

International Journal of Learning, Teaching and Educational Research
Vol. 21, No. 7, pp. 269-285, July 2022
<https://doi.org/10.26803/ijlter.21.7.14>
Received May 15, 2022; Revised Jul 23, 2022; Accepted Jul 26, 2022

Chinese College Students' Perceived Teacher Autonomy Support and Engagement: A Moderated Mediation Model

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Abstract. The purpose of this study was to examine the correlation between perceived teacher autonomy support (PAS) and student engagement (SE), as well as the mediating role of learning motivation (LM) and the moderating role of the class climate (CC) among 1517 college students in Chinese universities. Survey questionnaires were used in gathering data, and the findings revealed that: (1) PAS had a significant positive impact on SE ($B=0.966$, $p<0.001$); (2) LM partially mediated the association between PAS and SE ($B=0.084$, $p<0.001$); (3) CC moderated the relation between PAS and LM ($B=1.895$, $p<0.001$); more specifically, favorable CC strengthened the effect of PAS on LM among college students. From the findings, this study contributes to a better comprehension of the influence of PAS on SE among Chinese college students. It is suggested higher education institutions and teachers should pay attention to college students' PAS, LM, and CC to improve college students' engagement.

Keywords: perceived teacher autonomy support; learning motivation; student engagement; class climate; college student

1. Introduction

Student engagement (SE) refers to the degree of students' efforts and the quality of learning activities (Kuh, 2009). Kuh (2009) stated that SE is a critical determinant of students' personal development and college impact and pointed out that the national survey of student engagement (NSSE) is the standard to evaluate the quality of university teaching in the United States. Coates (2009) advocated the Australasian survey of student engagement (AUSSE), noting that the main purpose of AUSSE is to clarify the service content of higher education

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institutions and promote its continuous improvement. However, past study has shown that college students' engagement in learning has a positive effect on learning outcomes, meaning that more engagement in learning corresponds to better learning gains and school satisfaction, as well as lower negative affect and undesirable behaviors (Gutiérrez & Tomás, 2019; Yin, 2018). Moreover, Fredricks et al. (2004) noted that SE was a critical factor in students' learning process and their academic success and a highly desirable variable to study. Students' high ability and good grades often require inherently conscientious construction of knowledge and engagement in learning, which can only produce ideal academic results and outcomes when students are engaged in learning (Einolander et al., 2021; Yin, 2018). In addition, Fredricks et al. (2019) found that PAS, teacher-student relationship, and peer relationship have a positive impact on urban adolescent students' engagement. Ryan and Deci (2020) reviewed the results of research covering many countries and, through the outline of self-determination theory (SDT), they stated that PAS could help promote students' self-determination motivation, thereby enhancing their engagement. So, there is evident that SE not only is one of the critical indicators of educational quality, but also predicts learning outcomes and reflects the learning process of students; therefore, SE has often received attention from researchers in various countries (Fredricks et al., 2019; Gutiérrez & Tomás, 2019; Reeve & Cheon, 2021).

Many factors influence SE in colleges, and students' PAS in class is crucial (Ryan & Deci, 2020; Zhao et al., 2021). Students' satisfaction with autonomy support increases engagement in learning, intrinsic motivation, skill development, academic achievement, vitality, and well-being (Reeve & Cheon, 2021). In recent years, PAS has drawn scholars' attention (Black & Deci, 2000; Maldonado et al., 2019; Reeve & Cheon, 2021) with past study having found that PAS significantly impacts SE (Fredricks et al., 2019; Jang et al., 2010; Li, 2020; Wang et al., 2017). Gutiérrez and Tomás (2019) suggested that college students' PAS had a significant direct influence on SE, which predicted school satisfaction and academic achievement. Therefore, the current study inferred that college students' PAS might positively affect SE.

Past researchers have often adopted the SDT when exploring the influences on SE (Einolander, 2021; Jang et al., 2010; Reeve & Tseng, 2011). SDT explains that satisfaction with basic psychological needs motivates individuals to gain intrinsic motivation and produce better subsequent behaviors (Ryan & Deci, 2020). According to the SDT, it is known that PAS in class leads to students' psychological changes, which, in turn, affects students' engagement in learning (Burkley & Burkley, 2018). Also, some studies have shown that secondary school students' PAS significantly affects LM and SE (Jang et al., 2009; Maldonado et al., 2019; Ryan & Patrick, 2001). In addition, Ryan and Deci (2020) indicated that the high LM of students could promote their engagement and academic performance. Many studies have reported that LM significantly impacts SE (Black & Deci, 2000; Fredricks et al., 2017; Wang & Eccles, 2013). Also, some researchers have found a mediating role of LM between PAS and SE (Benita et al., 2021; Yoo, 2015; Zhu & Burrow, 2022). Thus, the current study suggests that college students might have higher learning motivation when they perceive

more teacher autonomy support, which would increase their engagement. Thus, LM may be an important mediating variable between college students' PAS and SE.

Previous study has noted significant differences in climate between classes (Vallerand et al., 1997; Wang, Degol, et al., 2020). Some empirical studies also have found that adolescents in a high-scored CC showed higher LM and SE than did students in a low-scored CC (Patrick et al., 2011; Ryan & Patrick, 2001; Wang, Degol, et al., 2020). Wang, Lee, et al. (2020) discovered that college students had higher motivation levels in a good CC, but lower motivation levels in a poor CC. In summary, differences in CC may lead to differences in LM and behaviors. Hence, present study suggests that CC might have a moderating role in the mediating model of college students' PAS affecting SE through LM.

Based on the previous discussion, this study aimed to investigate the influence of PAS on SE in colleges, the mediating role of LM between PAS and SE, and the moderating role of CC in the influence of PAS on LM. Knowing these, would broaden our knowledge of the crucial influencing factors and mechanisms on college students' engagement, and provide new insights on theoretical contributions. The research findings can provide useful suggestions to improve college students' engagement, which is conducive to the development of students' learning, and can also provide valuable information for future research on SE.

2. Literature Review

2.1 Perceived Teacher Autonomy Support and Student Engagement

This study used the concept of PAS to measure teachers' exhibited class behaviors that college students can perceive, such as providing choices to students, fostering understanding and interest in students, allowing criticism and independent thinking from students (Assor et al., 2002). SE refers to the quality of students' own investment and effort in the academic environment and learning activities (Fredricks et al., 2004). It is conceptualized as behavioral engagement, cognitive engagement, and emotional engagement (Fredricks et al., 2004), and agentic engagement (Reeve & Tseng, 2011; Wang et al., 2016).

Ryan and Deci (2020) pointed out that PAS significantly impacted SE and learning processes. When students perceive autonomous support from teachers, they show more enjoyment in learning and put more effort and engagement into learning (Fredricks et al., 2017; Jang et al., 2010). Previous studies have found that PAS has a wide range of positive effects on SE (Gutiérrez, & Tomá, 2019; Li et al., 2020; Reeve & Cheon, 2021). In addition, some studies have further shown that PAS has a significant positive effect on SE among college students (Einolander, 2021; Zhao & Qin, 2021). In conclusion, college students' higher level of PAS may result in higher SE. Therefore, this study proposes hypothesis 1: College students' PAS positively and significantly affects SE.

2.2 The Mediating Role of Learning Motivation

SDT applies the concept of motivation continuum to reflect the quality of motivation and ranks intrinsic motivation, extrinsic motivation and amotivation in turn (Ryan & Deci, 2000a). LM in this study refers to the self-determined motivation that college students spontaneously generate toward learning activities in the classroom, which represents several variations of intrinsic motivation to amotivation (Bureau et al., 2022; Deci & Ryan, 2000).

SDT suggests that PAS is often associated with intrinsic motivation (Ryan & Deci, 2020). Thus, PAS in the classroom stimulates students' greater intrinsic motivation, curiosity, and desire to be challenged (Ryan & Deci, 2000a, 2000b). Black and Deci (2000) indicated that PAS was associated with high LM among college students. Many studies have shown that PAS significantly affects LM (Domen et al., 2019; Fredricks et al., 2019; Maldonado et al., 2019; Ryan & Patrick, 2001; Stolk et al., 2018). In addition, some researchers noted that LM enhanced SE (Guay et al., 2016; Ryan & Deci, 2020; Wang & Eccles, 2013). Past empirical studies have also found that highly motivated students had a better engagement, which led to better GPAs (Guo, 2018; Yin, 2018; Yoo, 2015).

Past study has often considered LM as a mediating variable. For example, Vallerand et al. (1997) showed that LM mediated the relation between PAS and behavioral intention in high school students. Maldonado et al. (2019) found that LM mediated the association between high school students' PAS and concentration. Jenő et al. (2021) showed that LM mediated the correlation between PAS and vitality in college students. In addition, Yoo (2015) claimed that LM had a mediating role between PAS on SE in secondary school students. Based on the discussion above, Deci and Ryan (2000) stated that all extrinsic facilitative conditions could only lead to action if internalized in the student's mind to form the motivation to learn. This study considers college students' PAS as an external facilitation condition and postulated it might influence SE through LM. Therefore, hypothesis 2 is proposed: LM mediates the association between PAS and SE among college students.

2.3 The Moderating Role of Class Climate

Class members share approximating ages, activities, interests, time, and friendships and frequently interact (Reeve & Cheon, 2021). Thus, CC reflects the collaborative environment and atmosphere shared by class members, which impacts students' perception of autonomy, competence, and LM (Vallerand et al., 1997; Wang & Eccles, 2013), and then affects the growth and development of students (Reeve & Cheon, 2021). As Wang, Degol, et al. (2020) suggested, a favorable CC produces better educational and psychosocial outcomes because, in a better CC, class organization and instructional practices are more effective, with interaction and support among students being more shared, and interpersonal relationships more harmonious, which allows students to experience more enjoyment and achieve growth in competence and promotes intrinsic motivation. Previous study has found that the better the CC, the better the student satisfaction, motivation, and academic performance (Reyes et al., 2012; Mucherah, 2014; Wang & Eccles, 2013). Wang, Lee, et al. (2020) claimed that students in the better CC showed higher LM levels, while students

exhibited lower motivation levels in the worse CC. In summary, this study speculates that the association between PAS and LM is stronger among college students in better CC than in worse CC. Therefore, hypothesis 3 is proposed: CC moderates the effect of PAS on LM.

In summary, Figure 1 presents the hypothetical model for this study.

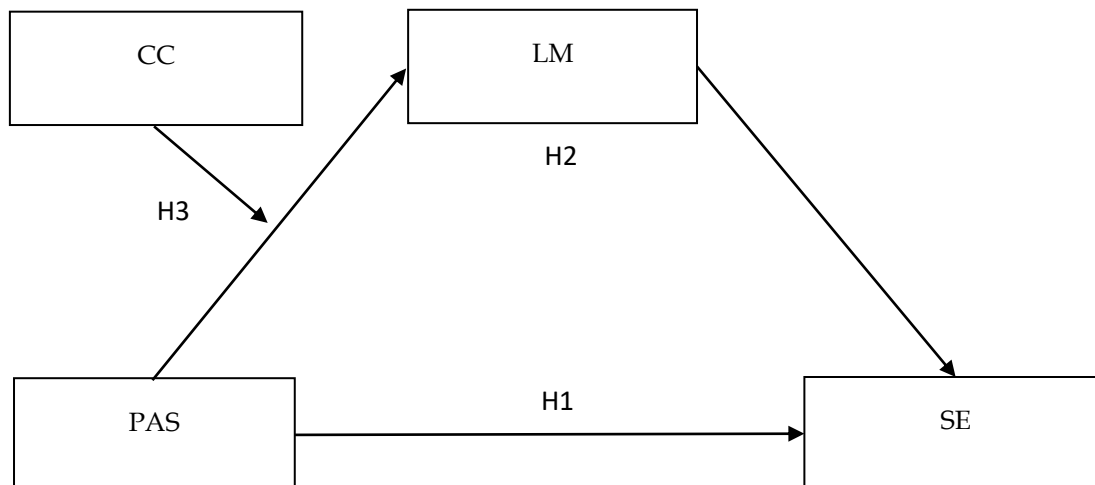


Figure 1. Hypothetical model

3. Method

3.1 Research Design

This study adopts quantitative methods, and the data are collected using a self-reported questionnaire scored by the Likert scale. The convenience sampling method was employed to recruit students from six universities in Shaanxi Province of China. Convenience sampling is a commonly used method in quantitative research, which is the method of subjectively selecting samples when researchers have greater access to participants (Etikan et al., 2016). Etikan et al. (2016) also stated that the convenience sampling method is very effective when researchers have limited resources, time, and labor because it is easy to collect samples and has the advantages of low survey cost, as well as the statistical power of convenient samples will also increase with the increase of sample size. The questionnaire of this study was distributed twice; one was the pilot test, and the other the questionnaire test. Among them, the purpose of the pilot test is to verify the scales' reliability and validity, and delete inappropriate items; the purpose of the questionnaire test is to explore the relationship between variables. The descriptive analysis describes the participants' engagement and their level of PAS, LM, and CC. In addition, the PROCESS macro of SPSS tests the mediating effect of LM and the moderating effect of CC.

3.2 Research Locale

This study conducted a sampling survey among students in six universities in Shaanxi Province of China. In 2019, Shaanxi Province, located in northwest China, ranked 10th in the full scale of higher education among 32 provinces in China, and the number of students in higher education ranked third in China

(CNR, 2021). Among them, University A, located in Xi'an city, the capital of Shaanxi Province, is the oldest key university in Northwest China. University B, located in Xi'an city, is a top national key university focusing on engineering. University C, located in Xi'an city, is an ordinary local university with application-oriented characteristics. University D, located in the small cities around Xi'an, is an ordinary multidisciplinary university focusing on teacher education. University E, located in another small city around Xi'an, is an engineering application-oriented university. University F, located in another city around Xi'an, is an ordinary university characterized by teacher education. In short, key universities are different from ordinary universities in terms of policy support, capital investment, infrastructure, teachers, and student qualifications. The six universities selected in this study covered different administrative regions and different university categories in Shaanxi Province of China, so they are highly representative.

3.3 Participants

In the pilot test, 458 questionnaires were distributed to three universities (W, L, Q) in Shaanxi Province, and 367 valid questionnaires were returned, with an effective rate of 80.13%. In the questionnaire test, we excluded college students who had previously participated in the pilot test. The questionnaire was administered to college students in six universities in Shaanxi Province. A total of 1856 questionnaires was distributed, 339 invalid questionnaires were excluded (such as response periods shorter than two minutes or longer than 25 minutes or missing data), and 1517 valid questionnaires were returned, with a return rate of 81.73%. The results show that, in terms of gender, 342 males accounted for 22.5% of the sample, and 1175 females accounted for 77.5%. As for their grades, 691 (45.6%) were first-year students, 431 (28.4%) were sophomores, 307 (20.2%) were juniors, and 73 (4.8%) were seniors.

3.4 Measures

3.4.1 Students' Engagement During Learning Activities Scale

This study used the Students' Engagement During Learning Activities Scale developed by Reeve and Tseng (2011) to measure SE, which contained four dimensions: Behavioral engagement, agentic engagement, cognitive engagement, and emotional engagement. It was a 7-point Likert scale with 22 items. Higher scores indicated better SE in learning. After the item analysis and EFA of pilot test samples, all scale items could be retained (see Appendix 1), which meets the criterion of factor loading of 0.40 (Hatcher, 1994; Schönrock-Adema et al., 2009). The scale's Cronbach's α in this study was 0.967, and the CFA results showed factor loadings were from 0.748 to 0.926, all greater than the criterion of 0.5 (Hair et al., 1998). In summary, the scale had acceptable reliability and validity in the current study. The table 1 shows the model fit indices, which means an acceptable fit of the scale model (McDonald & Ho, 2002).

3.4.2 Autonomy Enhancement Scales

This study employed the Autonomy Enhancement Scales developed by Assor et al. (2002) to measure college students' PAS, containing 18 questions on three dimensions: providing choices to students, fostering understanding and interest in students, allowing criticism and independent thinking. It was a 5-point Likert

scale, and higher scores indicate a higher level of PAS. After the item analysis and EFA of pilot test samples, two cross dimensional items were deleted, and the remaining 16 items (see Appendix 2) were distributed (Hatcher, 1994; Schönrock-Adema et al., 2009). The Cronbach's α for the scale in this study was 0.959, and the results of the CFA showed that the factor loadings were from 0.710 to 0.895, which were greater than 0.5 and indicated acceptable reliability and validity in this study (Hair et al., 1998). The table 1 shows the model fit indices, which indicate an acceptable fit of the scale model (McDonald & Ho, 2002).

3.4.3 Academic Motivation Scale

This study adopted the Academic Motivation Scale developed by Vallerand et al. (1992) to measure LM. It consisted of 28 questions on seven dimensions: intrinsic motivation-to know and learn, intrinsic motivation-toward achievement and accomplishment, intrinsic motivation-to experience stimulation, extrinsic motivation-identified, extrinsic motivation-introjected regulation, extrinsic motivation-external regulation, and amotivation. The items were scored on a 7-point Likert scale. Higher scores meant higher LM levels, but the amotivation dimension was different, with high scores indicating low LM. In addition, Self Determination Index (SDI) was used to integrate the above motivational factors into a single score (Ryan & Deci, 2020; Stolk, 2018), which is calculated as follows (Stolk, 2018; Vallerand et al., 1997): $2 \times (\text{intrinsic motivation-to know and learn} + \text{intrinsic motivation-toward achievement and accomplishment} + \text{intrinsic motivation-to experience stimulation}) / 3 + 1 \times \text{extrinsic motivation-identified} - 1 \times (\text{extrinsic motivation-introjected regulation} + \text{extrinsic motivation-external regulation}) / 2 - 2 \times \text{amotivation}$. The SDI is used to reflect the degree of individuals' self-determined motivation. In particular, a higher SDI score indicates a more elevated level of self-determined motivation, and a lower SDI score reflects a lower self-determined motivation (Black & Deci, 2000; Vallerand et al., 1997). A higher SDI also predicts better educational outcomes (Ryan & Deci, 2020). Seven items were deleted due to cross-dimension and factor loading less than 0.40. The remaining 21 items (see Appendix 3) were distributed after the item analysis and EFA of pilot test samples (Hatcher, 1994; Schönrock-Adema et al., 2009). The Cronbach's α for the scale in this study was 0.948. The results of the CFA showed that the factor loadings ranged from 0.653 to 0.959, which were all greater than 0.5 (Hair et al., 1998). The table 1 shows the model fit indices, which means an acceptable fit of the scale model (McDonald & Ho, 2002).

3.4.4 College and University Classroom Environment Inventory

This study used the College and University Classroom Environment Inventory adapted by Nair and Fisher (1999), which contained seven dimensions: personalization, cooperation, student cohesiveness, equity, task orientation, innovation, and individualization. It was a 5-point Likert scale with 49 questions—the higher scores meant the more favorable CC. Item analysis and EFA test on pilot test samples eliminated 13 items due to cross-dimension and factor loading less than 0.40 (Hatcher, 1994; Schönrock-Adema et al., 2009). Thirty-six items remained (see Appendix 4) for the scale with its Cronbach's α of 0.979. The results of the EFA showed that the factor loadings were from 0.700 to

0.946, greater than 0.5, indicating acceptable reliability and validity in this study (Hair et al., 1998). The table 1 shows the model fit indices, which indicate an acceptable fit of the scale model (McDonald & Ho, 2002).

Table 1. Model fit index of the scales

Standard	X ² /df <5	SRMR <.08	RMSEA <.1	CFI >.9	GFI >.8	NFI >.9	TLI >.9	PNFI >.5
SE	11.730	0.052	0.084	0.937	0.865	0.932	0.928	0.819
PAS	14.443	0.047	0.094	0.934	0.872	0.929	0.921	0.782
LM	7.177	0.035	0.064	0.971	0.927	0.967	0.964	0.773
CC	6.456	0.044	0.060	0.954	0.873	0.946	0.949	0.860

Note: CFI: comparative fit index; TLI: Tucker-Lewis index; GFI: goodness of fit index; NFI: normed fit index; PNFI: parsimonious normed fit index; SRMR: Standardized root mean residual; RMSEA: root mean square error of approximation.

3.5 Data Gathering Procedures

We follows the Declaration of Helsinki (Goodyear et al., 2007), and collect the data in two rounds: a pilot test and a questionnaire test. Specifically, the head teacher of classes distributed the questionnaires. After informing the survey's purpose and obtaining their consent, the respondents answered the online questionnaire by visiting the questionnaire link address. When the respondents completed filling in and clicked the submit button, we obtained the data. Simultaneously, the researchers also told the respondents that they can withdraw from the questionnaire at any time.

3.6 Data Analysis

After using the online questionnaire platform to collect the questionnaire data, SPSS and AMOS software were used to sort out and analyze the sample data. The pilot test data were analyzed using SPSS 25 for item analysis, reliability and validity, and, after the substandard items were deleted, the questionnaire was formed. On the questionnaire data, descriptive statistics, Pearson's correlation analysis, and scale reliability tests were performed with SPSS 25, and confirmatory factor analysis (CFA) and common method variance (CMV) tests were conducted with AMOS 25. Moreover, the mediating effects were tested with Model 4 in the PROCESS macro of SPSS; then, the moderated mediating effects were tested with Model 7. Finally, the study used the bias-corrected nonparametric percentile Bootstrap method to examine the confidence interval (CI) and confirm whether the mediating and moderating effects were significant (Hayes, 2013).

3.7 Common Method Variance (CMV) Test

To test the CMV problem, a CFA test for the multi-factor model was performed and compared with the CFA test for the single-factor model (Podsakoff & Organ, 1986) in this study. It was revealed that the multi-factor model in the present study had a good fit with the data ($X^2=15391.314$, $GFI=0.803$, $RMSEA=0.042$), but the single-factor model had exceptionally poor fit with the data ($X^2=90276.283$, $GFI=0.225$, $RMSEA=0.114$). The comparison showed that the multi-factor model significantly outperformed the single-factor model ($\Delta X^2= 74884.969$, $\Delta df=209$,

$p < 0.001$), which meant that the two models were significantly different, thus showing no serious CMV problem in this study.

4. Result

4.1 Descriptive Statistics and Correlations Analysis

Descriptive statistics for the four variables of PAS, SE, LM, and CC are present in table 2. The correlation analysis shows that PAS and SE are significantly and positively correlated ($r = 0.608$, $p < 0.001$); PAS and LM are significantly and positively correlated ($r = 0.502$, $p < 0.001$); PAS and CC are significantly and positively correlated ($r = 0.737$, $p < 0.001$); LM and SE are significantly and positively correlated ($r = 0.374$, $p < 0.001$); CC and SE are significantly and positively ($r = 0.562$, $p < 0.001$); and CC and LM are significantly positively correlated ($r = 0.526$, $p < 0.001$). The correlation coefficients between any two of the four variables are less than 0.8, indicating a moderate correlation between variables and no serious collinearity problems (Benesty et al., 2009).

Table 2. Descriptive statistics and correlations analysis

VARIABLE	M	SD	PAS	SE	LM	CC
PAS	3.862	0.616	1			
SE	5.093	0.970	0.608***	1		
LM	4.939	4.531	0.502***	0.374***	1	
CC	3.896	0.561	0.737***	0.562***	0.526***	1

Note: $n = 1517$; *** $p < 0.001$

4.2 The Mediating Role of Learning Motivation

The mediating effect of LM was examined using Model 4 in the PROCESS (Hayes, 2013). As observed in Table 3, PAS in Model 1 significantly and positively predicts SE ($B = 0.966$, $p < 0.001$); PAS in Model 2 also significantly and positively predicts LM ($B = 3.596$, $p < 0.001$). After adding LM as a mediating variable in Model 3, PAS still significantly and positively predicts SE ($B = 0.881$, $p < 0.001$), but the predictive power decreases compared to that in Model 1; LM can also significantly and positively predicts SE ($B = 0.023$, $p < 0.001$), indicating that LM has a partial mediating effect in the relation between PAS and SE in college students. The mediating effect of LM was further examined using the bias-corrected nonparametric percentile Bootstrap method. The indirect effect value was 0.084, with a 95% CI of 0.044-0.124, excluding 0. The direct effect value was 0.881, with a 95% CI of 0.809-0.953, not containing 0. The total effect value was 0.966, with a 95% CI of 0.903-1.029, excluding 0. The mediating effect accounted for 8.70% of the total effect, validating the significant partial mediating role of LM in the correlation between college students' PAS and SE.

Table 3. Testing the Learning Motivation mediation model

VARIABLE	MODEL 1 SE B (T)	MODEL 2 LM B (T)	MODEL 3 SE B (T)
PAS	0.966 (30.112***)	3.596 (21.706***)	0.881 (23.994***)
LM			0.023 (4.615***)
<i>R</i> ²	0.411	0.282	0.420
<i>F</i>	90.600***	50.904***	86.007***

Note: B are unstandardized coefficients; *** $p < 0.001$

4.3 The Moderating Role of Class Climate

To verify whether CC moderated the relationship between college students' PAS and LM, this study ranked all CC scores and divided them into the high-scored group (top 27% of the rank) and the low-scored group (bottom 27% of the rank) to test the moderated mediation model with Model 7 in PROCESS (Hayes, 2013). Table 4 shows the results. It can be observed in Model 1 that PAS significantly and positively predicts LM ($B=2.723$, $p < 0.001$), and CC significantly and positively predicts LM ($B=2.655$, $p < 0.001$); the interaction of PAS and CC also significantly and positively predicts LM ($B=1.895$, $p < 0.001$). While in Model 2, it is clear to notice that SE can be predicted significantly and positively by both PAS ($B=0.887$, $p < 0.001$) and LM ($B=0.034$, $p < 0.001$), suggesting that CC moderates the relationship of PAS and LM.

Table 4. Testing the Moderated Mediation Model

VARIABLE	MODEL 1 LM B (T)	MODEL 2 SE B (T)
PAS	2.723 (11.437***)	0.887 (18.512***)
LM		0.034 (4.427***)
CC	2.655 (7.201***)	
PAS \times CC	1.895 (3.991***)	
<i>R</i> ²	0.473	0.525
<i>F</i>	51.445***	68.651***

Note: B are unstandardized coefficients; *** $p < 0.001$

This study also used the bias-corrected nonparametric percentile Bootstrap method to verify further. The index of moderated mediation was 0.065 (LLCI=0.021, ULCI = 0.120), with CI not containing 0, indicating that a significant moderating mediation model holds (Hayes, 2013). That is, the indirect effect of LM among college students in the high-scored CC was stronger ($B=0.126$, LLCI=0.061, ULCI=0.192) than that in the low-scored CC ($B=0.061$, LLCI=0.026, ULCI=0.105).

Furthermore, this study conducted a simple slope analysis. Figure 2 presents the results that the effect of PAS on LM is stronger in the high-scored CC (Simple slope=3.669, $t=10.760$, $p < 0.001$) than that in the low-scored CC (Simple

slope=1.774, $t=5.355$, $p<0.001$). It meant that the high-scored CC enhanced the impact of PAS on LM more than the low-scored CC.

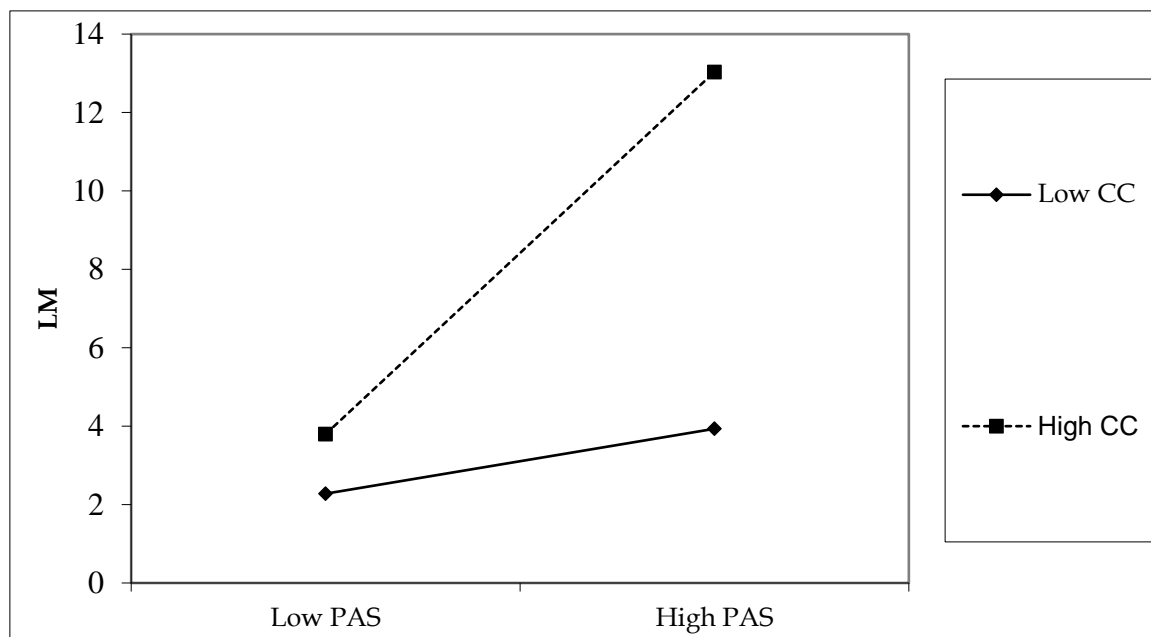


Figure 2. *The moderating effect of class climate*

5. Discussion

5.1 Relationship Between Perceived Teacher Autonomy Support and Student Engagement

The study results supported hypothesis 1 that college students' PAS positively and significantly affected SE, which is consistent with previous studies (Gutiérrez, & Tomás, 2019; Li, 2020; Jang et al., 2010; Wang et al., 2017). The findings indicate that college students' PAS can promote SE and support the SDT, which states that satisfying basic psychological needs positively influences individual behavior (Fredricks et al., 2019; Reeve & Cheon, 2021; Ryan & Deci, 2020). The results suggest that, when college students perceive autonomous support from teachers and feel valued, they behave more happily and show more effort and engagement in learning (Einolander, 2021; Zhao & Qin, 2021).

5.2 The Mediating Role of Learning Motivation

The results of the study verified hypothesis 2 that LM partially mediates the association between PAS and SE among college students, consistent with previous findings that college students' PAS directly predicts LM (Bureau et al., 2022; Domen et al., 2019; Fredricks et al., 2019; Maldonado, 2019; Stolk et al., 2018). Furthermore, the findings also revealed that LM could directly predict SE, consistent with previous findings (Fredricks et al., 2017; Guo, 2018; Yin, 2018). It indicates that the more college students perceive teacher autonomous support during learning, the more motivated they tend to be toward self-determination, which promotes SE. It supports the SDT that high autonomous motivation, which drives learning behavior, occurs when college students' psychological need for autonomy is met (Deci & Ryan, 2000; Ryan & Deci, 2000b). This may be because the teaching activities, such as providing choices for students in

learning, generate a willingness to learn, which encourages students to agree on what they are doing entirely and pulls them into the learning (Guay et al., 2016). This current study further broadens the results of the above research. It deepens the comprehension of the internal mechanism of the effect of PAS on SE among college student. The results reveal that college students' PAS not only has a direct impact on SE, but also can influence SE through LM.

5.3 The Moderating Role of Class Climate

The findings verified hypothesis 3 that CC positively moderates the effect of PAS on LM. In other words, the impact of PAS on LM among college students was stronger in the high-scored CC than in the low-scored CC. The results are consistent with previous findings (Patrick et al., 2011; Reeve & Cheon, 2021; Vallerand et al., 1997). This is because college students in the high-scored CC are more advantaged in the learning experiences, which motivates them toward good cohesion and interpersonal support, so their intrinsic motivation is enhanced. In other words, the proportion of intrinsic motivation components is higher than that of extrinsic motivation components and amotivation components, which means that college students with high-scored CC are more inclined toward self-determination (Jafari & Asgari, 2020; Mucherah et al., 2014; Ryan & Patrick, 2001). By comparison, college students in the low-scored CC receive less teacher and peer support, and undergo poorer learning experiences. So, these disadvantages undermine their intrinsic motivation; that is, they are more inclined to non-self-determination (Allodi, 2010; Cayubit, 2021; Wang, Lee, et al., 2020). Overall, the findings of this study provide empirical support that CC boosts the effect of college students' PAS on LM.

6. Conclusion and Suggestions

Overall, this study explored the effects of college students' PAS on SE, the mediating role of LM, and the moderating role of CC. It was verified that college students' PAS not only directly influenced SE, but also indirectly impacted SE through the mediating variable of LM. And finally, it was validated that CC moderated the relation between PAS and LM. Specifically, the impact of PAS on LM was stronger among college students in the high-scored CC than those in the low-scored CC. These findings support the SDT and enrich our comprehension of the combined effects of PAS, LM, and CC on SE among college students.

Based on the findings, the following practical suggestions are proposed. First, higher education institutions should offer training programs for teachers about autonomy support. For example, relevant training should be applied to strengthen college teachers' understanding of PAS and to improve the teaching methods of PAS, so that teachers can provide more autonomous support to college students in the classroom. Second, college teachers should strive to improve the classroom teaching method, especially the use of autonomous support to college student. For example, providing students with choices, increase the in-depth interpretation of the knowledge to be learned and the connection between theory and the real world, allowing students to criticize and encouraging students to think independently so as to improve college students' LM and engagement.

7. Limitations

There are three main limitations of this study. First, this study was limited by sampling conditions, and questionnaires were only administered to college students in six higher education institutions in Shaanxi Province of China. Geographical expansion of the sample can be considered for subsequent studies. Second, interview studies can be included in future studies to elucidate better the potential influence mechanism of college students' PAS on SE. Third, this study was based on a discussion of the relationship between college students' PAS, LM, CC, and SE. It is suggested that task value should be used as mediating variables in future research (Zumbrunn et al., 2014), and mindfulness could also be used as a moderating variable (Zhang & Yue, 2021), to obtain more empirical research evidence.

Acknowledgment

This study has been funded by the 2020 annual project of the 13th Five-Year Plan of Educational Science in Shaanxi Province, "Influence of College Students' Perceived Teacher Autonomy Support on Engagement" (No. SGH20Y1269).

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Appendix 1

Students' Engagement During Learning Activities Scale

Dimension	Item Number	Item
Behavioral engagement	BE1	I listen carefully in class.
	BE2	I pay attention in class.
	BE3	The first time my teacher talks about a new topic, I listen very carefully.
	BE4	I try very hard in school.
	BE5	I work hard when we start something new in class.
Agentic engagement	AE1	During class, I express my preferences and opinions.
	AE2	During class, I ask questions.
	AE3	I tell the teacher what I like and what I don't like.
	AE4	I let my teacher know what I am interested in.
	AE5	I offer suggestions about how to make the class better.
Cognitive engagement	CE1	When doing schoolwork, I try to relate what I'm learning to what I already know.
	CE2	When I study, I try to connect what I am learning with my own experiences.
	CE3	I try to make all the different ideas fit together and make sense when I study.
	CE4	I make up my own examples to help me understand the important concepts I study.
	CE5	When what I am working on is difficult to understand, I change the way I learn the material.
	CE6	When I'm working on my schoolwork, I stop once in a while and go over what I have been doing.
	CE7	As I study, I keep track of how much I understand not just if I am getting the right answers.
	CE8	Before I begin to study, I think about what I want to get done.
Emotional engagement	EE1	When I am in class, I feel curious about what we are learning.
	EE2	When we work on something in class, I feel interested.
	EE3	I enjoy learning new things in class.
	EE4	Class is fun.

Note: Revised from Reeve and Tseng (2011)

Appendix 2

Autonomy Enhancement Scales (AES)

Dimension	Item Number	Item
Providing choice	PC1	When I am doing something that interests me - the teacher gives me enough time to finish it.
	PC2	The teacher allows me to choose how to do my work in the classroom.
	PC3	The teacher asks us which topics we would like to study more and which we prefer.
	PC4	The teacher asks us if there are things we would like to change in the way we study.
	PC5	The teacher allows me to choose to study topics that interest me.
	PC6	When the teacher gives us an assignment she allows us to choose which questions to answer.
	PC7	The teacher encourages me to work in my own way.
Fostering understanding and interest	FU1	The teacher talks about the connection between what we study in school and what happens in real life.
	FU2	The teacher explains why it is important to study certain subjects in school.
	FU3	The teacher talks to us about how we feel about the subjects we study.
Allowing criticism and encouraging independent thinking	AC1	The teacher listens to my opinions and ideas.
	AC2	The teacher tells us that it is important that we express our disagreement if we do not agree with her.
	AC3	The teacher is willing to listen to students' complaints about her.
	AC4	The teacher respects students who tell her what they really think and are not ingratiating.
	AC5	The teacher allows me to decide things myself.
	AC6	The teacher shows me how to solve my problems myself.

Note: Revised from Assor et al. (2002)

Appendix 3

Academic Motivation Scale (AMS)

Dimension	Item Number	Item
Intrinsic motivation - to know and learn	IK1	For the pleasure I experience when I discover new things I have never seen before.
	IK2	For the pleasure I experience in broadening my knowledge about subjects that appeal to me.
	IK3	Because my studies allow me to continue to learn about many things that interest me.
Intrinsic motivation - towards achievement and accomplishment	IA1	For the pleasure I experience when I surpass myself in one of my personal achievements.
	IA2	For the satisfaction I feel when I am in the process of accomplishing difficult academic activities.
	IA3	Because college allows me to experience personal satisfaction in my quest for excellence in my studies.
Intrinsic motivation - to experience stimulation and engagement	IS1	For the pleasure I experience when I read books by interesting authors.
	IS2	For the pleasure I experience when I feel completely absorbed by what certain authors have written.
Extrinsic motivation - identified	EI1	Because I think a college education will help to better prepare me for the career I have chosen.
	EI2	Because eventually it will enable me to enter the job market in a field I like.
	EI3	Because this will help me to make a better choice in relation to my career orientation.
	EI4	Because I believe that a few additional years of education will improve my competence as a worker.
Extrinsic motivation - Introjected regulation	EJ1	To prove to myself that I am capable of completing my college degree.
	EJ2	Because I want to show myself that I can succeed in my studies.
Extrinsic motivation - external regulation	EX1	In order to obtain a more prestigious job later.
	EX2	Because I want to have "a good life" later.
	EX3	In order to have a better salary later.
Amotivation	AM1	Honestly, I don't know; I really feel I am wasting my time in school.
	AM2	I once had good reasons for going to college, but now I wonder if I should continue.
	AM3	I can't see why I go to college and frankly, I couldn't care less.
	AM4	I don't know; I can't understand what I am doing in school.

Note: Revised from Vallerand et al. (1992)

Appendix 4

College and University Classroom Environment Inventory (CUCEI)

Dimension	Item Number	Item
Personalization	PS1	The instructor considers students' feelings.
	PS2	The instructor talks individually with students.
	PS3	The instructor goes out of his/her way to help students.
	PS4	The instructor helps each student who is finding the work difficult.
	PS5	The instructor is friendly and considerate toward students.
Cooperation	CP1	I cooperate with other students when doing assignments.
	CP2	I share my books and resources with other students when doing assignments.
	CP3	When I work in a group in this class, there is teamwork.
	CP4	I work with other students on projects in this class.
	CP5	I learn from other students in this class.
	CP6	I cooperate with other students on class activities.
	CP7	Students work with me to achieve class goals.
Student cohesiveness	CH1	Each student knows the other members of the class by their first name.
	CH2	Friendships are made among students in this class.
	CH3	It not takes a long time to get to know everybody' s first name in this class.
	CH4	Students in this class get to know each other well.
	CH5	Students in this class are very interested in getting to know other students.
Equity	EQ1	The instructor gives my questions as much attention as other students' questions.
	EQ2	I get the same amount of help from the instructor as other students do.
	EQ3	I am treated the same as other students in this class.
	EQ4	I receive the same encouragement from the instructor as other students do.
	EQ5	I am given the same opportunity to answer questions as other students.
	EQ6	My work receives as much praise as other students' work.
	EQ7	I have the same amount of say as other students in this class.
Task orientation	TO1	The group is often sticking to the point instead of side-tracked.
	TO2	This is an organized class.
	TO3	Class assignments are clear so that everyone knows what to do.
Innovation	IN1	New ideas are often tried out in this class.

	IN2	New and different ways of teaching are used in this class.
	IN3	The instructor thinks of innovative activities for students to do.
	IN4	Teaching approaches in this class are characterized by innovation and variety.
	IN5	The instructor often thinks of unusual class activities.
Individualization	DV1	Students are generally allowed to work at their own pace.
	DV2	Students have a say in how class time is spent.
	DV3	Students are allowed to choose activities and how they will work.
	DV4	Teaching approaches allow students to proceed at their own pace.

Note: Revised from Nair and Fisher (1999)