

The role of curiosity and perseverance in academic engagement: A structural model of emotional and cognitive pathways

Xiaoling Wang¹, Xiang Deng^{1,*} and Wan Marzuki Wan Jaafar²

¹School of Educational and Psychological Science, Sichuan University of Science and Engineering, Zigong, China

²Faculty of Educational Studies, Universiti Putra Malaysia, Serdang, Selangor, Malaysia

*Correspondence: Xiang Deng, dengx@suse.edu.cn

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Abstract: Universities increasingly emphasise the development of soft skills because they are associated with students' well-being and academic success. However, it remains unclear whether different soft skills relate to academic engagement through similar or distinct psychological pathways, particularly within the context of Chinese higher education. This study examined whether curiosity and perseverance were associated with academic engagement directly and indirectly through positive emotions and life satisfaction. A total of 425 undergraduates from universities in South Sichuan, China, participated in the study (females = 77.2%). Participants completed validated measures of curiosity, perseverance, positive emotions, life satisfaction, and academic engagement. Structural equation modelling findings indicated that curiosity was associated with academic engagement indirectly through positive emotions for higher academic engagement ($\beta = 0.101$, $p < 0.05$). Perseverance was associated with academic engagement both directly ($\beta = 0.329$, $p < 0.01$) and indirectly ($\beta = 0.074$, $p < 0.05$) through life satisfaction. The results suggest partially differentiated emotional and cognitive pathways linking soft skills to academic engagement. Consistent with the Engine of Well-being model and Broaden-and-Build Theory, the results indicate that emotional and cognitive well-being resources may represent partially differentiated pathways linking soft skills to academic engagement. These findings contribute to a more context-sensitive understanding of how specific soft skills relate to students' behavioural engagement in Chinese higher education. Practically, higher education institutions may consider designing learning activities that cultivate curiosity, support perseverance, and promote students' well-being-related learning experiences.

Keywords: Curiosity; perseverance; positive emotions; life satisfaction; academic engagement; undergraduates

Introduction

Curiosity and perseverance are considered to be two types of important soft skills that could regulate individuals' emotions (positive affect), cognition (satisfaction) and behaviour (engagement) in the educational environment (Feraco et al., 2023b). They are distinct soft skills in educational development (Feraco et al., 2023a; Mitsea et al., 2021). Specifically, students with a high level of soft skills could efficiently obtain successful personal development because these skills could help them be more energetic and resilient when facing study obstacles, even in stressful and difficult studying situations (Mitsea et al., 2021). Such soft skills have been listed as the most important personality traits of the 21st century and noted by educational institutions (Feraco et al., 2023b). Previous research has generally linked both curiosity and perseverance to desirable academic outcomes, including motivation, engagement, achievement, and well-being (Feraco et al., 2023a; Jirout, 2020). However, emerging evidence suggests that these soft skills may not function in identical ways. Much would depend on emotional and cognitive pathways involved, of which the evidence is presently lacking.

Curiosity and perseverance

Curiosity refers to students' tendency to seek, explore, and understand new information and experiences (Kashdan et al., 2020), whereas perseverance refers to sustained effort toward academic goals despite obstacles or setbacks (Duckworth et al., 2007). Although perseverance is often

discussed alongside grit, the present study focuses specifically on effort maintenance under academic challenges rather than long-term consistency of interests (Duckworth & Quinn, 2009).

Curiosity is more closely associated with exploratory learning, interest, and positive emotional activation (Fredrickson, 2001; Kashdan et al., 2020), but it does not always translate into sustained behavioural engagement, particularly when students lack sufficient structure or self-regulation (Jirout, 2020). Perseverance, by contrast, is more strongly associated with persistence and goal-directed effort (Duckworth et al., 2007), although excessive perseverance may also involve stress, pressure, or reduced immediate positive affect (Credé et al., 2017).

These distinctions suggest that curiosity and perseverance may relate to academic engagement through partially differentiated psychological processes rather than functioning as a single, undifferentiated soft-skill factor. While curiosity may be more closely associated with affective activation and exploratory involvement (Fredrickson, 2001), perseverance may reflect a different form of academic adaptation characterised by sustained effort and cognitive evaluation of progress (Feraco et al., 2023a). This distinction provides the basis for examining whether emotional and cognitive well-being factors function differently across these two soft skills.

Positive emotions and life satisfaction

Positive emotions and life satisfaction represent two related but distinct aspects of students' well-being (Diener

et al., 1999). Positive emotions refer to affective experiences such as interest, enthusiasm, and enjoyment, whereas life satisfaction reflects individuals' broader cognitive evaluation of their life conditions (Diener et al., 1985). In the present study, positive emotions are conceptualised as an affective resource, while life satisfaction is treated as a cognitive-evaluative resource associated with academic engagement.

However, positive emotions should not be interpreted as universally beneficial or sufficient for engagement. Their association with engagement may depend on contextual conditions such as meaningful learning experiences, self-regulation, and supportive educational environments (Pekrun, 2006; Reeve et al., 2020). Accordingly, the present study examines positive emotions as one possible pathway through which curiosity may be associated with engagement rather than as a deterministic explanatory mechanism.

Life satisfaction differs from positive emotions because it involves a relatively stable cognitive judgement regarding one's life as a whole (Diener et al., 1985). In higher education contexts, students with higher life satisfaction may perceive their academic experiences as more meaningful, manageable, and aligned with personal goals (Chen et al., 2023). Such evaluations may strengthen students' willingness to persist and invest effort in learning activities (Antaramian, 2017). This distinction is particularly relevant for perseverance, as sustained effort may not always generate immediate positive emotions but may contribute to longer-term perceptions of accomplishment and personal progress (Credé et al., 2017; Feraco et al., 2023a).

Academic engagement

Academic engagement is conceptualised as "an energising and positive learning state" characterised by vigour, dedication, and absorption (Reeve et al., 2020; Schaufeli et al., 2002). It reflects students' active and psychologically invested participation in academic activities. Previous research has consistently linked engagement to desirable educational outcomes, including academic achievement, persistence, and learning quality (Fredricks et al., 2004; Trogden et al., 2023). Accordingly, academic engagement is widely regarded as an important indicator of student development and educational quality (Reeve et al., 2020; Trogden et al., 2023).

In the present study, academic engagement is treated as the outcome variable because it represents a proximal behavioural indicator of students' learning involvement (Fredricks et al., 2004). Compared with more distal outcomes such as academic achievement or graduation intention, engagement more directly reflects students' everyday participation in academic activities and is therefore particularly suitable for examining how soft skills and well-being-related resources relate to learning processes (Zhong et al., 2025).

Cognitive pathway. The cognitive pathway is conceptualised somewhat differently. Perseverance may not always generate immediate positive emotions because sustained effort frequently occurs under conditions of difficulty or delayed reward (Credé et al., 2017). However,

persistence through challenge may contribute to students' sense of accomplishment, goal progress, and broader life evaluation (Duckworth et al., 2007). Accordingly, life satisfaction may function as a cognitive-evaluative resource associated with continued academic involvement (Antaramian, 2017).

At the same time, the relationships among positive emotions, life satisfaction, and academic engagement may also be dynamic and potentially reciprocal over time (Salmela-Aro et al., 2022). However, because the present study employed a cross-sectional design, the proposed model focuses on theoretically informed directional associations rather than reciprocal causal processes.

Theoretical basis. The proposed framework integrates the Engine of Well-being model (Jayawickreme et al., 2012) and Broaden-and-Build Theory (Fredrickson, 2001, 2004), both of which are relevant to this study. The Engine of Well-being model proposes that life satisfaction represents a cognitive-evaluative resource, whereas academic engagement reflects the behavioural expression of adaptive academic functioning (Diener et al., 1999; Fredricks et al., 2004). By contrast, Broaden-and-Build Theory explains a more specific affective process within this broader framework. According to the theory, positive emotions may broaden individuals' thought-action repertoires and help build enduring psychological resources (Fredrickson, 2001, 2004). Applied to academic contexts, students with higher curiosity may be more likely to experience interest, enjoyment, and psychological openness during learning activities, which may subsequently relate to stronger academic involvement (Ouweneel et al., 2011).

Theoretically, curiosity and perseverance may be associated with engagement through partially differentiated routes. Curiosity may relate more closely to exploratory involvement and positive emotional activation (Jirout, 2020; Kashdan et al., 2020), whereas perseverance may be more strongly associated with sustained effort and persistence under academic pressure (Credé et al., 2017; Duckworth et al., 2007). Positive emotions and life satisfaction may further contribute to engagement by functioning as affective and cognitive resources that support students' continued involvement in learning activities (Ouweneel et al., 2011). Accordingly, academic engagement is positioned as the behavioural expression of students' soft skills, emotional experiences, and cognitive evaluations within the academic context.

The China Context. The Chinese higher education, students often study within highly competitive and examination-oriented environments characterised by strong academic expectations and long-term achievement pressure (Li, 2012). These learning environments are shaped not only by institutional competition, but also by broader cultural expectations that emphasise effort, persistence, self-discipline, and educational attainment as important routes to personal and family advancement (Li, 2012; Guo et al., 2022; Tan, 2023).

In such contexts, perseverance may be socially and academically reinforced as a valued form of endurance, responsibility, and sustained effort. Within many East Asian educational contexts, perseverance is often socially

valued as a form of endurance and responsibility, particularly when students face academic difficulty or delayed rewards (Datu et al., 2016; Xu et al., 2023). This may explain why perseverance was more closely associated with life satisfaction and engagement than with immediate positive emotions. Students who persist through demanding academic tasks may not always experience enjoyment during the process, but they may derive a sense of progress, competence, and fulfilment from meeting valued academic expectations. By contrast, curiosity may require more autonomy-supportive and emotionally safe learning environments to develop into sustained academic engagement (Jirout, 2020). In highly evaluative or tightly structured classrooms, curiosity may generate interest and positive emotion but may not necessarily translate into behavioural engagement unless students are given opportunities for inquiry, exploration, and self-directed learning. Under such conditions, curiosity may contribute to engagement primarily through emotionally supportive learning experiences, whereas perseverance may align more closely with culturally valued forms of sustained effort and endurance (Li, 2012).

Goal of the study

Although previous studies have linked soft skills with academic achievement, well-being, motivation, and engagement (Feraco et al., 2023a), several limitations remain. First, curiosity and perseverance have often been examined either separately or within broader soft-skill or grit-related frameworks (Credé et al., 2017; Duckworth et al., 2007), making it difficult to determine whether they relate to academic functioning through similar or differentiated processes. Second, prior research has focused primarily on achievement or general well-being outcomes (Datu, 2018; Feraco et al., 2023a), whereas less attention has been paid to academic engagement as a behavioural indicator of students' everyday learning involvement (Fredricks et al., 2004; Reeve et al., 2020). Third, although positive emotions and life satisfaction represent distinct affective and cognitive dimensions of well-being (Diener et al., 1999; Robitschek & Keyes, 2009), few studies have examined them simultaneously as potential pathways linking soft skills to academic engagement.

The present study aims to examine whether curiosity and perseverance are differentially associated with academic engagement through emotional and cognitive well-being factors among undergraduate college students. The study tested the following hypotheses (Figure 1):

Hypothesis 1: (i) positive emotions, (ii) life satisfaction would directly predict academic engagement.

Hypothesis 2: Curiosity and related factors: curiosity would directly predict (i) positive emotions, (ii) life satisfaction, and (iii) academic engagement.

Hypothesis 3: Perseverance and related factors: perseverance would directly predict with (i) positive emotions, (ii) life satisfaction, and (iii) academic engagement.

Hypothesis 4: Positive emotions as mediating roles: it was hypothesised that positive emotions mediated relations between (i) curiosity and academic engagement, and (ii) perseverance and academic engagement.

Hypothesis 5: Life satisfaction as mediating roles: it was hypothesised that life satisfaction mediated relations between (i) curiosity and academic engagement, and (ii) perseverance and academic engagement.

Methodology

Participants

A total of 425 undergraduates (male = 97, 22.8%; female = 328, 77.2%) voluntarily participated in this study. The substantial overrepresentation of female participants should be considered when interpreting the findings and their generalisability. Regarding place of residence, 71.5% of the participants (n = 304) were from rural areas and 28.5% (n = 121) were from urban areas. In addition, 27.8% of the participants (n = 118) were only children, whereas 72.2% (n = 307) had at least one sibling. Regarding academic disciplines, 67.5% of the participants (n = 287) were from the social sciences and 32.5% (n = 138) were from science and technology fields.

Measures

All constructs were assessed using previously validated instruments widely applied in educational and psychological research. To ensure linguistic and cultural appropriateness, all scales were translated into Chinese using a forward-backward translation procedure involving bilingual experts. In addition, bilingual researchers and postgraduate students reviewed the translated items for linguistic clarity, contextual appropriateness, and cultural relevance for Chinese undergraduate students. Minor wording adjustments were made where necessary to improve readability and conceptual equivalence before formal data collection.

As shown in Table 1, all constructs demonstrated satisfactory internal consistency, with Cronbach's alpha values exceeding the recommended 0.70 threshold (Nunnally & Bernstein, 1994). Given the self-report nature of the measures and the use of adapted instruments, particular attention was paid not only to statistical fit, but also to construct coverage, theoretical interpretability, and measurement consistency across scales.

Curiosity scale

Curiosity was assessed using the six-item curiosity subscale from Feraco et al.'s (2022) soft skills framework, which was adapted from Litman and Mussel's (2013) measure of epistemic curiosity. The subscale assesses individuals' tendency to seek and acquire new knowledge. Items were rated on a 6-point Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree). Mean scores were calculated. Because the study was conducted in China and participants were not familiar with English, the scale was translated into Chinese with permission from the original authors, followed by back-translation by bilingual speakers.

CFA indicated that Item 6 demonstrated a factor loading below 0.50, while Item 5 showed substantial residual covariance with other items. Consequently, these items were removed, and the revised unidimensional model demonstrated acceptable fit ($\chi^2/df = 0.292$, GFI = 0.999, CFI = 1.000, TLI = 1.006, NFI = 0.999,



Figure 1. Hypothesised model. *Note.* The dotted lines represent the indirect paths; Curves represent correlations.

Table 1. Factor loadings, reliability, and convergent validity of the measurement model

Constructs	Factor loadings
Curiosity	
Cronbach's $\alpha = 0.747$, CR = 0.849, AVE = 0.589	
I like discovering new things.	0.665
I try to learn new things in my spare time.	0.679
I like finding new ideas.	0.888
When I see something new, I try to understand what is.	0.814
Perseverance	
Cronbach's $\alpha = 0.766$, CR = 0.822, AVE = 0.484	
When faced with a difficult situation I don't give up.	0.624
If I get a bad mark at school I get straight to work to try and do better.	0.751
If I do badly in a test I thought I'd do well, I want to be able to try again	0.826
I think I can cope with all the difficulties in order to be ready.	0.611
Even if I don't always know what to do, I continue to help out.	0.642
Positive emotions	
Cronbach's $\alpha = 0.867$, CR = 0.864, AVE = 0.517	
Interested	0.739
Excited	0.770
Strong	0.801
Proud	0.634
Inspired	0.611
Active	0.740
Life satisfaction	
Cronbach's $\alpha = 0.813$, CR = 0.822, AVE = 0.488	
In most ways my life is close to my ideal.	0.716
The conditions of my life are excellent.	0.545
I am satisfied with my life.	0.857
So far, I have gotten the important things I want in life.	0.774
If I could live my life over, I would change almost nothing.	0.545
Academic engagement	
<i>Absorption</i>	
Cronbach's $\alpha = 0.859$, CR = 0.857, AVE = 0.502	
Times flies when I am studying.	0.596
When I am studying, I forget everything else around me.	0.671
I feel happy when I am studying intensely.	0.669
I am immersed when I'm studying.	0.828
I get carried away when I am studying.	0.706
It is difficult to detach myself from my study.	0.758
<i>Vigor</i>	

Table 1. (Continued)

Constructs	Factor loadings
Cronbach's $\alpha = 0.875$, CR = 0.868, AVE = 0.525	
When I am study, I feel bursting with energy.	0.638
When I am study, I feel strong and vigorous.	0.729
When I get up in the morning, I feeling like going to school.	0.779
I can continue studying for very long periods at a time.	0.797
At my study, I am very resilient, mentally.	0.689
At my study, I always persevere, even when things do not go well.	0.702
<i>Dedication</i>	
Cronbach's $\alpha = 0.813$, CR = 0.803, AVE = 0.460	
I find the studying that I do full of meaning and purpose.	0.520
I am enthusiastic about my study.	0.748
My studying inspires me.	0.882
I am proud of the studying that I do.	0.539
To me, my study is challenging.	0.633

Note. Academic engagement was treated as a multidimensional construct comprising three first-order dimensions: absorption, vigour, and dedication. Reliability, CR, and AVE values for these dimensions are therefore reported separately.

RMSEA = 0.000). However, near-perfect fit indices were interpreted cautiously, as values approaching CFI = 1.000 and RMSEA = 0.000 may reflect model simplicity or potential overfitting rather than flawless measurement quality (Hu & Bentler, 1999; Xia & Yang, 2019). Accordingly, the measurement quality of the scale was evaluated not only through fit indices, but also through theoretical coherence and construct interpretability.

Perseverance scale

Perseverance was measured using the six-item perseverance subscale reported by Feraco et al. (2022) as part of their soft skills framework. The scale assesses individuals' tendency to persist toward goals despite obstacles or setbacks. The original scale consisted of six items rated on a 6-point Likert scale from 1 (strongly disagree) to 6 (strongly agree). Following translation into Chinese, CFA was conducted to examine construct validity. Item 1 demonstrated a factor loading below 0.50 and was therefore removed. The revised model demonstrated acceptable fit ($\chi^2/\text{df} = 2.370$, GFI = 0.991, CFI = 0.992, TLI = 0.981, NFI = 0.987, RMSEA = 0.057). Although the psychometric performance of the scale was generally satisfactory, the removal of one item may have slightly reduced construct breadth and should therefore be interpreted cautiously.

Positive and negative affect scale

Positive emotions were assessed using the positive affect subscale of the Positive and Negative Affect Schedule (PANAS), originally developed by Watson et al. (1988). The Chinese version adapted by Qiu et al. (2008) was used in this study. Only the positive affect subscale was included because the present study focused on positive emotional experiences in academic contexts. The subscale consisted of 10 items rated on a 5-point Likert scale ranging from 1 (not at all) to 5 (extremely). CFA results supported acceptable construct validity after removing

Item 6 due to a factor loading below 0.50, $\chi^2/\text{df} = 3.538$, GFI = 0.974, CFI = 0.978, TLI = 0.964, NFI = 0.970, RMSEA = 0.077.

Life satisfaction scale

Life satisfaction was measured using the Satisfaction with Life Scale originally developed by Diener et al. The Chinese version adapted by Xiong and Xu (2009) was used in this study. The instrument consists of five items assessing individuals' global cognitive evaluations of their lives using a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). CFA indicated acceptable construct validity, $\chi^2/\text{df} = 1.188$, GFI = 0.994, CFI = 0.999, TLI = 0.997, NFI = 0.992, RMSEA = 0.021. As with the curiosity scale, these very high fit indices were interpreted cautiously and considered alongside construct coverage and theoretical interpretability.

Academic engagement scale

Academic engagement was assessed using the Utrecht Work Engagement Scale–Student Version (UWES-S), adapted for university students by Schaufeli et al. (2002). The Chinese adaptation by Fang et al. (2008) was employed in this study. The scale contains 17 items across three dimensions: vigour, dedication, and absorption. Responses were recorded on a 7-point Likert scale ranging from 1 (almost never) to 7 (always).

CFA supported acceptable, although comparatively weaker, construct validity for the academic engagement scale, $\chi^2/\text{df} = 4.594$, GFI = 0.879, CFI = 0.910, TLI = 0.885, NFI = 0.889, RMSEA = 0.092. Although the RMSEA value was relatively higher than those of the other constructs, the overall pattern of fit indices remained within an acceptable range for a broad multidimensional educational construct. Academic engagement encompasses vigour, dedication, and absorption, and this multidimensional structure may contribute to greater measurement complexity and comparatively weaker model fit.

Therefore, the engagement measurement was retained but interpreted with caution.

Procedure

This study was approved by the University Research Ethics Committee of Universiti Putra Malaysia (JKEUPM-2024-033) and conducted in accordance with established ethical guidelines for human participant research. All participants were undergraduate students aged 18 years or above; therefore, informed consent was obtained directly from the participants themselves. Before completing the questionnaire, participants were provided with an electronic informed consent form explaining the purpose of the study, the voluntary nature of participation, the confidentiality of responses, and their right to withdraw at any time without penalty or negative consequences. To protect anonymity and confidentiality, no personally identifying information, such as names, student identification numbers, phone numbers, or IP addresses, was collected. All data were stored in password-protected electronic files accessible only to the research team and used exclusively for academic research purposes.

Data analysis

Data were analysed using SPSS and AMOS. Descriptive statistics, skewness, and kurtosis were calculated to examine variable distributions. Pearson correlation analysis was used to examine bivariate associations among the main variables. CFA was conducted to assess the measurement structure of each construct and the overall measurement model. Factor loadings, Cronbach's alpha, CR, and AVE were used to evaluate reliability and convergent validity. Discriminant validity was assessed using the Fornell–Larcker criterion. SEM was then used to test the hypothesised structural model. Model fit was evaluated using χ^2/df , GFI, CFI, NFI, TLI, and RMSEA. Values of CFI, TLI, NFI, and GFI above 0.90 and RMSEA below 0.08 were considered acceptable. Indirect effects were tested using bias-corrected bootstrapping. Standardised path coefficients, standard errors, *p* values, and confidence intervals were reported.

Convergent and discriminant validity

Convergent validity was assessed using factor loadings, composite reliability (CR), and average variance extracted (AVE). Although most constructs met recommended thresholds, several AVE values were slightly below the conventional 0.50 criterion. Given that CR values remained acceptable and factor loadings were generally adequate, these constructs were retained but interpreted cautiously.

Discriminant validity was assessed using the Fornell–Larcker criterion (see Table 2). The results indicated acceptable construct distinctiveness across the study variables. Overall, the psychometric performance of the scales was generally acceptable, although some constructs demonstrated stronger measurement quality than others. Therefore, the measurement findings should be interpreted as adequate but not uniform across all constructs. Moreover, acceptable model fit alone should not be interpreted as definitive evidence of construct validity, as

psychometric adequacy also depends on theoretical coherence, construct coverage, and measurement consistency across contexts.

Particular attention was given to the distinction between positive emotions and academic engagement because some PANAS Positive Affect items are semantically similar to wording appearing in the UWES-S. Conceptually, however, positive affect represents affective experiences, whereas academic engagement captures sustained study-related vigour, dedication, and absorption. Empirically, the correlation between positive emotions and academic engagement was 0.544, which was lower than the square roots of the AVE for positive emotions (0.756) and academic engagement (0.709), providing additional support for their discriminant validity.

Common method bias

Given that all variables were measured using self-report questionnaires, potential common method bias was examined. Harman's single-factor test was conducted, and the first unrotated factor accounted for less than 40% of the total variance, suggesting that common method variance was unlikely to represent a serious concern. Nevertheless, the possibility of shared method variance cannot be fully excluded due to the cross-sectional self-report design.

Results

The descriptive statistics and variable correlations

As presented in Table 2, skewness values ranged from -0.561 to 0.031 , and kurtosis values ranged from -0.455 to 1.508 . These values suggested acceptable univariate distributional properties for the study variables. Table 2 also shows that all variables were significantly and positively correlated. In addition, the square root of the AVE for each construct exceeded the corresponding inter-construct correlations, supporting discriminant validity according to the Fornell–Larcker criterion.

SEM analysis

Measurement model

The measurement model included five key constructs: curiosity, perseverance, positive emotions, life satisfaction, and academic engagement. Academic engagement was specified as a multidimensional construct comprising three first-order dimensions—vigour, dedication, and absorption—whereas the other four constructs were represented as unidimensional constructs. Overall, the measurement model demonstrated acceptable fit, $\chi^2/\text{df} = 1.926$, GFI = 0.919, CFI = 0.959, TLI = 0.953, NFI = 0.918, RMSEA = 0.047. Most constructs met recommended reliability thresholds, with CR values exceeding 0.70. At the construct level, the AVE values for perseverance (AVE = 0.484) and life satisfaction (AVE = 0.488) were slightly below the conventional 0.50 criterion. Academic engagement was treated as a multidimensional construct comprising three first-order dimensions: vigour, dedication, and absorption. Among these dimensions, dedication showed a slightly lower AVE (AVE = 0.460), whereas absorption and vigour met the conventional criterion. Given that their CR values remained acceptable and most factor loadings were adequate, these constructs were

Table 2. Descriptive statistics, correlations, and discriminant validity of the study variables

Variables	M	SD	Skewness	Kurtosis	1	2	3	4	5
1 Curiosity	4.274	0.681	−0.025	0.218	0.719				
2 Perseverance	4.178	0.652	−0.116	1.508	0.660**	0.696			
3 Positive emotions	2.934	0.614	−0.214	−0.455	0.361**	0.363**	0.756		
4 Life satisfaction	3.845	1.088	0.031	0.213	0.167**	0.190**	0.356**	0.700	
5 Academic engagement	4.633	0.914	−0.561	0.625	0.403**	0.440**	0.544**	0.383**	0.705

Note. N = 425. Bold values on the diagonal represent the square roots of the average variance extracted ($\sqrt{\text{AVE}}$) for each construct. Off-diagonal values represent Pearson correlation coefficients. ** $p < 0.01$.

Table 3. The model fit results of the structural model

	χ^2/df	GFI	CFI	TLI	NFI	RMSEA
Model	1.899	0.921	0.960	0.954	0.920	0.046
Model fit	<5	>0.90	>0.90	>0.90	>0.90	<0.08

retained but interpreted cautiously. Overall, these results indicate generally acceptable, although not uniform, convergent validity across the measurement model.

Structural model

Table 3 presents the fit indices of the structural model. The model demonstrated acceptable overall fit to the data, $\chi^2/\text{df} = 1.899$, GFI = 0.921, CFI = 0.960, TLI = 0.954, NFI = 0.920, and RMSEA = 0.046. These indices suggest that the hypothesised model was reasonably consistent with the observed covariance structure and broadly supported the proposed theoretical framework linking curiosity, perseverance, emotional and cognitive resources, and academic engagement. However, acceptable model fit should not be interpreted as definitive evidence of causal or comprehensive explanatory validity. Given the cross-sectional nature of the study, the findings should be interpreted as theory-informed associations rather than causal mechanisms. In addition, acceptable fit indices alone do not guarantee strong construct validity or complete explanatory adequacy, as model interpretation must also consider theoretical coherence, construct coverage, and contextual relevance.

The structural model explained 17.5% of the variance in positive emotions, 25.0% of the variance in life satisfaction, and 47.5% of the variance in academic engagement. The explanatory power for academic engagement was moderate, suggesting that the model captured meaningful variance in students' behavioural involvement in learning. However, the relatively lower R^2 values for positive emotions and life satisfaction indicate that these constructs are likely associated with additional psychological, interpersonal, and contextual factors not included in the present model, such as personality traits, academic stress, social support, learning climate, self-regulated learning, or mental health. Therefore, although the proposed framework offers theoretically meaningful insight into differentiated emotional and cognitive pathways, its explanatory scope should be interpreted cautiously and as partial rather than comprehensive.

Positive emotions and life satisfaction. As shown in Table 4, positive emotions were positively associated with

academic engagement ($\beta = 0.364$, $p < 0.001$), and life satisfaction was also positively associated with academic engagement ($\beta = 0.234$, $p < 0.001$). Thus, H1 was supported. These findings support the view that both affective experiences and broader cognitive evaluations of life may contribute to students' engagement in academic activities.

Curiosity and related factors. Curiosity was positively associated with positive emotions ($\beta = 0.279$, $p = 0.023$), but its direct association with academic engagement was not significant ($\beta = -0.046$, $p = 0.661$). Interestingly, curiosity demonstrated a negative and marginally non-significant association with life satisfaction ($\beta = -0.229$, $p = 0.065$). Thus, H2 was partially supported. This pattern suggests that curiosity may not directly translate into sustained behavioural engagement unless it is accompanied by emotionally supportive learning experiences. In this sense, curiosity may function more strongly as an affective activator than as a direct behavioural predictor. Besides, this finding also suggests that curiosity may not uniformly contribute to positive cognitive evaluations of life within academically demanding contexts. One possible explanation is that highly curious students may also experience increased uncertainty, intellectual dissatisfaction, or exploratory pressure arising from unmet academic expectations. In highly competitive educational environments, curiosity may stimulate exploration and emotional activation without necessarily enhancing broader evaluations of life quality. Therefore, the relationship between curiosity and life satisfaction may be more context-dependent and psychologically complex than traditionally assumed.

Perseverance and related factors. Perseverance was positively associated with life satisfaction ($\beta = 0.316$, $p = 0.013$) and academic engagement ($\beta = 0.329$, $p = 0.002$), but its association with positive emotions was not significant ($\beta = 0.161$, $p = 0.195$). Thus, H3 was partially supported. This finding suggests that perseverance may be more closely related to sustained effort, long-term goal pursuit, and cognitive evaluation than to immediate positive emotional experience. Such a pattern is consistent with the possibility that perseverance often operates under conditions of difficulty, pressure, or delayed reward, where students may remain behaviourally engaged despite not experiencing strong positive emotions.

Positive emotions and life satisfaction as mediating roles. The bootstrapping results indicated that curiosity was indirectly associated with academic engagement through positive emotions ($\beta = 0.101$, $p = 0.039$, 95% CI [0.029, 0.212]). Curiosity also demonstrated a small indirect association with academic engagement through life satisfaction

Table 4. The (in)direct effects of pathway analysis

Path	β	SE	<i>p</i>
Direct path			
Life satisfaction -> Academic engagement	0.234	0.055	<0.001
Positive emotions -> Academic engagement	0.364	0.066	<0.001
Curiosity -> Academic engagement	-0.046	0.12	0.661
Perseverance -> Academic engagement	0.329	0.116	0.002
Positive emotions -> Life satisfaction	0.443	0.057	0.000
Curiosity -> Life satisfaction	-0.229	0.142	0.065
Perseverance -> Life satisfaction	0.316	0.149	0.013
Curiosity -> Positive emotions	0.279	0.132	0.023
Perseverance -> Positive emotions	0.161	0.137	0.195
Indirect path			
Curiosity -> Positive emotions -> Academic engagement	0.101	0.065	0.039
Curiosity -> Life satisfaction -> Academic engagement	-0.053	0.049	0.031
Perseverance -> Positive emotions -> Academic engagement	0.059	0.079	0.160
Perseverance -> Life satisfaction -> Academic engagement	0.074	0.074	0.017

Note. β —standardized beta coefficient, SE—standard error.

($\beta = -0.053$, $p = 0.031$). In addition, perseverance was indirectly associated with academic engagement through life satisfaction ($\beta = 0.074$, $p = 0.017$, 95% CI [0.023, 0.186]). However, the indirect association between perseverance and academic engagement through positive emotions was not significant ($\beta = 0.059$, $p = 0.160$). Thus, H4 and H5 were both partially supported. These indirect effects were statistically significant but modest in magnitude and therefore should be interpreted as limited but meaningful pathway associations rather than strong explanatory mechanisms.

Overall, the structural findings support a partially differentiated pathway model. Curiosity appears to be associated with academic engagement primarily through affective processes involving positive emotions, whereas perseverance appears to operate more strongly through cognitive-evaluative and behavioural processes involving life satisfaction and sustained effort. At the same time, the modest explanatory power of several pathways suggests that additional contextual, motivational, and interpersonal variables may be required to more fully explain students' emotional well-being and academic engagement in higher education contexts.

Figure 2 illustrates the structural model, displaying all estimated path coefficients along with their statistical significance levels.

Discussion

The present study examined how curiosity and perseverance were associated with academic engagement through positive emotions and life satisfaction among Chinese undergraduates. Rather than proposing entirely novel relationships, the study contributes primarily by offering a context-sensitive and comparatively differentiated interpretation of how two soft skills may relate to emotional, cognitive, and behavioural aspects of academic functioning (Feraco et al., 2023a).

Taken together, the findings suggest that curiosity and perseverance were not associated with academic engagement through a single uniform process. Curiosity was

more closely associated with positive emotions, whereas perseverance was more strongly associated with life satisfaction and academic engagement. These patterns indicate that curiosity and perseverance may relate to academic engagement through partially differentiated emotional and cognitive associations (Duckworth et al., 2007; Fredrickson, 2001). However, given the cross-sectional design and the modest magnitude of several indirect effects, these findings should be interpreted as theory-informed associations rather than causal mechanisms (Maxwell & Cole, 2007).

Integrative interpretation of curiosity, perseverance, and well-being

The findings suggest that curiosity may be more closely linked to emotional activation than to direct behavioural engagement. Curiosity was positively associated with positive emotions, supporting the idea that exploratory tendencies may be accompanied by interest, enjoyment, and psychological openness in learning contexts (Fredrickson, 2001; Kashdan et al., 2020). However, curiosity was not directly associated with academic engagement. This suggests that curiosity alone may not be sufficient to sustain behavioural involvement in academic activities, particularly when students face limited autonomy, high academic pressure, or insufficient opportunities for exploration (Jirout, 2020; Reeve et al., 2020).

The negative and marginally non-significant association between curiosity and life satisfaction further suggests that curiosity may not uniformly contribute to all dimensions of well-being. One possible explanation is that highly curious students may experience greater intellectual openness and emotional stimulation while also becoming more aware of unmet academic expectations, uncertainty, or dissatisfaction with existing learning opportunities (Liu et al., 2024). In this sense, curiosity may be adaptive for emotional engagement but less directly related to stable cognitive evaluations of life quality (Diener et al., 1999).

Perseverance showed a different pattern. It was positively associated with life satisfaction and academic

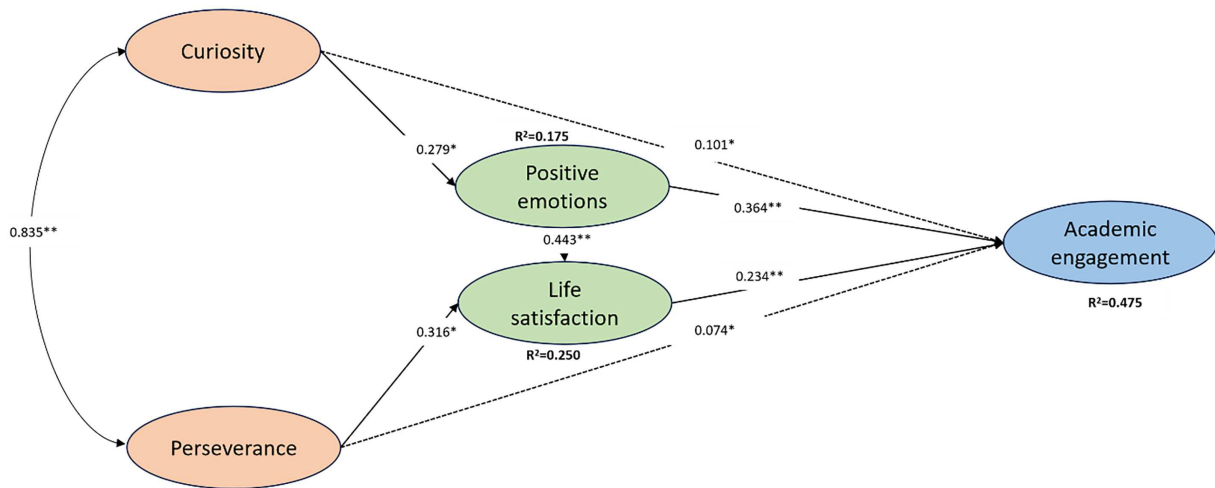


Figure 2. Path model and construct estimates. *Note.* Numbers represent standardised beta coefficients; only significant paths are represented; the dotted lines represent the indirect paths; curves represent correlations; * $p < 0.05$ and ** $p < 0.01$.

engagement, but not significantly associated with positive emotions. This finding suggests that perseverance may be more closely related to sustained effort, goal progress, and cognitive evaluation than to immediate emotional positivity (Credé et al., 2017; Duckworth et al., 2007). Students who persist through academic difficulty may not necessarily experience enjoyment during the process, but they may develop a stronger sense of competence, accomplishment, and long-term progress.

These findings also help explain why positive emotions and life satisfaction should not be treated as interchangeable indicators of well-being. Positive emotions appear to reflect more immediate affective involvement in learning, whereas life satisfaction reflects broader cognitive evaluations of personal and academic functioning (Diener et al., 1999; Robitschek & Keyes, 2009). Thus, the present model suggests that emotional and cognitive well-being may contribute differently to academic engagement.

Emotional and cognitive pathways to academic engagement

The results showed that both positive emotions and life satisfaction were positively associated with academic engagement. This indicates that students' academic involvement may be linked not only to how they feel during learning activities, but also to how they evaluate their broader life and academic progress (Ouweneel et al., 2011; Chen et al., 2023). Positive emotions may help students remain psychologically involved in learning tasks, whereas life satisfaction may support persistence by helping students view academic challenges as meaningful and worthwhile (Wang et al., 2025).

However, the indirect effects were relatively modest in magnitude. Therefore, the emotional and cognitive pathways identified in this study should not be interpreted as strong or exclusive explanatory mechanisms. Rather, they represent limited but meaningful associations within a broader network of factors that may shape engagement (Pekrun, 2006; Reeve et al., 2020). Variables not included in the present model, such as self-regulated learning, academic climate, social support, personality

traits, institutional pressure, and mental health, may also influence the relationships among soft skills, well-being, and engagement (Salmela-Aro et al., 2022).

By contrast, curiosity may require more supportive learning environments to translate into sustained academic involvement. When learning contexts provide autonomy, inquiry opportunities, and emotional support, curiosity may be more likely to generate positive emotions and engagement (Jirout, 2020; Kashdan et al., 2020). The present findings nevertheless suggest that curiosity may not always translate directly into sustained behavioural engagement.

Implications for research and practice

Overall, the present findings indicate that curiosity and perseverance should not be treated as interchangeable positive traits. Curiosity appears to be more closely associated with emotional activation, whereas perseverance appears to be more closely linked to cognitive evaluation and sustained behavioural involvement (Credé et al., 2017; Duckworth et al., 2007). Rather than proposing entirely novel relationships, the study contributes by offering a context-sensitive and comparatively differentiated examination of how different soft skills may relate to behavioural engagement through partially distinct psychological associations (Feraco et al., 2023a). The findings also suggest possible bidirectional relationships. For example, although positive emotions and life satisfaction were modelled as antecedent pathways to engagement, it is equally plausible that students who are more academically engaged may later experience greater positive emotions or higher life satisfaction (Salmela-Aro et al., 2022). At the same time, these conclusions should be interpreted cautiously. The study provides context-specific, cross-sectional evidence of differentiated associations rather than universally generalisable causal explanations (Maxwell & Cole, 2007). Therefore, the contribution of the study lies in offering a context-sensitive extension of existing well-being and engagement literature by examining how curiosity and perseverance may show different patterns of association within Chinese higher education.

From a practical perspective, the findings suggest that higher education institutions may benefit from adopting more differentiated approaches to student development. For example, learning environments that encourage inquiry, discussion, autonomy, and exploratory learning may help foster curiosity and positive emotional involvement. At the same time, structured goal-setting, academic mentoring, reflective learning activities, and long-term progress monitoring may help strengthen perseverance and students' cognitive evaluations of academic progress and life satisfaction. Accordingly, soft-skill development may be more effective when emotional and cognitive dimensions of student well-being are considered simultaneously.

Strengths, limitations and future study directions

Several limitations should be acknowledged. First, because the study employed a cross-sectional design, the findings cannot establish causal relationships or temporal ordering among the variables. Reciprocal associations among engagement, positive emotions, and life satisfaction remain possible and should be examined using longitudinal designs. Second, all data were collected using self-report measures, which may introduce common method variance and social desirability bias despite procedural efforts to reduce such effects. Third, the sample was drawn from universities in South Sichuan and included a substantial overrepresentation of female participants, which may limit the generalisability of the findings to broader undergraduate populations. Fourth, although validated instruments were used, several items were removed during measurement refinement, which may have reduced construct breadth and should therefore be interpreted cautiously. Longitudinal research is therefore needed to clarify temporal ordering and reciprocal effects among these variables (Maxwell & Cole, 2007).

Future research is encouraged to examine these relationships using longitudinal or multi-method approaches and more demographically balanced samples. Additional contextual and psychological variables, such as self-regulated learning, academic climate, social support, or mental health, may also help explain how soft skills relate to well-being and academic engagement under different educational conditions.

Conclusion

The present study examined how curiosity and perseverance were associated with academic engagement through positive emotions and life satisfaction among Chinese undergraduates. Overall, the findings suggest that curiosity and perseverance may relate to academic engagement through partially differentiated emotional and cognitive associations rather than through a single uniform process. Curiosity was more closely associated with positive emotions and exploratory involvement, whereas perseverance was more strongly associated with life satisfaction and sustained academic engagement. These findings indicate that emotional and cognitive dimensions of well-being may contribute differently to students' behavioural involvement in learning activities.

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Availability of Data and Materials: The data that support the findings of this study are available from the corresponding authors upon reasonable request.

Ethics Approval: The studies involving human participants were subjected to a review and approval process conducted by the Ethics Committee for Research Involving Human Subjects of University Putra Malaysia (JKEUPM-2024-033). Informed consent was obtained from all subjects involved in the study.

Conflicts of Interest: The authors declare no conflicts of interest.

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