and the perceived availability of pathways to achieve their goals, thereby diminishing their hope. This sequence underscores the SSO model's application in understanding the progression from stressor to strain to outcome within the context of PIU.

By integrating the RMSC with the SSO model, the present study provides a more comprehensive lens to understand the dynamics between PSMU, PG, academic exhaustion, and hope. This integration not only deepens the understanding of the existing theories but also broadens the SSO model's application scope, providing a more nuanced understanding of how stress and academic exhaustion related to PIU influence individuals' sense of hope.

Parenthetically, existing literature has primarily focused on generalized PIU when examining its relationship with exhaustion and hope, consistently showing negative associations [34–36]. However, research examining specific types of PIU, such as PSMU and PG, remains scarce, with PG being even less studied than PSMU in relation to these psychological constructs. Additionally, most studies have concentrated on middle and high school students, leaving a significant gap in the understanding of these dynamics among university students—a demographic for whom hope plays a crucial role, particularly in career preparation and its effects on motivation and engagement [37]. Furthermore, comprehensive studies simultaneously examining the effects of both PSMU and PG on academic exhaustion and hope from the perspective of the SSO model are lacking. This limitation impedes a thorough understanding of PIU's broader implications among university students, highlighting the need for more targeted research in this area.

The association of mattering with PSMU and PG

While several constructs likely play a significant role in providing protection from PIU, this present study breaks new ground by considering feelings of mattering to others as a potential key protective factor. The concept of 'mattering' was formally introduced by Rosenberg and McCullough [38], extending the seminal work on self-esteem initially explored by Rosenberg in 1965 [39]. Mattering was couched primarily in positive terms and described by Rosenberg, both as a feeling and a motive in terms of the need to feel a sense of mattering [40]. More recently, the concept of mattering has been explored in-depth by researchers such as Flett [41–43], who has contributed extensively to the understanding of the human need to be significant. It is defined as 'the feeling being valued and having personal significance to others' [41]. Feelings of mattering to others represent a form of worth that is highly protective [38]. Mattering to others is a core need that results in life satisfaction and happiness when it is satisfied. It is associated with a range of positive outcomes, including higher levels of self-esteem, resilience, and psychological well-being [41–43]. However, when mattering is missing in someone's life, including the lives of students, it can be quite debilitating and destructive and associated with distress and various forms of dysregulation, such as depression, anxiety, and loneliness [41, 44].

Recent analyses have highlighted a significant gap in addiction research: the underrepresentation of both mattering and fears related to not mattering [45]. While

studies have explored the relationship between fear of missing out (FoMO) and both PSMU and PG [46, 47], mattering and fear of not mattering remain underexamined. These constructs encompass broader psychological implications than FoMO, potentially offering deeper insights into PIU motivations.

More specifically, mattering and fear of not mattering are more comprehensive than FoMO, addressing core aspects of self-concept and the universal need for social validation [48]. They have wider applicability across life domains and greater potential for developing interventions to enhance well-being. Given that PIU often stems from attempts to fulfill unmet psychological needs, understanding mattering could provide a more nuanced perspective on PIU development and maintenance. Future research investigating the role of mattering and fear of not mattering in PIU contexts is crucial, potentially enhancing the understanding of PIU's psychological underpinnings and informing more effective prevention and intervention strategies.

The inclusion of a focus on mattering is perhaps the most unique element of the present study. The present study evaluated two inter-related issues involving mattering versus fear of not mattering to others. While recent research has established an association between deficits in feelings of mattering and the fear of not mattering with burnout [49], the precise relationship between these constructs and specific forms of PIU, such as PSMU and PG, remains insufficiently explored within the context of university student populations. To date, research by Watson et al. [50] has indicated that feelings of mattering are significantly associated with PSMU among US adolescents. Research has identified an association between higher scores on the Anti-Mattering Scale [44] and PSMU among community adults in Italy [51]. Conversely, a study conducted with a Turkish university student sample did not find any significant associations between scores on the General Mattering Scale [52] and PG [53].

Moreover, distinct from the social functions associated with PSMU, individuals engaged in PG may become so deeply engrossed in online gaming activities that they inadvertently neglect their real-life social interactions. This potential neglect may result in a diminished sense of 'mattering' during social encounters, thereby potentially leading to increased psychological stress.

These observations highlight the need to investigate the relationships between mattering, fear of not mattering, and aspects of PIU across diverse groups. Current research on these associations is limited and inconsistent, especially among university students. The present study addressed this gap by examining how general mattering and fear of not mattering relate to PSMU and PG among Chinese university students.

Mattering as a moderator

To date, the limited research exploring mattering in the context of PIU has predominantly focused on their direct relationship. However, the potential moderating effect of mattering on the association between specific forms of PIU (such as PSMU and PG) and psychological variables such as academic exhaustion and diminished hope remains largely unexplored.

The Cognitive Appraisal Theory (CAT) [54] provides insight on this dynamic, positing that an individual's response to stress is influenced by their perception and management of stressors. In the context of university students, PSMU and PG have been identified as a stressor, and their impact is influenced by the individual's evaluative and coping strategies. Students who have a strong sense of mattering - feeling that they are valued and significant to others - are more likely to alleviate the stress caused by PIU due to their increased likelihood of discovering online support [55] and experiencing reduced feelings of loneliness [56, 57]. This is because they may effectively harness their cognitive resources and self-concept to manage these challenges [45]. Consequently, this can lessen the adverse effects of PIU on their academic exhaustion levels and, in turn, safeguard their sense of hope. Conversely, students who are preoccupied with the fear of not mattering may perceive stress more acutely and experience greater loneliness [41, 58, 59], especially if they already feel undervalued or isolated in their offline life. This heightened perception of stress and loneliness could exacerbate the adverse effects of PIU on academic exhaustion and, by extension, erode their hope.

Guided by the aforementioned literature, the present study evaluated whether elevated levels of general mattering would buffer the impact of two specific types of PIU (e.g. PSMU and PG) on academic exhaustion and hope. Moreover, the study also considered whether a heightened fear of not mattering may increase susceptibility to the negative consequences of these specific types of PIU.

Another unique element of the present study was to consider the likelihood that different mattering profiles exist when various measures are used to assess distinguishable facets of the mattering construct. More specifically, the intricate manner in which the configuration of various aspects of mattering can shape an individual's overall sense of significance was a key rationale for exploring mattering profiles. As individuals, even when confronted with negative experiences or societal perceptions that might lead to anxiety of unimportance (i.e., fear of not mattering), some individuals still derive

the feelings of mattering from key relationships in their daily lives. For instance, while an individual might feel marginalized in a broader societal context, they may still view themselves as valuable and cherished by their close friends or family. In other words, the complex interplay of different forms of mattering can create a unique profile within an individual. To capture this complexity and identify these unique profiles, the present study employed a novel methodological approach.

More specifically, the present study adopted a person-centered approach, employing latent profile analysis (LPA), to identify unique individual mattering profiles. Following the identification, the study proceeded to assess the impact of these profiles on the relationship between PSMU, PG, academic exhaustion, and hope. This approach is supported by existing research [60, 61], which has shown that person-centered methods excel at identifying groups of individuals with shared characteristics or relationships between these attributes. These methods are better suited for examining how these groups differ in their developmental patterns, compared to variable-centered methods, which concentrate on the associations between variables. LPA is particularly crucial in this context, because it allows the identification of distinct profiles of mattering among university students, which is not possible with traditional variable-centered approaches.

Empirical research utilizing LPA to identify mattering-related groups remains limited. Saritepeci et al. [53] applied LPA to identify distinct clusters among university students, considering factors such as screen addiction, gaming addiction, general mattering, and family belonging. Subsequently, Wang et al. [62] employed LPA to identify distinct mattering profiles, through general mattering, anti-mattering, and fear of not mattering among university students and examined these profiles in relation to various types of PIU, including PSMU and PG, as well as adaptability, with a particular emphasis on the differences among the profiles in PIU types. Building on this precedent, the present study employed LPA to identify various mattering profiles, aiming to understand the heterogeneity in students' perceptions of mattering and fear of not mattering. It is anticipated that these findings will inform tailored interventions based on students' unique mattering profiles and internet use patterns, contributing to a more comprehensive understanding of the psychosocial dynamics underlying students' digital engagement and well-being.

The present study and research hypotheses

The present study examined the interrelationships between PSMU, PG, academic exhaustion, hope, and mattering in a university student population. The study focused on three main aspects: (1) the mediating role of academic exhaustion in the impact of PSMU and PG on hope, (2) the associations of feeling mattering and fear of not mattering with these two specific PIUs, and (3) how latent profiles formed from different aspects of mattering (general mattering and fear of not mattering) moderate these mediation processes. Based on extant theoretical frameworks and empirical findings, in addition to hypothesizing significant correlations between the two dimensions of mattering and both PSMU and PG, five hypotheses were proposed as illustrated in Fig. 1.

First, based on the RMSC [29], it was hypothesized that PSMU (H1a) and PG (H1b) would be positively

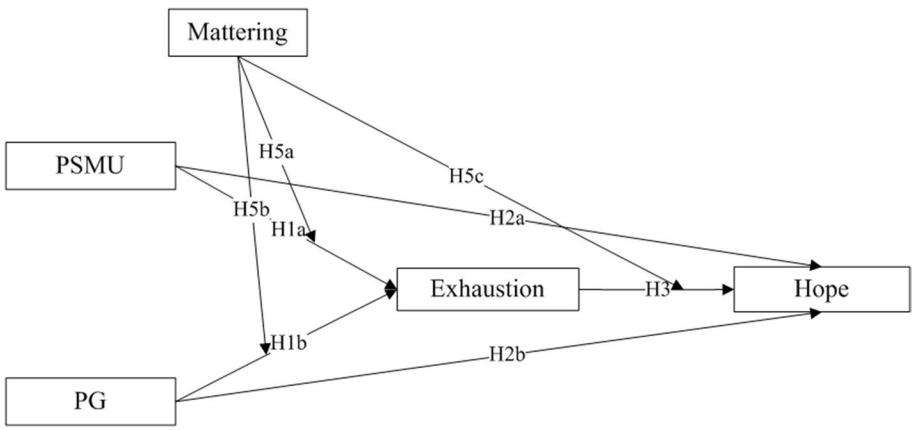

Fig. 1 Conceptual model. Notes: PSMU = problematic social media use, PG = problematic gaming, Exhaustion = Academic Exhaustion. Mattering means the different profiles

associated with academic exhaustion among university students.

Second, drawing on the concept that PIU limits students' opportunities to gain experience in other areas [63], potentially affecting their level of hope [21], it was hypothesized that PSMU (H2a) and PG (H2b) would be negatively associated with hope.

Third, it was hypothesized that academic exhaustion would be negatively associated with hope (H3), as academic exhaustion may undermine students' pursuit of goals.

Fourth, guided by the SSO model, it was hypothesized that PSMU (H4a) and PG (H4b) would be associated with hope through academic exhaustion.

Finally, a moderated mediation effect of mattering was hypothesized (H5). More specifically, it was hypothesized that PSMU's effect on academic exhaustion (H5a), PG's effect on academic exhaustion (H5b), and academic exhaustion's impact on hope (H5c) would vary depending on mattering profiles. This hypothesis was based on the concept of mattering as a stress buffer [42, 45, 58], where high mattering may protect against stress caused by PIU, while high fear of not mattering may exacerbate academic exhaustion in response to PIU.

Methods

Procedure and participants

The study employed convenience sampling to conduct a large-scale online survey, approved by the Institutional Review Board of Jiangxi Psychological Consultant Association (IRB ref: JXSXL-2022-Jul13). More specifically, data collection was initiated by contacting university instructors through an online higher education community, inquiring about their willingness to assist in the study. Those who expressed a willingness to participate were provided with a hyperlink and a QR code for the purpose of distributing these to their students within their respective courses. Subsequently, students who provided informed consent were directed to complete an online survey instrument. During August and October of 2022, data were collected.

After filtering out participants with exceptionally short response times, 3,035 participants from 19 universities throughout 13 provinces in mainland China were analyzed. The average age of the participants was 19.24 years, with a standard deviation of 1.83. The distribution of participants by university can be found in Table S1. To address possible clustering effects, the Intraclass Correlation Coefficient (ICC) for the variables of academic exhaustion and hope was determined, resulting in values of 0.052 and 0.029, respectively. With both ICC values falling below the threshold of 0.059, following Cohen's [64] recommendation, the clustering effect was considered negligible.

Table 1 Participant characteristics (N = 3,035)

Variable	Category	n (%)
Sex	Male	1,579 (52.0)
	Female	1,456 (48.0)
Sibling	Yes	2,598 (85.6)
	No	437 (14.4)
School type	University with 4-year study programs	2,384 (78.6)
	University with 3-year study programs	651 (21.4)
Grade	Freshman	1,726 (56.9)
	Sophomore	575 (19.0)
	Senior	526 (17.3)
	Graduate student	208 (6.8)
University location	East region	689 (22.7)
	North region	1147 (37.8)
	Central region	282 (9.3)
	South region	917 (30.2)

Table 1 shows the demographic details of the participants. The sample was slightly male-dominated (52.0%), with most participants coming from families with siblings (85.6%), enrolled in four-year study programs (78.6%), and in their freshman year (56.9%). The distribution of institutions was relatively balanced across the eastern (22.7%), northern (37.8%), and southern (30.2%) regions of China.

Instruments

Bergen Social Media Addiction Scale (BSMAS)

The BSMAS is a widely used tool for assessing PMSU severity. It is based on the Bergen Facebook Addiction Scale [65], and comprises six items (e.g., *"You feel an urge to use social media more and more"*), each rated on a five-point scale from 1 (*very rarely*) to 5 (*very often*). The scale's one-factor structure suggests that a higher cumulative score is indicative of an elevated risk of PSMU. In a validated Chinese version of the BSMAS, it exhibited robust factorial validity and internal reliability [66]. The present study further confirmed BSMAS reliability with a McDonald's ω of 0.84, signifying very good internal consistency.

Internet Gaming Disorder Scale-Short Form (IGDS-SF9)

PG was assessed using the IGDS-SF9. A key aspect of the IGDS-SF9 is the alignment with the nine gaming disorder criteria in the *Diagnostic and Statistical Manual of Mental Disorders, 5th Edition* [67]. Each item (e.g., "*Do*

you systematically fail to control or cease your gaming activity?") is rated on a five-point scale from 1 (*never*) to 5 (*very often*). A systematic review has endorsed IGDS-SF9 as a reliable instrument for evaluating disordered gaming [68]. Furthermore, the Chinese version of the IGDS-SF9 has shown a high level of internal consistency and factorial validity among Hong Kong University students [69]. The present study showed excellent internal reliability for the IGDS-SF9, with a McDonald's ω of 0.93.

General Mattering Scale (GMS) and Fear of Not Mattering Inventory (FNMI)

To assess university students' perceptions of general mattering and their fear of not mattering, the GMS [52] and FNMI [70] were used. Both scales comprise five items, with the GMS items being rated from 1 (*not at all*) to 4 (*a lot*), and the FNMI items being rated from 0 (*not at all*) to 3 (*almost all of the time*). Both are unidimensional measures. Sample items include: *"How much do you feel others would miss you if you went away?"* (GMS) and *"Do you worry that others will see you as unimportant or insignificant?"* (FNMI). The Chinese versions of both scales have been validated, demonstrating satisfactory factorial validity through classical test theory and Rasch analysis [71]. The present study showed McDonald's ω values were 0.86 for the GMS and 0.92 for the FNMI.

Maslach Burnout Inventory–Student Survey (MBISS)

The MBISS was designed to specifically assess students' burnout resulting from school-related academic demands. The instrument was developed using the MBI-General Survey (MBI-GS) [72]. The MBISS includes three subscales: exhaustion, cynicism, and reduced efficacy, with items being rated on a five-point scale from 0 (*never*) to 4 (*always*). For the present study, only the exhaustion subscale was used as an indicator of participants' academic exhaustion because academic exhaustion is a core component of students' burnout [13]. The Chinese version of the MBISS has been evaluated and found to have satisfactory psychometric properties [49]. The academic exhaustion subscale comprises five items (e.g., *"I feel used up at the end of a day at university"*). As demonstrated in the present study, the scale has excellent internal reliability, with a McDonald's ω of 0.93.

Dispositional Hope Scale (DHS)

Hope was assessed with the Chinese version of the DHS [73]. The original DHS comprises 12 items (e.g., *"I can think of many ways to get the things in life that are most important to me"*) which are rated on a scale ranging from 1 (*definitely false*) to 4 (*definitely true*) [27]. In addition to the four filter items, the scale consists of two subscales: agency (4 items) and pathways (4 items). The Chinese version of the DHS has been evaluated and demonstrated a consistent factor structure aligning with the original two-factor structure [73]. In addition, the two latent factors in the scale were significantly related to general well-being and general health status, suggesting its criterion validity [73]. In the present study, the internal reliability of the two subscales – 'agency' and 'pathways' – was robust, with McDonald's ω values of 0.79 and 0.84 respectively.

Data analysis

Descriptive statistics were computed for the observed variables, and Pearson correlations were analyzed between the study variables. Subsequently, LPA was utilized to identify how many latent profiles were present for two types of mattering, as represented by the items of GMS and FNMI. Guided by the recommended criteria [74], several metrics were evaluated to determine the optimal number of latent profiles. As part of the analysis, these metrics were examined. They include Akaike's Information Criterion (AIC), Bayesian Information Criterion (BIC), Sample-Adjusted BIC (SABIC), Integrated Complete-data Likelihood (ICL), Entropy, and Bootstrap Likelihood Ratio Test (BLRT). Models with a superior fit typically have a lower AIC, BIC, and SABIC value, as well as higher ICL and entropy (with an ideal entropy value exceeding 0.90). The BLRT comparisons played a pivotal role, aiding in contrasting model structures with 'k' and 'k-1' classes. Using the "elbow-criterion" for large sample sizes, a profile solution was chosen when the curve began to level off. After pinpointing potential latent profiles, an ANOVA was conducted to further differentiate among profiles based on the variables of interest.

Considering the SSO model, it was hypothesized that PSMU and PG would have an indirect effect on hope via academic exhaustion. However, an alternative hypothesis warrants consideration: hope could have an indirect effect on academic exhaustion through PSMU and PG. This alternative proposition suggests that a decrease in hope might lead to PIU as individuals seek to cope with negative emotions, which could subsequently result in academic exhaustion. To determine the optimal model, the proposed SSO model was initially evaluated using structural equation modeling (SEM) in the open-source statistical software Jamovi 2.3.23, utilizing the SEMlj module. Subsequently, a comparative analysis between this model and an alternative model was conducted to ascertain which one best aligns with the empirical data. Model fit was assessed using multiple indices, including the Comparative Fit Index (CFI), Tucker–Lewis

Table 2 Descriptive statistics and Pearson correlations between problematic social media use, problematic gaming, academic exhaustion, hope, and two kinds of mattering

	M (SD)	1	2	3	4	5	6
1. Problematic social media use (range: 6–30)	14.75 (4.35)	1.00					
2. Problematic gaming (range: 9–45)	16.29 (6.50)	0.44**	1.00				
3. Academic exhaustion (range: 0–20)	11.04 (4.49)	0.36**	0.36**	1.00			
4. Hope (range: 8–32)	22.97 (4.53)	-0.17**	-0.23**	-0.30**	1.00		
5. General mattering (range: 5–20)	13.11 (3.01)	-0.04*	-0.16**	-0.23**	0.37**	1.00	
6. Fear of not mattering (range 0–15)	3.99 (3.15)	0.37**	0.30**	0.37**	-0.25**	-0.05*	1.00

Notes: $^{**}p < 0.01$, $^{*}p < 0.05$

Index (TLI), and Root Mean Square Error of Approximation (RMSEA). Adhering to Hu and Bentler's [75] recommendations, the following criteria were adopted for acceptable fit in the structural model: CFI and TLI values ≥ 0.90, and RMSEA value < 0.08.

The moderated mediation analysis for the best-fit mediation model was conducted using the jamovi module "jAMM", which is built upon the lavaan R-package. We employed the bias-corrected percentile bootstrap method with 5000 resamples and a 95% confidence interval (CI) to provide robust estimations of effects, considering a CI not containing zero as indicative of significant mediation. Notably, the analysis incorporated control variables including common demographics (grade, sex, and school type) and sibling presence. The inclusion of sibling status as a control variable is grounded in research demonstrating siblings' significant impact on emotional well-being through emotional support and validation, which mitigate loneliness and depression—factors associated with fostering hope [76]. Furthermore, within the Chinese context, studies have shown sibling size influences individual happiness, which is associated with hope [77]. This comprehensive approach, accounting for these multifaceted influences on hope, enhances the robustness of the study's findings.

Results

Descriptive statistics and Pearson correlations

The means and standard deviations for the participants' scores on PSMU, PG, academic exhaustion, hope, general mattering, and fear of not mattering are presented in Table 2. Regarding the correlations between variables, both PIU measures showed moderate positive correlations with academic exhaustion and fear of not mattering, with *r*-values ranging from 0.30 to 0.37. Additionally, both specific types of PIU were significantly negatively correlated with hope, with *r*-values of -0.17 (PSMU with hope) and -0.23 (PG with hope). Moreover, academic exhaustion was found to have a significant negative correlation of -0.30 with hope.

Academic exhaustion was negatively correlated with general mattering ($r = -0.23$) and positively correlated with fear of not mattering to others ($r = 0.37$). As shown in Table 2, the scores on the general mattering had a negligible association with the PIU measures, although general mattering had a small but significant negative association with PSMU ($r = -0.04$) and PG ($r = -0.16$). In contrast, the fear of not mattering was more robustly associated with PG ($r = 0.30$) and PSMU ($r = 0.37$).

Latent profile analysis

LPA was used to identify meaningful mattering profiles among participants. The fit indices (AIC, BIC, SABIC, ICL, and BLRT), shown in Table S2, did not provide a clear indication of the optimal number of profiles. Therefore, an alternative strategy was employed, which involved examining the differences in fit indices between consecutive profiles. In comparison to the preceding profile, the 4-profile model showed the most significant changes in AIC, BIC, SABIC, and ICL, and the 'elbow' plot (Fig. 2) further supported this choice. The 4-profile solution was selected because it balanced model performance and parsimony, with the highest entropy of 0.97.

The four classes were characterized by their levels of general mattering and fear of not mattering (Table S3 and Fig. 3): Class 1 (46.5%) with Moderate Perceived Mattering – Low to Moderate Fear of Not Mattering; Class 2 (13.6%) with Moderate Perceived Mattering – Moderate Fear of Not Mattering; Class 3 (13.2%) with Low Perceived Mattering – Low Fear of Not Mattering; and Class 4 (26.6%) with High Perceived Mattering – Low Fear of Not Mattering. Overall, students in Class 3 had the most problematic profile due to an exceptional low level of general mattering while students in Class 4 have the most positive profile in terms of psychosocial adjustment. A one-way ANOVA with post-hoc Games-Howell tests confirmed the naming of these groups, with significant differences in general mattering ($F = 700.58$, $p < 0.001$) and fear of not mattering ($F = 2920.94$, $p < 0.001$) among the classes.

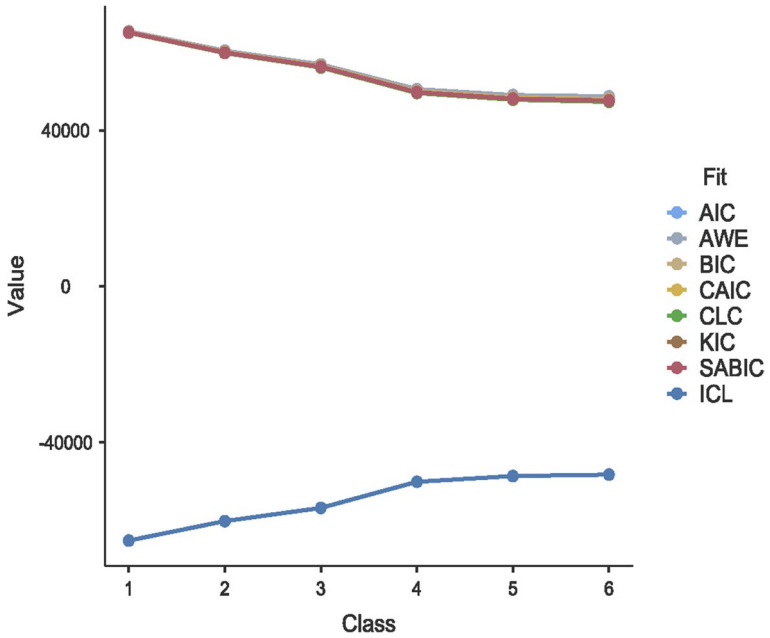

Fig. 2 Elbow plot showcasing the information criteria values across all latent profiles. A 4-class profile is chosen. Notes: AIC = Akaike information criterion, AWE = Accepted weight estimate, BIC = Bayesian information criterion, CAIC = Consistent Akaike information criterion, CLC = Complete-data log-likelihood criterion, KIC = Kullback information criterion, SABIC = Sample-size adjusted BIC, ICL = Integrated complete-data likelihood

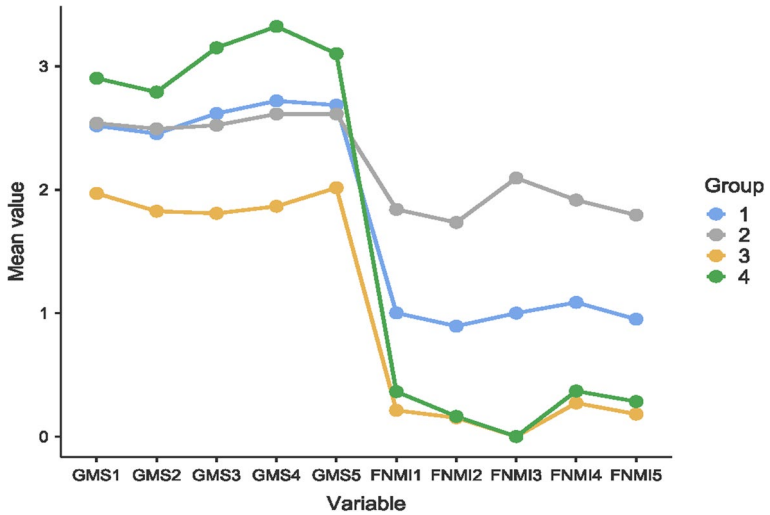

Fig. 3 Line chart illustrating comparisons of profiles for general mattering and fear of not mattering. Notes: GMS = General Mattering Scale, FNMI = Fear of Not Mattering Inventory

Moderated mediation analysis

Prior to analyzing the hypothesized indirect effect, we examined the model fit for both the proposed SSO-based model and the alternative model. The SSO-based model demonstrated an acceptable fit with χ^2 (df) = 2253 (444), CFI = 0.982, TLI = 0.979, and RMSEA = 0.037. In contrast, the alternative model (with PSMU and PG as mediators) did not fit the data well: χ^2 (df) = 10,824 (449), CFI = 0.894, TLI = 0.883, and RMSEA = 0.087. Furthermore, the AIC of the SSO-based model (2485) was substantially lower than that of the alternative model (11,046), indicating that the proposed model provided a better fit to the data, according to Raftery [78].

Table 3 Results of moderated mediation analysis (unstandardized coefficient and bootstraps confidence interval)

	Mediator model				Dependent model			
			95% CI				95% CI	
	B (se)	*t*	LLCI	ULCI	B (se)	*t*	LLCI	ULCI
Sex	0.05 (0.03)	1.68	-0.01	0.11	-0.49 (0.16)	-3.03	-0.81	-0.17
Sibling	-0.09 (0.04)	-2.18	-0.17	-0.01	-0.26 (0.22)	-1.21	-0.69	0.16
School type	0.01 (0.04)	0.32	-0.06	0.08	-0.30 (0.19)	-1.57	-0.67	0.08
Grade	0.02 (0.01)	1.29	-0.01	0.05	-0.24 (0.08)	-2.99	-0.39	-0.08
PSMU	0.04 (0.004)	9.86	0.03	0.05	0.01 (0.02)	0.14	-0.04	0.04
PG	0.03 (0.003)	10.68	0.03	0.04	-0.08 (0.01)	-5.65	-0.11	-0.05
Class 1	0.32 (0.04)	8.39	0.25	0.40	-0.69 (0.51)	-1.37	-1.70	0.31
Class 2	0.75 (0.06)	13.64	0.65	0.86	-2.49 (0.74)	-3.35	-3.94	-1.03
Class 3	0.33 (0.05)	6.28	0.23	0.43	-1.61 (0.62)	-2.61	-2.82	-0.40
PSMU × Class 1	-0.01 (0.01)	-0.08	-0.02	0.02				
PSMU × Class 2	0.01 (0.01)	0.97	-0.01	0.04				
PSMU × Class 3	0.01 (0.01)	0.26	-0.02	0.03				
PG × Class 1	-0.01 (0.01)	-0.69	-0.02	0.01				
PG × Class 2	-0.01 (0.01)	-1.15	-0.02	0.01				
PG × Class 3	0.02 (0.01)	2.08	0.01	0.03				
Academic exhaustion					-0.87 (0.10)	-8.64	-1.07	-0.67
Academic exhaustion × Class 1					-0.73 (0.24)	-3.02	-1.20	-0.26
Academic exhaustion × Class 2					-0.15 (0.29)	-0.51	-0.71	0.42
Academic exhaustion × Class 3					-0.48 (0.29)	-1.68	-1.04	0.08

Notes: *PSMU* Problematic social media use, *PG* Problematic gaming. Class 1–3 refers to the comparison between Class 1 vs. Class 4, Class 2 vs. Class 4, and Class 3 vs. Class 4, respectively

Subsequently, the proposed mediation model was examined while controlling for sex, sibling presence, grade, and school type (Table 3). The variance inflation factors for all independent variables, the mediator, and the moderator were below 1.20, indicating an absence of multi-collinearity. Path analysis showed that both PSMU and PG were positively associated with academic exhaustion (supporting H1a and H1b), and academic exhaustion was negatively associated with hope (H3 supported). PSMU was not significantly associated with hope (not supporting H2a), whereas PG exhibited a negative association with hope (supporting H2b). Bias-corrected bootstrapping mediation test confirmed that both PSMU and PG were associated with hope through academic exhaustion (supporting H4a and H4b).

The moderated mediation model, including the same control variables, showed that the interactions between PSMU and the dummy variables for the other three latent profiles of mattering did not have a significant association with academic exhaustion when using Class 4 as the reference category. However, the interaction between PG and the dummy variable for Class 3 (compared to Class 4) was significant ($b = 0.02$, $p < 0.01$, Boot SE = 0.01, 95% CI = [0.01, 0.03]), suggesting that PG's positive association with academic exhaustion in Class 3 (with a coefficient of 0.047) was stronger than in Class 4 (with a coefficient of 0.030) (see simple effect plot in Fig. 4). Moreover, the interaction between academic exhaustion and the dummy variable was significant when contrasting Class 1 with Class 4 ($b = -0.73$, $p < 0.01$, Boot SE = 0.24, 95% CI = [-1.20, -0.26]), indicating that the negative relationship between academic exhaustion and hope in Class 1 (with a coefficient of -1.26) was more pronounced than in Class 4 (with a coefficient of -0.53) (see Fig. 5 for simple effect plot). These findings supported the moderated mediation model (supporting H5b and H5c).

Further analysis of the conditional indirect effects showed that PSMU's negative indirect effect on hope was more pronounced in Class 1 (ab = −0.047, Boot SE = 0.008, 95% CI = [−0.063, −0.031]) than in Class 4 (ab = −0.020, Boot SE = 0.005, 95% CI = [−0.031, −0.010]). The indirect effect of PG on hope was more substantial in Class 1 (ab = −0.032, Boot SE = 0.005, 95% CI = [−0.042, −0.022]) and Class 3 (ab = −0.047, Boot SE = 0.008, 95% CI = [−0.064, −0.031]) than in Class 4 (ab = −0.016, Boot SE = 0.004, 95% CI = [−0.024, −0.008]).

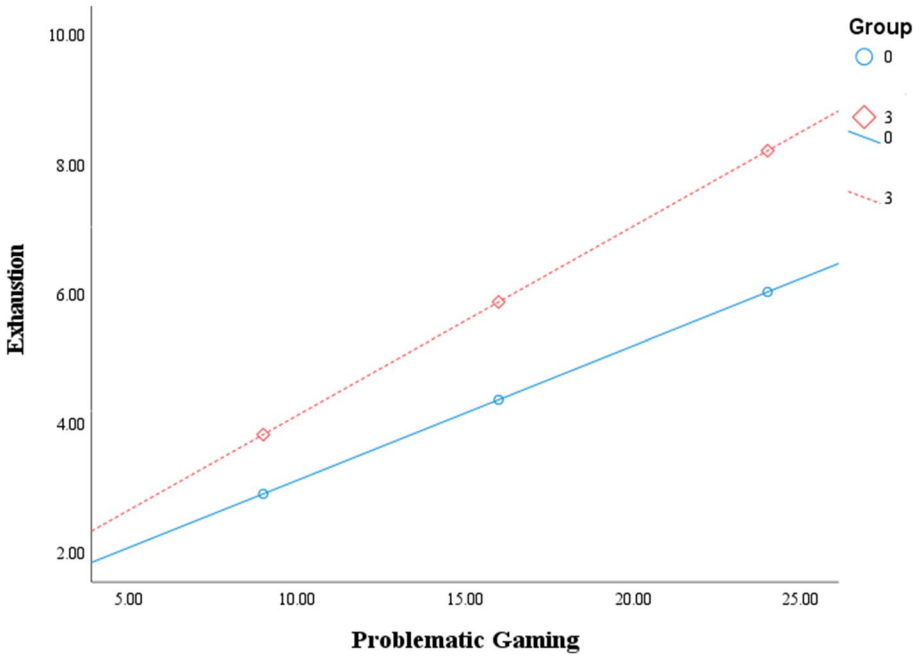

Fig. 4 Simple effect plot of problematic gaming on academic exhaustion across groups. Notes: 3 = Class 3, 0 = Class 4 and Exhaustion = Academic exhaustion

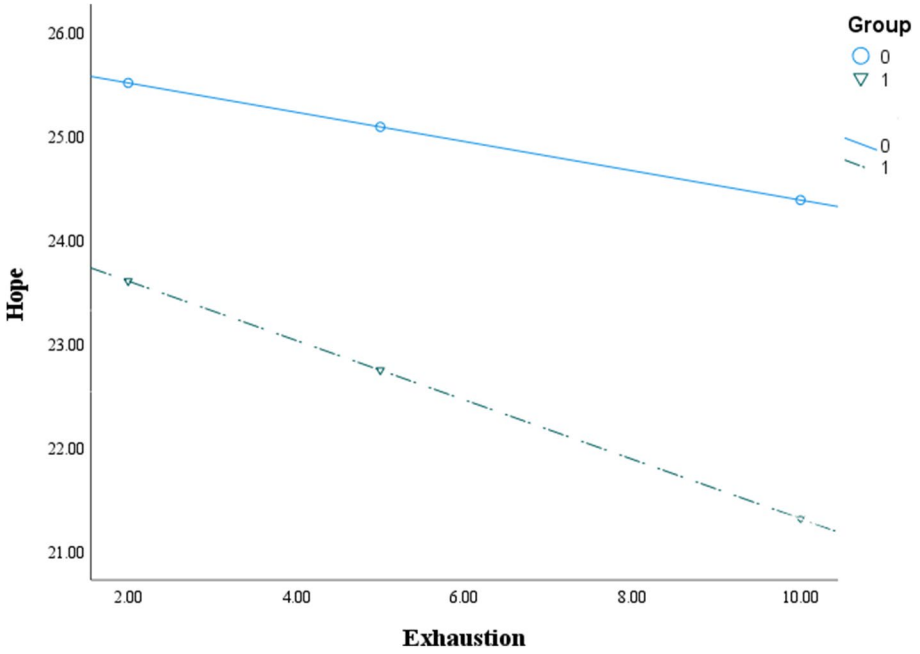

Fig. 5 Simple effect plot of academic exhaustion on hope across groups. **Notes:** 1 = Class 1, 0 = Class 4 and Exhaustion = Academic exhaustion

Discussion

The present study involved a large-scale survey among Chinese university students to examine the association between PSMU, PG, academic exhaustion and hope through the lenses of RMSC and the SSO model, while also considering levels of mattering and fear of not mattering as individual variables which were elicited by CAT. Furthermore, the research delineated distinct mattering

profiles utilizing LPA. The zero-order correlation analysis showed positive associations between PSMU and PG with the constructs of academic exhaustion and hope. These findings augment existing research by corroborating the positive correlation between two specific types of PIU (e.g. PSMU and PG) and academic burnout within student cohorts [10, 34]. RMSC offers a plausible explanation for this dynamic, positing that intense engagement in online activities may deplete the self-control resources of university students leading to ego depletion and subsequent learning academic exhaustion. This theoretical framework provides a comprehensive understanding of the potential mechanisms linking problematic online behaviors to academic exhaustion experiences among students.

Regarding the association between PSMU and PG with the construct of hope, the analysis showed distinct effects of these two specific forms of PIU on hope. Through the application of path analysis to concurrently assess the relationships between PSMU, PG, and hope, a significant negative association with hope was observed for PG. This result extends previous research that has documented a positive association between generalized PIU and hope [35, 36]. Conversely, PSMU was not found to have a statistically significant association with hope. These findings suggest that the relationship between PSMU and hope merits further exploration.

Building upon the previous discussion, the detrimental effect of PG on university students' hope is further substantiated by RMSC model. This model posits that intense engagement in PG depletes self-control resources, which in turn, can erode hope by diminishing individuals' sense of agency and their ability to envision pathways towards desired goals. However, the analysis did not yield a significant negative effect of PSMU on hope. This discrepancy might be due to the dominant impact of PG in the analysis and the unique context of increased internet use for socializing during COVID-19. According to the Compensatory Internet Use Model [79], PSMU, while problematic, might have served a compensatory role in fulfilling unmet social interaction needs and preserving hope during this period.

Additionally, the findings of the present study, interpreted through the SSO model, indicate that academic exhaustion serves as a mediator in the relationships between PSMU, PG, and hope. This mediating effect aligns with previous research that demonstrated a negative association between academic burnout and hope among university students [28].

The study's unique focus on the feelings of mattering to others and the fears of not mattering to others allows for a deeper understanding of how these cognitive appraisals can lead to differential outcomes in terms of addictive behaviors. Correlational analyses established that a heightened fear of not mattering was associated jointly with PSMU and PG. Positive feelings of mattering were largely unrelated to these tendencies. The association found between fear of not mattering and PSMU among university students extends earlier research from Italy associating feelings of not mattering (i.e., anti-mattering) with PSMU in a sample of community adults [51]. The present study's findings support the notion that concerns related to feelings of not mattering may play a role in addictive behavior [45]. The association with a fear of not mattering suggests the possibility that concerns about being or becoming insignificant may be fuelling problematic behavior. When it reaches a problematic level of social media use, this may entail exposure to information and exchanges with others that can add to a sense of diminished worth. It provides a clear link between cognitive evaluations and behavioral choices. This finding is in line with CAT's assertion that how individuals appraise an event (in this case, the perception of an individual's significance to others) directly influences their emotional and behavioral reactions. The conclusions extend the application of CAT to the realm of digital addictions, thereby enriching the theory's scope and relevance in contemporary society.

Furthermore, the profile analyses conducted with the mattering scores resulted in the identification of a unique class of students marked by comparatively low mattering to others but also low fear of not mattering (i.e., Class 3). Students with this pattern could perhaps have little fear of not mattering because they feel little sense of mattering to begin with. The mean level of mattering on the GMS for these students as a group was quite low relative to existing norms [42]. Overall, about 1 in 7 students in the present study were represented in Class 3, and this suggests the presence of a substantial proportion of students who are clearly distinguished by a lack a positive feeling of mattering to others.

For further depicting the students of Class 3, characterized by low perceived mattering, the present study suggested they may be usually accompanied by low hope (as evidenced by the unique Pearson correlation of 0.37 in Table 2 and relative low hope in Table S3), and their less optimistic outlook could lead to involvement in problematic behavior. Research supports this, showing that low levels of hope and mattering are associated with increased risk-taking and problematic behaviors [43, 80]. Conversely, when hope and mattering are jointly present, individuals are well protected against negative influences, preventing risky decisions and problematic behaviors [81]. Given these findings, students in Class 3 should benefit from preventive interventions designed to boost their sense of being valued and cared about by

others, fostering a more optimistic outlook and reducing the likelihood of problematic behaviors.

Overall, the research validated the moderating effects of mattering and fear of not mattering in the relationship between PIU, academic exhaustion, and hope among university students, as informed by the CAT. Indeed, in the analyses with the mattering profiles yielded a complex set of results. The comparative analysis, using Class 4 as a benchmark, showed that Class 3 displayed a stronger positive association of PG with academic exhaustion compared to Class 4, while Class 1 demonstrated a more pronounced negative relationship between academic exhaustion and hope compared to Class 4. Mattering acts as a buffer against stress, enhancing the ability to cope adaptively and solve problems by efficiently utilizing cognitive resources [41]. It can also alleviate feelings of loneliness and safeguard both mental and physical well-being during times of crisis [56, 58]. Consequently, the high level of perceived mattering in Class 4 was associated with relatively low academic exhaustion, and the low level of perceived mattering in Class 3 was associated with increased risk-taking as noted above, leading to high level of academic exhaustion, which ultimately moderated the negative effect of PG on academic exhaustion. In contrast, Class 1, characterized by lower general mattering and higher fear of not mattering, exhibited fewer protective factors from mattering, therefore amplifying academic exhaustion's negative effects on hope. This amplification can be explained through the lens of social expectations and cognitive processing. Individuals develop expectations about others' behaviors, and unmet expectations trigger arousal and cognitive assessments [82]. Moreover, for students with high fear of not mattering, extensive cognitive processing of social interactions depletes cognitive resources. The RMSC posits that such assessments can result in ego depletion [29], intensifying academic exhaustion's impact on hope.

Interestingly, it was anticipated that Class 2 would be distinguishable from Class 4 in both pathways, but these differences were not found. This may be attributed to the restriction of range phenomenon [83], where constrained data range for variables leads to underestimating the strength of relationships between variables. In Class 2, the elevated mean values for PSMU and PG, alongside medium to large effect sizes, indicate a potential underestimation of the relationships between these factors, academic exhaustion, and hope, explaining the absence of significant differences between Class 2 and Class 4.

Limitations and conclusion

The present study is subject to specific limitations. First, the cross-sectional design precluded the evaluation of the temporal trends in the impact of PIU types on academic exhaustion and hope. Future research should consider longitudinal studies to address this gap. Second, regarding the influence of PSMU and PG on hope across various mattering profiles, Class 2 did not exhibit significant differences from Class 4, contrary to expectations. This discrepancy may be attributed to the restriction of range phenomenon. Consequently, a more thorough analysis and investigation of each subgroup are warranted in subsequent studies. Third, a key limitation was the study's timing during the COVID-19 pandemic in China, coinciding with strict containment measures. This context may have influenced the findings. Future research should replicate the present study post-pandemic to assess the stability of these relationships under normal conditions, thereby enhancing the generalizability of the results.

The present study highlights the importance of combining variable-centered and person-centered approaches in examining the impact of PIU on academic exhaustion and hope among university students with varying levels of mattering. It suggests the need for targeted academic exhaustion prevention strategies, particularly for subgroups characterized by low level of mattering and high level of fear of not mattering. Moreover, the study appears to indicate that internet gaming is especially addictive among some university students, exerting a more substantial negative impact on hope compared to PSMU. Authorities should implement measures to curb PIU, with a specific focus on online gaming among university students.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s40359-025-02500-x.

Supplementary Material 1

Supplementary Material 2

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Authors' contributions

Conceptualization, X.M.C, G.L.F and I.H.C; methodology, X.M.C., Y.F.N and C.Y.L; validation, L.L.L and X.Y.J; investigation, X.L.L, L.L.L, X.Y.J and P.J.L; data curation, X.M.C and Y.F.N; writing—original draft preparation, X.M.C, G.L.F and I.H.C; writing—review and editing Y.F.N, G.L.F, X.L.L, L.L.L, X.Y.J, J.H.G, M.D.G, P.J.L and C.Y.L; visualization, I.H.C. and C.Y.L; supervision, M.D.G, P.J.L and C.Y.L; All authors have read and agreed to the published version of the manuscript.

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Data availability
Data is provided within the supplementary information files.

Declarations

Ethics approval and consent to participate
The study was conducted in accordance with the Declaration of Helsinki, and approved by Institutional Review Board of Jiangxi Psychological Consultant Association (IRB ref: JXSXL-2022-Jul13). Before completing the survey, electronically informed consent was obtained from all participants.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests except M.D.G. M.D.G. has received research funding from *Norsk Tipping* (the gambling operator owned by the Norwegian government). M.D.G. has received funding for a number of research projects in the area of gambling education for young people, social responsibility in gambling and gambling treatment from *Gamble Aware* (formerly the *Responsibility in Gambling Trust*), a charitable body which funds its research program based on donations from the gambling industry. M.D.G. undertakes consultancy for various gambling companies in the area of player protection and social responsibility in gambling.

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