



## Examining the reliability and validity of self-efficacy beliefs, stress, perceived teachers' support and academic burnout scales using the PLS-SEM approach

Jingyuan Li<sup>1</sup>  
Yoon Fah Lay<sup>2\*</sup>

<sup>1</sup>Faculty of Social Sciences and Liberal Arts, UCSI University, Kuala Lumpur, Malaysia.

Email: [1002161218@ucsiuniversity.edu.my](mailto:1002161218@ucsiuniversity.edu.my)

<sup>2</sup>Faculty of Psychology and Education, Universiti Malaysia Sabah, Kota Kinabalu; Faculty of Social Sciences and Liberal Arts, UCSI University, Kuala Lumpur & School of Liberal Arts and Sciences, Taylor's University, Kuala Lumpur, Malaysia.

Email: [layyff@ums.edu.my](mailto:layyff@ums.edu.my)



(+ Corresponding author)

### ABSTRACT

#### Article History

Received: 13 November 2023

Revised: 11 October 2024

Accepted: 31 October 2024

Published: 1 January 2025

#### Keywords

Academic burnout  
Perceived teachers' support  
PLS-SEM approach  
Stress  
Students' self-efficacy beliefs.

Likert scales were used in this study to collect data on measures such as the student academic burnout scale, the student stress scale, the student self-efficacy beliefs scale and the student perceived teacher support scale. The purpose of this study is to examine the four-part scales' reliability and validity used in this research. The number of measurement indicators for the four scales was 11, 13, 12 and 10, respectively. Seventy-five college students from five colleges and universities participated in the research and the partial least squares structural equation modelling (PLS-SEM) approach was applied to analyze the data. Consequently, the internal consistency and reliability of the measures were assessed using Cronbach's alpha (CA) and composite reliability (CR) both of which exceeded the clinical thresholds of 0.6 and 0.7, respectively. The average variance extracted (AVE) was used to evaluate the scales' convergent validity and the reported values were all stated above 0.5. The scales' discriminant validity was also framed within the range of threshold values. As a result, the scales used in this study demonstrated good validity and reliability and can be useful in assessing relationships throughout a range of study situations.

**Contribution/Originality:** This study employed the second-generation statistical method, PLS-SEM, in a novel approach to assess the reliability and validity of the scales used in the study. In terms of research methodology, it offers a new method for evaluating the reliability and validity of research instruments.

### 1. INTRODUCTION

Training talent for societal growth is one of the three responsibilities of contemporary higher education. However, students' academic achievement is now a crucial factor in defining their level of achievement in China's modern university education system. Although this standard is relatively one-sided, the degree of academic scores is representative of evaluating students' academic performance to some extent. Many factors influence college students' academic achievement. Extensive studies have been undertaken on student self-efficacy beliefs, stress, student perceptions of teacher support and academic burnout and it is considered that these elements have substantial impacts on student academic performance. However, outcomes may change when studies are undertaken on different research populations. It is necessary to validate the research instrument before commencing the

research since the research population in this study consists of regular undergraduate and junior college students in Shandong Province (China).

Structural equation modelling is beneficial in discussing complex models with relevant simple appliances (Dash & Paul, 2021) but selecting the appropriate approach takes much work. The two most popular approaches researchers have applied to conduct research are covariance-based structural equation modelling (CB-SEM) and Partial least square structural equation modelling (PLS-SEM). Researchers have determined that PLS-SEM is more useful for assessing the composite-based mode while the CB-SEM appliance is more appropriate for estimating the factor-based model (Dash & Paul, 2021; Hair, Ringle, & Sarstedt, 2011; Henseler, Hubona, & Ray, 2016).

Researchers are increasingly using second-generation statistical approaches as opposed to first-generation techniques like factor analysis and regression analysis (Hair, Hult, Ringle, & Sarstedt, 2017). According to Hair et al. (2011), PLS-SEM was highly influential in testing causal models and an increasing number of researchers are using this method to investigate the connections between endogenous and exogenous constructs. Researchers may choose the PLS-SEM approach for various reasons including a complex structural model, a relatively small sample size, a lack of normal distribution, etc. (Ghasemy, Teeroovengadum, Becker, & Ringle, 2020; Hair, Risher, Sarstedt, & Ringle, 2019). The aforementioned reasons support the notion that it is more beneficial to do more research using the PLS-SEM strategy rather than the first-generation statistical method.

SPSS software and the CB-SEM method are usually used to validate the internal consistency reliability of the four scales (SSBS, SSS, SPTSS and SABS) from the perspective of content reliability and CA while the scales' convergent validity and discriminant validity were not mentioned. Hence, it is crucial to use the PLS-SEM approach to assess the reliability and validity of the scales used in the study to confirm their internal consistency and reliability, convergent validity and discriminant validity before undertaking the actual research.

## 2. LITERATURE REVIEW

### 2.1 Students' Self-Efficacy Beliefs Scale

Previous research has shown that students' self-efficacy beliefs (SSB) have a significant and favourable influence on their academic achievement. Specifically, academics have increasingly focused on college students at the higher education level as a prominent demographic. The SSB is a highly influential factor in shaping human behavior and emotions (Hamann, Pilotti, & Wilson, 2020; Viviers, De Villiers, & van der Merwe, 2023). It holds a prominent position as a critical focus of academic research. It is also an essential manifestation of self-efficacy in education. Based on the result expectations and efficacy expectations dimensions provided by Bandura (1977), Chinese researchers (Guo & Su, 2021; Liang, 2000; Xu, Luo, Yu, Tian, & Zhu, 2021) assessed students' self-efficacy beliefs from the perspectives of learning capacity and learning behaviour based on Bandura's (1977) outcome expectations and efficacy expectations dimensions.

High self-efficacy students will maintain a positive outlook when they experience difficulties with their learning and build themselves up when they experience failures. Additionally, they believe they can overcome obstacles in the learning process by applying effort. Meanwhile, students who have low academic efficacy are more susceptible compared to their peers (Aftab, Shah, & Mehmood, 2012; Demirel, Türkel, & Aydın, 2020; Hwang, 2021). When encountering obstacles, they could use poor coping strategies, avoid problems or even give up on trying to solve them.

Research indicates variations in self-efficacy views among college students and discrepancies in perception across different groups. The study by Basith, Syahputra, and Ichwanto (2020) contradicted this perspective asserting no substantial gender disparities in self-efficacy views among college students. According to Saleh, Camart, and Romo (2017), French university students typically exhibit low levels of self-efficacy. However, male students demonstrate significantly higher self-efficacy levels than their female counterparts. Hence, the researcher's goal for the study should be taken into consideration while choosing a scale.

The Students' Self-Efficacy Beliefs Scale (SSBS) used in this research was compiled initially by Liang (2000) and consisted of two dimensions: learning ability efficacy (LAE) and learning behavior efficacy (LBE). Higher scores suggest higher levels of self-efficacy beliefs. The 5-point Likert scale with 22 items in this study was converted to a 7-point Likert scale while keeping the original items to ensure the measures' accuracy. CA values were recorded as 0.820 and 0.752 in the two dimensions on the original scale.

Xu et al. (2021) used a consistent measurement scale to evaluate the relationship between SSB and engagement. The findings indicated that CA coefficients for LAB and LBE were 0.780 and 0.710, respectively. Additionally, the overall Cronbach's alpha coefficient for the scale was 0.829. During the same period, Chen and Zhou (2021) compiled a 12-item questionnaire based on SSBS to examine the students' self-efficacy and belief level. The instrument exhibited an overall alpha coefficient of 0.823. Furthermore, the two sub-dimensions of the questionnaire showed CA coefficients of 0.834 and 0.573, respectively.

### 2.2. Student Stress Scale

Student performance in colleges and universities is also influenced by factors related to self-identity, interpersonal relationships, academics and future development in addition to self-efficacy beliefs (Acharya, Jin, & Collins, 2018; Li, Yang, Zhou, Zhao, & Liu, 2022; Othman, Ahmad, El Morr, & Ritvo, 2019; Satpathy, Siddiqui, Parida, & Sutar, 2021). Academic stress is typically regarded as the stressor that has the most considerable effect on students among these stressors (Li et al., 2022; Satpathy et al., 2021). According to the former researchers (Alduais et al., 2022; Deng et al., 2022), stress can negatively affect college students' mental and physical health, ultimately affecting their academic performance. According to the cognitive appraisal theory of stress, there are four ways in which stress can impact an individual: prospective stressors, cognitive evaluation, coping and reaction (Lazarus & Folkman, 1984).

The China College Student Psychological Stress Scale (CCSPSS) developed by Liang and Hao (2005) served as a model for the Student Stress Scale (SSS) which measures the stress levels of college students in Shandong Province. It maintains the four main sources of stress that students face: academic stress, interpersonal stress, future development stress and student life stress.

In the original scale, the number of items for the four dimensions was 18, 18, 10 and 28 and the alpha values reported for the four sub-scales were 0.860, 0.840, 0.810 and 0.870, respectively. The overall Cronbach's alpha was 0.960.

In the study investigating the correlation between stress and adaptation in college students, Ma, Qu, Yan, and Fu (2017) evaluated the precision and uniformity of the scale used in the research to examine the relationship between stress and adaptability in college students.

They discovered that the overall CA of the scale evaluated three times surpassed 0.950. Two retests also demonstrated a retest reliability exceeding 0.700. The researchers determined that the China College Student Psychological Stress Scale (CCSPSS) exhibited both reliability and validity. An and Pei (2017) used the CCSPS to create the student stress questionnaire which was designed to investigate the relationship between academic stress and emotional intelligence in university students.

As a result, the questionnaire proved to be highly reliable and valid with an internal consistency reliability value of 0.90, a composite reliability value of 0.95, and an average variance extracted value of 0.61.

### 2.3. Student Perceived Teachers' Support Scale

Social support theory (Cullen, 1994) focuses on the adaptation of human beings to society and the utilization of social resources and teachers' support belongs to the perspective of micro-level support. Researchers often employed the analytical dimensions of emotional support, learning support and competency support to measure students' perceptions of teachers' support (Abdullah, Shamsi, Jenatabadi, Ng, & Mentri, 2022; Liu, Du, & Lu, 2022).

Therefore, teachers are regarded as the closest partners for students in the learning process. Students benefit greatly from the assistance that professors offer them, whether they are learning in-person or virtually (Brandisauskiene et al., 2021; Frazier, Gabriel, Merians, & Lust, 2019) just as it does to help students reduce uncertainty and insecurity (Abdullah et al., 2022) as well as stimulate students' learning participation (Liu et al., 2022). In particular, the support provided by teachers plays an irreplaceable role in improving students' learning environment (Abdullah et al., 2022), stimulating students' participation in learning (Liu et al., 2022) and affecting college students' academic mood (Hao, Cui, & Chiu, 2018).

The Student Perceived Instructors' Support Scale (SPTSS) was developed by OuYang (2005) and has three dimensions: learning support (LS), emotional support (ES) and capacity support (CS). This allows researchers to analyse how college students perceive support from their teachers. Simultaneously, values of the composite reliability for the three dimensions were reported as 0.840, 0.730 and 0.790. The questionnaire's overall reliability was 0.870.

Chen and Ma (2022) used the student perceived teachers' support behaviour questionnaire (SPTSQBQ) to evaluate the relationship between students' information literacy skills and the perceived support from their teachers. The study produced a CA coefficient of 0.87 indicating a high degree of internal consistency. Furthermore, the three sub-dimensions of the construct demonstrated satisfactory reliability with alpha values of 0.84, 0.73, and 0.79, respectively. Chen and Tu (2019) revealed that the CA values for each of the three sub-dimensions were 0.929, 0.897 and 0.889 in a different investigation that also used this scale.

The total alpha coefficient of this study was 0.937. All of which indicate that the questionnaire has high reliability and validity.

#### 2.4. Student Academic Burnout Scale

Scholars initially used the term "burnout" to evaluate the mental health of individuals at work due to excessive demands on energy, strength and resources. Later, the researchers noticed that students had diverse levels of burnout in the learning process which were influenced by factors such as age, gender and even parental education (Chahid, Ahami, Chigr, & Najimi, 2018; Hyytinen, Tuononen, Nevgi, & Toom, 2022) and displayed features of various types of academic burnout. Students' levels of academic burnout eventually have a detrimental effect on their academic performance, independent of the form of academic burnout, emotional weariness, sense of cynicism towards school or inadequacy (Asikainen, Salmela-Aro, Parpala, & Katajavuori, 2020; Madigan & Curran, 2020). The extent of academic burnout and its effect on academic performance similarly demonstrated an upward trend over time (Asikainen et al., 2020; Madigan & Curran, 2020; Raisanen, Postareff, & Lindblom-Ylanne, 2021; Yu, Yin, Zhao, & Xin, 2020).

Lian, Yang, and Wu (2005) developed the undergraduates' learning burnout scale (ULBS) to assess college students' academic burnout in learning contexts and the resulting burnout behavior. It contains three dimensions: emotional exhaustion (EE), improper behavior (IB) and low sense of achievement (LSA) and 8, 6 and 6 items comprise each dimension. According to Lian et al. (2005), the overall Cronbach's alpha was 0.865 and the values for the three dimensions were 0.812, 0.704 and 0.731, respectively. The scale applied in the current study is compiled from USBS by altering the 5-point Likert scale to a 7-point Likert scale and 1 to 7 were used to signify the degree of student assent to the observed indicator, from strongly disagree to strongly agree.

Chen and Zhou (2021) conducted a study to examine the relationship between academic self-efficacy, academic stress and learning burnout. They found the total alpha coefficient for SABS was 0.750 and Cronbach's alpha of the sub-dimensions was 0.817 for EE, 0.676 for IB, and 0.326 for LSA. Wu, Yu, An, and Li (2021) applied the same scale to investigate the effect of college students' academic burnout emotions on disciplinary competitions using LBS. In the reliability test of the scale, the total Cronbach's alpha was 0.887, 0.867 for EE, 0.766 for IB and 0.745 for LSA. Liu, Zhou, Li, Wang, and Teng (2018) used the CSABS to understand the level of academic burnout and

its relationship with college students' academic stress and psychological toughness. An internal consistency coefficient of 0.750 from the factor analysis confirmed the questionnaire's good structural validity.

### 3. METHODOLOGY

#### 3.1. Research Instruments

Four scales were used to collect data for this investigation. First, there is the Students' Self-Efficacy Beliefs Scale (SSBS), a 22-item measure that assesses students' LBE and LAE (Liang, 2000). The scale used to measure the stress of college students during college life and study is the Student Stress Scale (SSS). The four facets of primary student stress examined in the study are student academic stress (SAS), student life stress (SLS), student interpersonal stress (SIS) and student further development stress (Liang & Hao, 2005). Meanwhile, the Student Perceived Teachers' Support Scale (SPTSS) was the primary tool used to assess the level of support that students perceived from teachers in their academic and personal lives in the domains of "learning support" (LS) and "capacity support" (CS) (OuYang, 2005). Finally, the Student Academic Burnout Scale (SABS) was used to measure the level of academic burnout among college students (Lian et al., 2005). Researchers obtained the student profiles for inappropriate behaviour (IB), emotional exhaustion (EE) and low sense of accomplishment (LSA). Appendix 1 presents the content of some of the question items on the scales used in the study.

#### 3.2. Procedure

The quota and random sampling methods were employed in this investigation. The researcher divided the 153 universities in Shandong province (China) into four groups according to their types before starting the sampling process: private colleges and universities, provincial undergraduate universities, provincial higher vocational colleges and colleges and universities under the central ministry's authority. In the first stage, five colleges and universities were selected from the 4 clusters using a quota sampling method. Fifteen college students from each university were randomly selected by simple random sampling from the 4 clusters in the second stage. Shandong University was chosen to represent the central ministry's colleges and universities, Linyi University was picked to represent the provincial undergraduate universities, Binzhou Polytechnic was determined to represent the provincial higher vocational colleges, QiLu Institute of Technology and Qilu Medical College were assigned to represent the Shandong Province's private colleges and universities. There were a total of 75 respondents employed for this investigation.

The researchers initially explained the goal of the study and the support required from teachers and school administrators at the five colleges and institutions they had chosen in order to collect data for the study. Simple random selection was used to choose 75 students after getting the schools' consent. This was followed by briefing the students on the purpose of the survey and the precautions to be taken in completing the questionnaire such as that the survey was voluntary, they were allowed to leave in the middle of the survey, the questionnaire was submitted anonymously, and the data obtained would be used only for conducting educational research. A teaching staff member was present to help with any problems.

#### 3.3. Data Analysis

The current study employed quantitative research, collected data using cross-sectional surveys and used Smart PLS software 4.0.8.7 to assess the scale's validity and reliability. Data screening was first carried out on the self-reports of the returned respondents in PLS-SEM data analysis to ensure that missing values, deviations and suspicious matching patterns were not included in the data and to verify that all the data examined was valid.

The questionnaire for this study contained four sub-scales with 46 items. Cronbach's alpha and composite reliability were used to examine the internal consistency and reliability of the scales. Convergent validity for the

instruments was mainly assessed by the Average Variance Extracted and three critical criteria for discriminant validity: the Fornell-Larker criterion, cross-loading and the Heterotrait-Monotrait ratio (HTMT).

#### 4. RESULTS

##### 4.1. Internal Consistency Reliability for the Instruments

Generally, the construct's CR value and the CA were used as metrics to evaluate the scale's internal consistency and reliability. The former is the most conventional and widely used criterion for assessing the internal consistency reliability of instruments in social science research (Hair et al., 2017) and this way of measuring reliability is proposed based on variable correlations. It is often assumed that in exploratory research, the measurement tool's reliability is adequate when the alpha coefficient hits 0.7 and high when the coefficient is between 0.7 and 0.9. Table 1 illustrates the CA values for the four latent components. Exactly, CA for construct SAB was presumed to be 0.898, 0.921 for SPTS, 0.930 for SS and 0.902 for SSB. All of the results were greater than 0.7.

Table 1. The constructs' internal consistency and reliability.

Construct	Cronbach's alpha	Composite reliability (CR)	Average variance extracted (AVE)
SAB	0.898	0.907	0.527
SPTS	0.921	0.930	0.540
SS	0.930	0.940	0.545
SSB	0.902	0.903	0.509

Note: SAB= Student academic burnout, SPTS=Students perceived teachers' support, SS= Student stress, and SSB=Students' self-efficacy beliefs.

Another criterion to evaluate the internal consistency and reliability of the instrument is composite reliability based on the latent constructs. The composite reliability values for SAB, SPTS, SS and SSB were 0.907, 0.930, 0.940 and 0.903, respectively based on the four reflecting constructs of the research as indicated in Table 1. The four CRs for the latent constructs were more significant than the threshold value (0.7). In addition, it was shown that the instrument's internal consistency and reliability had been established by combining CA values with CRs.

##### 4.2. Convergent Validity for the Instruments

Table 1 shows the AVE values for the constructs. The AVE values for constructs SSB, SS, SPTS and SAB are 0.509, 0.545, 0.540 and 0.527 as indicated. Hence, all four AVE values represented have exceeded the threshold value (0.5) and the convergent validity has been validated from the perspective of the average variance extracted.

##### 4.3. Discriminant Validity for the Instruments

Three criteria are necessary to evaluate the Heterotrait-monotrait (HTMT) ratio of correlations, cross-loading and the Fornell-Larcker criterion in order to determine the instrument's discriminant validity. Cross-loading which concentrates on the indicators is the first criteria to assess discriminant validity. Any item's loading should always be greater than its cross-loadings. Table 2 and Figure 1 illustrate the loading and outer loadings for all the items. Constructs SAB comprises ten items: SAB\_EE1, 2, SAB\_IB4, 7 and SAB\_LSA1, 2, 3, 4, 5, 7. Table 2 shows that all 10 item loadings on the correlation construct SAB are greater than cross-loadings on the other three constructs (SPTS, SS, and SSB). Constructs SS and SSB exhibit cross-loadings on the other constructs. However, the loadings on the particular construct are more substantial similar to those of SAB and SPTS. Loadings for items SS\_SAS2, 4, 5, 6, 7, SS\_SFDS6, 11, SS\_SIS1, 2, 3 and SS\_SLS1, 2, 9 are the largest on construct SS. Meanwhile, loadings on SSB construction are the same. Loadings on items SSB\_LAE1, 2, 3, 4, 6, 8, 9, 10 and SSB\_LBE2, 8, 10 exceed cross-loadings on constructs SAB, SS, and SPTS. The loadings of the indicators on the respective structures are all greater than the cross-loadings on the other constructs.

There were 14 items with a loading value smaller than 0.7 in Figure 1 including SAB\_EE1, SAB\_LSA2, SAB\_LSA3, SAB\_LSA7, SPTS\_CS1, SPTS\_LS1, SSB\_LAE2, SSB\_LAE10, SSB\_LBE8, SSB\_LBE10, SS\_SAS2, SS\_SIS1, SS\_SIS2 and SS\_SLS1. However, these items were retained, considering that the CA, CR and AVE values for the constructs in which these items were located all exceeded the minimum threshold required.

**Table 2.** Cross-loadings for constructs SAB, SPTS, SS and SSB.

Item	SAB	SPTS	SS	SSB
SAB_EE1	0.677	-0.359	0.344	-0.433
SAB_EE3	0.756	-0.509	0.381	-0.419
SAB_IB4	0.780	-0.409	0.265	-0.465
SAB_IB7	0.782	-0.436	0.371	-0.384
SAB_LSA1	0.779	-0.452	0.279	-0.436
SAB_LSA2	0.579	-0.286	0.153	-0.452
SAB_LSA3	0.671	-0.371	0.319	-0.467
SAB_LSA4	0.739	-0.538	0.254	-0.45
SAB_LSA5	0.829	-0.554	0.367	-0.536
SAB_LSA7	0.628	-0.331	0.196	-0.332
SPTS_CS1	-0.337	0.609	-0.075	0.27
SPTS_CS2	-0.447	0.756	-0.221	0.32
SPTS_CS3	-0.418	0.749	-0.22	0.407
SPTS_CS4	-0.569	0.801	-0.186	0.465
SPTS_CS5	-0.448	0.727	-0.216	0.384
SPTS_LS1	-0.339	0.506	-0.083	0.271
SPTS_LS2	-0.553	0.765	-0.267	0.460
SPTS_LS3	-0.381	0.725	-0.153	0.213
SPTS_LS4	-0.498	0.847	-0.148	0.400
SPTS_LS6	-0.367	0.726	0.027	0.228
SPTS_LS9	-0.395	0.792	-0.288	0.349
SPTS_LS12	-0.383	0.750	-0.178	0.217
SSB_LAE1	-0.448	0.378	-0.283	0.726
SSB_LAE2	-0.353	0.225	-0.181	0.675
SSB_LAE3	-0.361	0.321	-0.244	0.707
SSB_LAE4	-0.365	0.361	-0.223	0.741
SSB_LAE6	-0.317	0.231	-0.099	0.715
SSB_LAE8	-0.461	0.439	-0.256	0.851
SSB_LAE9	-0.474	0.178	-0.239	0.771
SSB_LAE10	-0.458	0.353	-0.206	0.613
SSB_LBE2	-0.366	0.240	-0.173	0.749
SSB_LBE8	-0.484	0.348	-0.357	0.699
SSB_LBE10	-0.511	0.474	-0.205	0.556
SS_SAS2	0.261	-0.287	0.478	0.018
SS_SAS4	0.226	-0.134	0.830	-0.158
SS_SAS5	0.181	-0.129	0.814	-0.146
SS_SAS6	0.209	-0.153	0.767	-0.224
SS_SAS7	0.334	-0.193	0.801	-0.097
SS_SFDS6	0.356	-0.231	0.827	-0.409
SS_SFDS11	0.278	0.014	0.746	-0.279
SS_SIS1	0.229	-0.19	0.648	-0.237
SS_SIS2	0.106	-0.117	0.682	-0.208
SS_SIS3	0.231	-0.118	0.720	-0.244
SS_SLS1	0.440	-0.294	0.639	-0.282
SS_SLS2	0.368	-0.231	0.762	-0.364
SS_SLS9	0.340	-0.050	0.803	-0.291

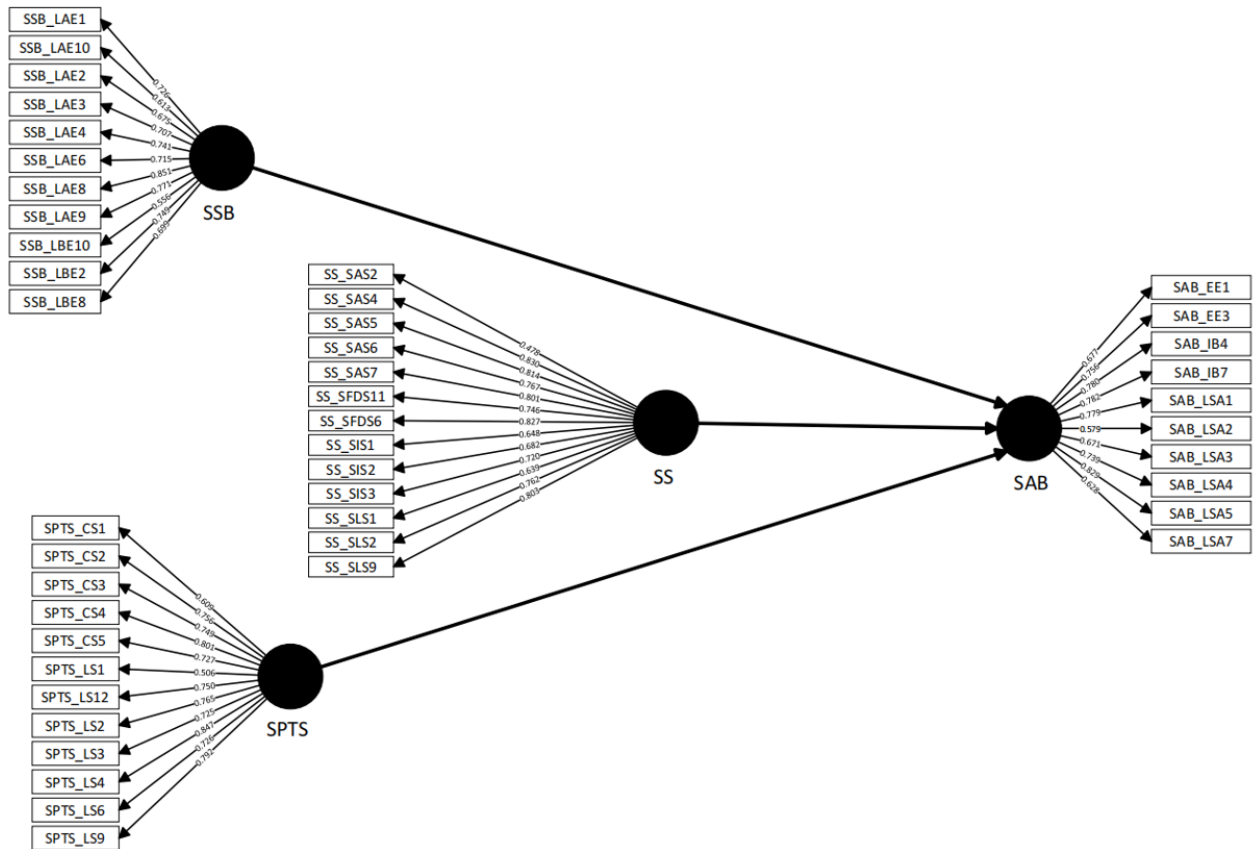


Figure 1. Outer-loadings for all the retained items.

The model demonstrates more considerable discriminant validity according to the Fornell-Larcker criterion when the square root of the AVE value for a particular construct is greater than its maximum correlation with any other construct (Hair et al., 2017). Table 3 illustrates the Fornell-Larcker criterion for the four constructs: SAB, SPTS, SS, and SSB. The square root of the AVE value for construct SPTS was 0.735 greater than the SAB (-0.596). The square root of construct SS's AVE yielded a value of 0.738 greater than its relationship with SAB (0.411) and SPTS (-0.237). Meanwhile, the square root of the AVE value for construct SSB (0.713) exceeded its highest correlations with SAB (-0.605), SPTS (0.467) and SS (-0.326).

Table 3. Fornell-Larcker criterion for the constructs SAB, SPTS, SS and SSB.

Construct	SAB	SPTS	SS	SSB
SAB	0.726			
SPTS	-0.596	0.735		
SS	0.411	-0.237	0.738	
SSB	-0.605	0.467	-0.326	0.713

The values below 0.9 show stronger discriminant validity than those above 0.9 from the perspective of the criteria Heterotrait-monotrait ratio.

The study's findings indicate that all values fell under the threshold of 0.9 and the four constructs SAB, SS, SPTS and SSB in the path model were more distinct. The HTMT for SPTS to SAB was 0.634, SS to SAB was 0.403, SS to SPTS was 0.264, SSB to SAB was 0.655, SSB to SPTS was 0.486 and SSB to SS was 0.344. According to the above criteria tested in the research, the discriminant validity of the instruments has been established.



## 5. DISCUSSION

The main objective of this study was to examine the internal consistency and reliability, convergent validity and discriminant validity of the four Likert scales by applying the PLS-SEM approach. The average undergraduate or junior college student who participated may complete the survey in five minutes. The number of items was reduced from 101 to 46 compared to the original four scales. There are metrics for multiple constructs in the validation process such as composite reliability, AVE value, Fornell-Larcker criterion and Heterotrait-monotrait ratio as well as measurements for specific items such as outer loading and cross-loading (Hair et al., 2017). The accuracy and precision of measurement findings may be increased by employing a variety of complex measuring standards.

SSBS tested the levels of college students' self-efficacy beliefs in two dimensions: LAE and LBE. The results showed that CA and CR values for construct SSB were 0.898 and 0.907 respectively indicating strong internal consistency reliability for SSBS. Convergent validity-wise, the stated AVE value for SSB is 0.527 which is higher than the necessary threshold of 0.5. The square root of its AVE value during the discriminant validity analysis was 0.726. Finally, eleven objects were kept and the HTMT value ranged between 0.85 and 0.85. Therefore, the reliability and validity of SSBS were good.

Liang and Hao (2005) calculated a CA value of 0.960 for the CCSPSS. The reflective measurement model SS's CA and CR values were 0.940 and 0.930, respectively as compared to this result, suggesting that the structure has a high level of internal consistency and reliability. The AVE value obtained during the validation of convergent validity was 0.545 exceeding the 0.5 threshold criterion. The square root of its AVE on the corresponding construct was revealed to be 0.738. 13 items (SS\_SAS2, SS\_SAS4, SS\_SAS5, SS\_SAS6, SS\_SAS7, SS\_SFDS11, SS\_SFDS6, SS\_SIS1, SS\_SIS2, SS\_SIS3, SS\_SLS1, SS\_SLS2 and SS\_SLS9) in this structure were preserved because the loadings in the corresponding structures far exceeded the cross-loadings in other structures and the HTMT value of the structure was below 0.85.

The student perceived teachers' support behavior questionnaire was created by OuYang (2005) to examine three aspects of students' perceptions of teachers' support: LS, CS and ES. She reported an overall reliability of 0.870 and an internal consistency reliability of 0.860. Two dimensions (LS and CS) were retained in the current research. The findings further demonstrated the scale's solid internal consistency reliability, convergent validity and discriminant validity. The internal consistency reliability of the scale was determined by the reported values of CA and CR for construct SPTS which were 0.921 and 0.930, respectively. The square root of the AVE on the associated construct was 0.735 which was more significant than that on the other constructs. The AVE value for SPTS was 0.540. From the perspective of loadings for the items and HTMT ratio (0.634), 12 items of the scale were preserved, namely SPTS\_CS1, SPTS\_CS2, SPTS\_CS3, SPTS\_CS4, SPTS\_CS5, SPTS\_LS1, SPTS\_LS2, SPTS\_LS3, SPTS\_LS4, SPTS\_LS6 and SPTS\_LS9. It was significant to observe that the student perceived teachers' support scale which was used in the actual research, only had two dimensions: learning support and capacity support. The emotional support sub-dimension was removed from the instrument since it did not match the requirements.

The undergraduate learning burnout scale underwent an internal consistency test by Lian et al. (2005). The outcome revealed a total alpha coefficient of 0.865. Cronbach's alpha for construct SAB was 0.898 in this study whereas the reported values for composite reliability and AVE were 0.907 and 0.527 respectively. As a result, it can be said that SABS has demonstrated high internal consistency, reliability and convergent validity. Ten items (SAB\_EE1, SAB\_EE3, SAB\_IB4, SAB\_IB7, SAB\_LSA1, SAB\_LSA2, SAB\_LSA3, SAB\_LSA4, SAB\_LSA5 and SAB\_LSA7) were retained after the discriminant validity for SABS was confirmed by the Fornell-Larcker criterion, cross-loading and HTMT ratio.

## 6. LIMITATIONS AND SUGGESTIONS

The purpose of this research is to determine the device's accuracy and dependability. Certain limitations still persist even with the researchers' best attempts to optimize the study's accuracy and dependability.

Indicators pertaining to the four variables—students' self-efficacy beliefs, stress, perceived teacher support and academic burnout were included study's actual investigation. Nonetheless, the participants' demographic data was excluded. Actually, college students' levels of self-efficacy beliefs, stress, perceived teachers' support and academic burnout might change regarding gender, grade, categories of colleges and universities and so forth (Abdullah et al., 2022; Mantooth, Usher, & Love, 2020; Omari, Moubtassime, & Ridouani, 2020; Satpathy et al., 2021; Wang, Guan, Li, Xing, & Rui, 2019). Therefore, multi-group analysis can be conducted to test whether the models are invariant by gender, age, etc.

Another potential constraint could be the presence of data bias. The only source of data for this study was participant self-reports. Although the researchers used different methods to ensure the reliability of the collected data, data bias was still inevitable. It is important to broaden the methods of data collecting and enhance the types of data that are collected in order to better accomplish the goal of the study. Interviews, observations, tests and even using secondary data in educational research (Cohen, Manion, & Morrison, 2018) are all good methods. Participants provide more real, comprehensive and in-depth ideas and information when collecting data through interviews and observation as opposed to formal questionnaires. Therefore, using multiple methods during the data collection helps analyze the interrelationships between individual latent constructs in greater depth.

## 7. CONCLUSION

One may conclude from the discussion that the four scales (SSBS, SSS, SPTSS and SABS) employed in the study showed strong discriminant validity, convergent validity and internal consistency reliability. The scales are also valid and reliable.

The final calculation findings compensated for the limitations of the original scale in the reliability and validity validation process by offering numerical support for the new scale's validity and reliability. Hence, the scale can be used to measure the mediating effect of academic burnout in the relationship between college students' self-efficacy beliefs, stress and perceived teachers' support on academic performance. Meanwhile, the new scale can be adopted for teacher training, measuring students' related behaviors and preventing students' adverse psychological conditions. It meets the requirements for quantitative measurement of students' self-efficacy beliefs, stress, perceived teachers' support and academic burnout and contributes to higher education research.

**Funding:** This study received no specific financial support.

**Institutional Review Board Statement:** The Ethical Committee of the Shandong Institute of Commerce and Technology, China has granted approval for this study on 25 October 2022 (Ref. No. SICT/2022-RB10-06).

**Transparency:** The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.

**Competing Interests:** The authors declare that they have no competing interests.

**Authors' Contributions:** All authors contributed equally to the conception and design of the study. All authors have read and agreed to the published version of the manuscript.

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**Appendix 1.** Part content of the Likert scales.

Code	Statement
Students' self-efficacy beliefs scale	
SSB_LAE1	I believe in my ability to get good grades in my studies.
SSB_LBE8	When I review for the exam, I can integrate the knowledge I have learned to review.
Student stress scale	
SS_SAS2	Failed to enter the ideal universities
SS_SLS9	Be criticized
SS_SIS3	No bosom friend
SS_SFDS11	Too difficult to find employments
Student perceived teachers' support scale	
SPTS_LS9	When I answer the question, the teacher will smile at me.
SPTS_CS2	My teacher often recommends me to take part in various activities or competitions.
Student academic burnout scale	
SAB_EE1	I find the knowledge I have learned useless.
SAB_IB7	I often doze off when I study.
SAB_LSA7	I am qualified for this stage course.

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