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Validity and Reliability Analysis of Learning Stress, Academic Self-efficacy, and Learning Burnout Scales

Zhang Zhongshuai[1], Siti Maziha Mustapha[2]
[1,2]*Faculty of Business, Information and Human Sciences, Kuala Lumpur University of Science and Technology, Kajang, Selangor, Malaysia*

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ABSTRACT:
This pilot study aimed to evaluate the reliability and construct validity of three instruments—University Student Learning Stress Scale (USLSS), Academic Self-Efficacy Scale (ASES), and Learning Burnout of Undergraduates Scale (LBUS)—for international undergraduates in Shanghai, China. A total of 122 valid responses were collected and analyzed using SPSS (version 27.0). Reliability analysis indicated good internal consistency for the three instruments, with Cronbach's alpha values of 0.863 (learning stress), 0.893 (academic self-efficacy), and 0.880 (learning burnout), and an overall alpha of 0.943 for the full 84-item questionnaire. Exploratory Factor Analysis (EFA) was conducted to examine the underlying factor structures and to refine the scales. For the USLSS, the original 42 items were subjected to PCA with varimax rotation; nine items with inadequate psychometric performance were removed, resulting in a final 33-item structure with seven retained components that explained 72.069% of the total variance. For the ASES, four items were deleted and the final 18-item scale confirmed a two-component structure (Self-Efficacy for Learning Ability; Self-Efficacy for Learning Behaviour), explaining 75.867% of the total variance. For the LBUS, three items were removed and the final 17-item scale supported a three-component structure (Emotional Exhaustion; Cynicism; Reduced Academic Efficacy), explaining 75.002% of the total variance. Overall, the findings demonstrate that the revised instruments exhibit satisfactory reliability and construct validity and are suitable for subsequent large-scale field data collection among international undergraduates in Shanghai.
KEYWORDS: Construct validity, reliability analysis, Exploratory Factor Analysis

I. INTRODUCTION

In recent years, Shanghai has become an important destination for international undergraduate education in Mainland China, and international undergraduates increasingly complete full-time degree study in linguistically and culturally complex learning environments. Based on the available data, a total of 31 universities in Shanghai host international undergraduate students, with a combined enrolment of 12,241 individuals. These institutions are classified into ten categories according to China's higher education classification system, and the six primary categories account for 11,297 international undergraduates (92.28% of the total), indicating that the academic experiences of most international undergraduates in Shanghai are shaped by these major types of institutions.

To ensure the representativeness of the pilot sample, a probability sampling strategy combined with proportionate random sampling was adopted. The target pilot population consisted of international undergraduates enrolled in six selected universities in Shanghai, with a total population size of 4,951(Tavakol & Wetzel, 2020; Kline, 2015). Using a random number table for each university, a total of 130 international undergraduates were selected for this pilot study. All 130 questionnaires were collected, and after data screening and cleaning, 122 valid responses were retained for the pilot analysis, yielding a response rate of 93.8%.

The primary purpose of the pilot study was to evaluate the reliability and initial applicability of three research instruments: the University Student Learning Stress Scale (USLSS), the Academic Self-Efficacy Scale (ASES), and the Learning Burnout of Undergraduates Scale (LBUS), consisting of 42, 22, and 20 items respectively. The pilot study was used for psychometric refinement, with reliability analysis and exploratory factor analysis applied to evaluate item performance and improve measurement quality before the subsequent field study examining the mediating role of academic self-efficacy between learning

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stress and learning burnout among international undergraduates in Shanghai.

II. MEASURE OF THE CONSTRUCTS

Likert-type rating scales are among the most widely used tools for capturing perceptions, attitudes, and behavioral tendencies in social science research (Likert, 1932; Boone & Boone, 2012). These instruments allow researchers to assign numerical values to qualitative constructs and statistically analyze relationships within theoretical frameworks.

In this study, a 5-point Likert scale was employed to measure learning stress, academic self-efficacy, and learning burnout. Each item was rated on a scale ranging from 1 (strongly disagree) to 5 (strongly agree), with a neutral midpoint included to allow respondents to express uncertainty or indifference; this design helps reduce response bias and supports more accurate self-assessments (Joshi et al., 2015).

The 5-point format is concise, easy to use, and particularly suitable for mobile-device users completing surveys (Revilla et al., 2014). It also enables robust statistical analysis in educational and psychological research (Privitera, 2019), thereby supporting its appropriateness for the subsequent validity and reliability evaluation of the scales in this study.

III. REARCH INSTRUMENTS

In this study, the researcher employed a quantitative, non-experimental, correlational survey design to evaluate the measurement quality of the study instruments and to support subsequent hypothesis testing (Creswell & Creswell, 2018). This design was selected because the present research focuses on examining the relationships among learning stress, academic self-efficacy, and learning burnout, and on establishing reliable and valid measurement tools before proceeding to large-scale field analysis.

In the conceptual framework of this study, academic self-efficacy was treated as a mediating variable in the relationship between learning stress and learning burnout. Learning burnout was positioned as the endogenous construct among international undergraduates in Shanghai, China, and the measurement model required sound reliability and construct validity evidence to ensure that the hypothesised mediation relationships could be interpreted meaningfully.

To collect data and address the research objectives, a structured questionnaire was developed for the pilot phase. The questionnaire consisted of three standardized instruments: the University Student Learning Stress Scale (USLSS), containing 42 items (Tian & Deng, 2007), the Academic Self-efficacy Scale (ASES), comprising 22 items (Liang, 2000), and the Learning Burnout of Undergraduates Scale (LBUS), including 20 items (Lian et al., 2005). All items were rated using a five-point Likert response format ranging from 1 (Disagree/Strongly Disagree) to 5 (Completely Agree/Strongly Agree).

These instruments were selected because they were well developed and have been widely used in relevant educational and psychological research, and they align closely with the constructs defined in the present study. The pilot study was conducted to examine the internal consistency reliability and the initial construct validity of these scales and to refine the questionnaire prior to the main field study. Based on the pilot reliability and factor-analytic screening results, several items with inadequate psychometric performance were removed (nine items from USLSS, four items from ASES, and three items from LBUS), and the revised (purified) questionnaire was adopted for subsequent field administration.

IV. PILOT DATA COLLECTIONPROCEDURES

Before distributing the questionnaire to the 130 randomly selected international undergraduates from six universities in Shanghai, China, several preparatory steps were taken. First, the researcher obtained formal permissions from the developers of the three instruments via email. Then, recommendation/authorisation letters were issued by Kuala Lumpur University of Science and Technology, which introduced the researcher and explained the purpose of the data collection; these letters facilitated the approval process from the target institutions and participants.

With the assistance of university coordinators, the researcher distributed the questionnaire via the online survey platform Questionnaire Star (Wenjuanxing). Participants received an invitation email containing instructions and the questionnaire access link/QR code. Upon completion, the responses were collected through the platform, exported by the researcher, and screened for completeness and response quality.

A total of 130 questionnaires were distributed, and all were returned. After data screening and cleaning, 122 valid responses were retained, resulting in an effective response rate of 93.8%. As a minimum of 100 responses is

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generally considered sufficient for a pilot study (Kline, 2015), the sample size was deemed adequate. Reliability analysis and exploratory factor analysis (EFA) were conducted on the cleaned pilot data to assess the internal consistency and construct validity of the instruments prior to the main study.

V. RELIABILITIES ANALYSIS

The reliability of the data collection instruments (USLSS, ASES, LBUS) used in this study was assessed using Cronbach's alpha to measure internal consistency. The analysis was conducted with SPSS Statistics 27 (Statistical Package for Social Sciences, version 27.0) after collecting the pilot data.

As shown in Table 1, the overall Cronbach's alpha value for all 84 items of the pilot study was 0.943. The reliability coefficients for the individual scales were as follows: learning stress (0.863), academic self-efficacy (0.893), and learning burnout (0.880).

Table 1 Reliability Analysis of Pilot Data (N = 122)

Variable / Dimension	No. of Items	Cronbach's α
Learning Stress	42	0.863
Academic Self-efficacy	22	0.893
Learning Burnout	20	0.880
Total	84	0.943

These findings indicate that the instruments used in this study exhibit high reliability, confirming their suitability for the main study.

VI. EXPLORATORY FACTOR ANALYSIS (EFA)

Exploratory Factor Analysis (EFA) is used to explore theunderlying structure of a set of variables and to identifypotential redundancy within those variables (Garson, 2013).It is particularly useful in the early stages of research touncover interrelationships among variables and test thehypothesized factor structure.

In this study, EFA was applied during the pilot phase withthree main objectives: (i) to determine the factor structureamong the constructs (Bentler & Chou, 1987), (ii) to assessthe unidimensionality of the theoretical constructs, and (iii)to reduce the number of variables (Hair et al., 2019; Watkins, 2021). Given its suitability, EFA was chosen to examinethe items used to measure learning stress, academic self-efficacy, and learning burnout.

A total of 122 responses were analyzed using SPSS Statistics27 to conduct the EFA, which provided insights into thefactor structure and dimensionality of the instruments.

Exploratory Factor Analysis for Learning Stress

The learning stress construct in this study was measured using the University Student Learning Stress Scale (USLSS), originally developed by Tian and Deng (2007). In its original form, the USLSS contains 42 items organised into seven dimensions: Learning Prospects Stress (LPS)(8 items), Learning Competition Stress (LCS)(10 items), Academic Achievement Stress (AAS)(5 items), Learning Environment Stress (LES)(4 items), Academic Workload Stress (AWS)(6 items), Learning Conditions Stress (LConS)(4 items), and Family Expectations Stress (FES)(5 items).

As shown in Table 2, the pilot data (N = 122) was suitable forfactor analysis. The value of the KMO for learning stress was 0.726. This value is higher than the threshold value of 0.5 (Hair et al., 2019). The Bartlett's Test of Sphericity was also significant (Chi-Square = 2957.155, p-value = 0.000). Certainly, when the KMO value is close to 1.0 and the significance value of Bartlett's Test of Sphericity is close to 0.0. Therefore, the learning stress variable with 42 items was adequate to proceed with exploratory factor analysis (EFA).

Table 2KMO and Bartlett's Test of Learning Stress

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.726
Bartlett's Test of Sphericity	Approx. Chi-Square	2957.155
	df	861
	Sig.	0.000

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Based on Principal Component Analysis (PCA) with varimaxrotation, Table 3 presents the factor extraction results for the 42 items measuring learning stress. The first result revealed that the PCA procedure has extracted 11 components with eigenvalue exceeding the value of 1.0, with the total variance explained for all 11 components to be 72.069%, over the 60% value as the minimum percentage of acceptable variance explained in factor analysis for a construct to be valid. Clearly, the 11 components explained a total of 72.069% of the variance, with component 1 contributing 10.156%, component 2 contributing 9.765%, component 3 contributing 9.207%, component 4 contributing 9.195%, component 5 contributing 7.41%, component 6 contributing 6.731%, component 7 contributing 6.694%, component 8 contributing 3.579%, component 9 contributing 3.347%, component 10 contributing 3.041%, and component 11 contributing 2.944%.

Table 3Total Variance Explained for Learning Stress

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.117	16.945	16.945	7.117	16.945	16.945	4.266	10.156	10.156
2	4.37	10.404	27.349	4.37	10.404	27.349	4.101	9.765	19.921
3	3.616	8.609	35.958	3.616	8.609	35.958	3.867	9.207	29.128
4	3.307	7.874	43.832	3.307	7.874	43.832	3.862	9.195	38.322
5	2.726	6.49	50.322	2.726	6.49	50.322	3.112	7.41	45.732
6	2.522	6.004	56.327	2.522	6.004	56.327	2.827	6.731	52.463
7	1.796	4.275	60.602	1.796	4.275	60.602	2.812	6.694	59.158
8	1.294	3.081	63.683	1.294	3.081	63.683	1.503	3.579	62.737
9	1.261	3.002	66.685	1.261	3.002	66.685	1.406	3.347	66.084
10	1.178	2.805	69.49	1.178	2.805	69.49	1.277	3.041	69.125
11	1.083	2.579	72.069	1.083	2.579	72.069	1.237	2.944	72.069

Extraction Method: Principal Component Analysis

As illustrated in Figure 1, the scree plot for learning stress indicated a clear inflection point after the seven components,suggesting a seven-factor solution.

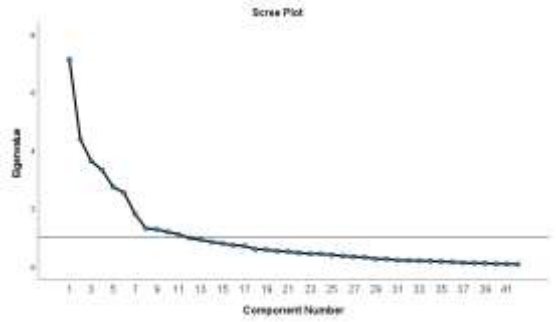

Figure 1 Scree Plot of Learning Stress

However, from the rotated component matrix results in Table 4, LPS2, item LPS5, item LCS2, item LCS5, item LCS6, item LCS9, item LConS4, item FES1, and item FES2 were loaded on Components 8, 9,10 and 10, which were rejected by the parallel analysis. Consistently, from the reliability analysis of learning stress mentioned earlier, item LPS2, item LPS5, item LCS2, item LCS5, item LCS6, item LCS9, item LConS4, item FES1, and item FES2, failed the reliability test.

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Therefore, these nine items were deleted from the final construct

Table 4Rotated Component Matrix of Learning Stress

Rotated Component Matrix[a]											
	Component										
	1	2	3	4	5	6	7	8	9	10	11
LPS1	0.932										
LPS2											
LPS3	0.794										
LPS4	0.755										
LPS5								0.545			
LPS6	0.826										
LPS7	0.754										
LPS8	0.737										
LCS1		0.913									
LCS2								0.542			
LCS3		0.763									
LCS4		0.746									
LCS5											
LCS6									0.758		
LCS7		0.834									
LCS8		0.671									
LCS9											
LCS10		0.783									
AAS1			0.913								
AAS2			0.771								
AAS3			0.844								
AAS4			0.787								
AAS5			0.821								
LES1					0.918						
LES2					0.798						
LES3					0.766						
LES4					0.826						
AWS1				0.923							
AWS2				0.72							
AWS3				0.668							
AWS4				0.796							
AWS5				0.701							
AWS6				0.785							
LConS1						0.914					
LConS2						0.909					
LConS3						0.907					
LConS4											
FES1										0.88	
FES2											0.835
FES3							0.854				

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FES4	0.903
FES5	0.878

Based on the results of the data analysis,the EFA results supported the seven-dimensional structure of learning stress in the pilot sample and confirmed that the refined 33-item learning stress scale demonstrated adequate construct validity for subsequent large-sample validation.

Exploratory Factor Analysis for Analysis for Academic Self-efficacy

The academic self-efficacy construct in this study was measured using an Academic Self-Efficacy Scale (ASES), which originally contained 22 items and was designed to capture two sub-constructs: Self-Efficacy for Learning Ability (SELA)(11 items) and Self-Efficacy for Learning Behaviour (SELB)(11 items). Items were refined during the pilot phase (N = 122) through Exploratory Factor Analysis (EFA) to confirm dimensionality and improve measurement quality before the field study.

As shown in Table 5, after deleting four items (SELA3, SELB1, SELB5, and SELB9) and rerunning EFA, the Kaiser–Meyer–Olkin (KMO) value for academic self-efficacy was 0.925, which is well above the recommended threshold of 0.50.Bartlett's Test of Sphericity was also significant (χ^2 = 2178.07, df = 231, Sig. = 0.000), indicating that the correlation matrix was appropriate for factor analysis. The correlation matrix further showed that many inter-item correlations were 0.30 or higher, supporting factorability.

Table 5KMO and Bartlett's Test of Academic Self-efficacy

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.925
Bartlett's Test of Sphericity	Approx. Chi-Square	2178.07
	df	231
	Sig.	0.000

Based on Principal Component Analysis (PCA) with varimaxrotation, Table 5 presents the factor extraction results for the 22 items measuring academic self-efficacy.Four components wereextracted,all with eigenvalues greater than 1.0,with the total variance explained for all four components to be 73.687%, over the sixty per cent value as the minimum percentage of acceptable variance explained in factor analysis for a construct to be valid. Clearly, a total of 73.687% of the variance was explained by the four components, with component 1 contributing 34.321%, component 2 contributing 27.812%, component 3 contributing 6.061%, and component 4 contributing 5.492%.

Table 6Total Variance Explained for Academic Self-efficacy

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of	Variance	Total	% of	Variance	Total	% of	Variance
1	9.26	42.092	42.092	9.26	42.092	42.092	7.551	34.321	34.321
2	4.432	20.147	62.239	4.432	20.147	62.239	6.119	27.812	62.134
3	1.335	6.067	68.306	1.335	6.067	68.306	1.333	6.061	68.195
4	1.184	5.381	73.687	1.184	5.381	73.687	1.208	5.492	73.687

Extraction Method: Principal Component Analysis

As illustrated in Figure 2, the scree for academic self-efficacy indicated a clear inflection point after thesecond component suggesting a two-factor solution.

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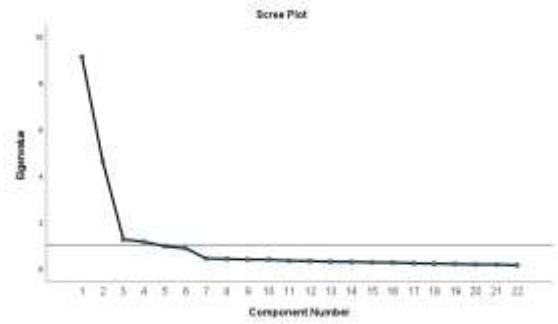

Figure 2 Scree Plot of Academic Self-efficacy

Table 7 presents the rotated component matrix for the final 18 items, where all items displayed factor loadings above 0.50, indicating strong practical significance. The parallel analysis result confirmed the scree plot by providing stronger evidence that only two components were retained for the academic self-efficacy construct after EFA.

Table 7 Rotated Component Matrix ofAcademic Self-Efficacy

Rotated Component Matrix[a]				
	Component			
	1	2	3	4
SELA1	0.852			
SELA2	0.887			
SELA3			0.699	
SELA4	0.827			
SELA5	0.857			
SELA6	0.821			
SELA7	0.851			
SELA8	0.884			
SELA9	0.879			
SELA10	0.852			
SELA11	0.839			
SELB1			0.777	
SELB2		0.855		
SELB3		0.865		
SELB4		0.861		
SELB5				0.743
SELB6		0.872		
SELB7		0.806		
SELB8		0.847		
SELB9				0.763
SELB10		0.859		
SELB11		0.878		

The items were cleanly grouped into the two intended sub-constructs, confirming that the refined academic self-efficacy scale comprises SELA (10 items) and SELB (8 items) and is suitable for subsequent analysis.

Exploratory Factor Analysis for Analysis for Learning Burnout

The learning burnout variable was evaluated using 20 items from the Learning Burnout of Undergraduates Scale (LBUS),

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comprising three dimensions: Emotional Exhaustion (EE), Cynicism (CY), and Reduced Academic Efficacy (RAE). Emotional exhaustion contains 8 items, cynicism contains 6 items, and reduced academic efficacy contains 6 items.

As shown in Table 8, the Kaiser–Meyer–Olkin (KMO) measure for learning burnout was 0.885, exceeding the acceptable threshold of 0.50, and Bartlett's Test of Sphericity was statistically significant (χ^2 = 1648.910, p < .001), indicating suitability for factor analysis. Based on the rotated component matrix and parallel analysis evidence, items CY2, RAE1, and RAE3 showed problematic loading patterns and were also identified as failing the reliability test; therefore, these three items were removed and EFA was rerun to obtain the final construct.

Table 8KMO and Bartlett's Test of Learning Burnout

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.885
Bartlett's Test of Sphericity	Approx. Chi-Square	1648.910
	df	190
	Sig.	0.000

Table 9 displays the PCA with varimax rotation results of the 20 items under the learning burnout construct. The result showed that the PCA procedure has extracted five components with eigenvalue exceeding the value of 1.0, with the total variance explained for all five components to be 75.128%, over the sixty per cent value as the minimum percentage of acceptable variance explained in factor analysis for a construct to be valid. Clearly, a total of 75.128% of the variance was explained by the five components, with component 1 contributing 29.461%, component 2 contributing 18.893%, component 3 contributing 15.506%, component 4 contributing 5.901%, and component 5 contributing 5.367%.

Table 9 Total Variance Explained for Learning Burnout

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of	Variance	Total	% of	Variance	Total	% of	Variance
1	7.676	38.38	38.38	7.676	38.38	38.38	5.892	29.461	29.461
2	3.217	16.087	54.467	3.217	16.087	54.467	3.779	18.893	48.354
3	1.904	9.518	63.985	1.904	9.518	63.985	3.101	15.506	63.86
4	1.214	6.068	70.053	1.214	6.068	70.053	1.18	5.901	69.761
5	1.015	5.075	75.128	1.015	5.075	75.128	1.073	5.367	75.128

Extraction Method: Principal Component Analysis

As illustrated in Figure3, the inspection of the scree plot illustrated that after the fifth component, the slope was very flat, indicating that there is no special factor to be extracted.

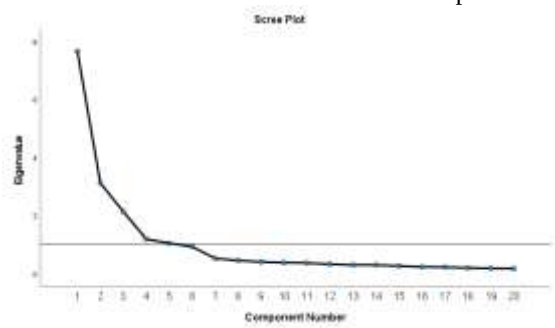

Figure 3 Scree Plot of Learning Burnout

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However, from the rotated component matrix results in Table 10, items CY2, RAE1, and RAE3 were loaded on Components 4 and 5, which were rejected by the parallel analysis. Consistently, from the reliability analysis of learning burnout, items CY2, RAE1, and RAE3 also failed the reliability test. Therefore, these three items were deleted from the final construct.

Table 10Rotated Component Matrix of Learning Burnout

Rotated Component Matrix[a]					
	Component				
	1	2	3	4	5
EE1	0.787				
EE2	0.788				
EE3	0.855				
EE4	0.83				
EE5	0.86				
EE6	0.865				
EE7	0.855				
EE8	0.861				
CY1		0.84			
CY2					0.965
CY3		0.848			
CY4		0.824			
CY5		0.796			
CY6		0.845			
RAE1				0.767	
RAE2			0.851		
RAE3				0.709	
RAE4			0.824		
RAE5			0.832		
RAE6			0.847		

The EFA results confirmed that learning burnout in the pilot sample is best represented by a three-dimensional structure with 17 retained items, namely Emotional Exhaustion (8 items), Cynicism (5 items), and Reduced Academic Efficacy (4 items), supporting the construct validity of the refined learning burnout scale for subsequent analyses.

VII. RELIABILITIES ANALYSIS

The pilot study was conducted to test the reliability and validity of the research instruments and to ensure the appropriateness of the questionnaire for the main field study. The pilot questionnaire comprised a total of 84 items, including the University Student Learning Stress Scale (USLSS, 42 items), the Academic Self-Efficacy Scale (ASES, 22 items), and the Learning Burnout of Undergraduates Scale (LBUS, 20 items). Following the pilot study and the results of exploratory factor analysis (EFA), a total of 16 items were removed across the three instruments due to inadequate psychometric performance. Specifically, nine items were removed from the USLSS, four items were removed from the ASES, and three items were removed from the LBUS. Consequently, the final version of the questionnaire used in the field study consisted of 68 items: USLSS (33 items), ASES (18 items), and LBUS (17 items). The refined instrument demonstrated sound psychometric properties and was deemed suitable for large-scale data collection in the main research phase. Although no substantive revisions were required at the comprehension/wording level, the pilot process provided important evidence for psychometric refinement. In preparation for the subsequent field study, the final questionnaire and its administration procedures were reviewed to ensure clarity and consistent implementation, and pilot participants' feedback on the format,

instructions, and wording further supported the usability of the instrument. This preparation phase was essential to ensure the validity and reliability of the instrument in the broader sample of participants for the main study.

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