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Perceived school support and online learning outcomes among Chinese college students: The serial mediating role of academic self-efficacy and online learning engagement

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The purpose of this study is to investigate the factors that influence the online learning outcomes of Chinese college students. The study was guided by Bandura's social cognitive theory. This study collected 959 valid questionnaires from college students in Hainan Province of China and used 4 scales to evaluate perceived school support, ASE online learning engagement, and online learning outcomes. The results of the study found that college students' perceived school support had a significant positive effect on online learning outcomes; ASE partially mediated the relationship between college students' perceived school support and online learning outcomes; online learning engagement partially mediated the relationship between college students' perceived school support and online learning outcomes; there was a serial mediation between college students' perceived school support and online learning outcomes with the mediators of ASE and online learning engagement. The findings suggest theoretical and practical implications. Suggestions are also made for colleges and universities on how to improve online learning outcomes for college students and ideas for future research.

Key words: Perceived school support, online learning outcomes, academic self-efficacy, online learning engagement, college students.

INTRODUCTION

Amidst globalization, the internet, and advanced technology, online education has emerged as a means to provide up-to-date educational content to a broader cross-border audience (Kim and Park, 2021). The popularity of online learning is surging in higher education settings (Mubarak et al., 2022) and experiencing rapid growth (Hsu et al., 2019; Martin et al., 2019). China's online education is expanding (Ting et al., 2018). Online learning became the new educational model (Zuo et al., 2021). However, whether the outcomes of online learning are identical to those of traditional learning remains unclear (Pye et al., 2015). The success of online learning

can be determined by the quality of students' learning outcomes (Panigrahi et al., 2018; Pinto et al., 2018), with learning outcomes referring to the specific knowledge, values or attitudes, skills, or behaviours that students are expected to exhibit after a period of learning (World Bank, 2011).

Achieving such outcomes is the ultimate goal of education (Kim and Park, 2021). Thus, online learning outcomes can be considered to be the objective of online education evaluation. A growing number of scholars are focusing on the study of online learning outcomes (Kim and Park, 2021; Wang et al., 2021; Xing and Saghaian, 2022; Yu, 2021).

Evaluation of learning outcomes is indispensable for determining the efficacy of teaching practices and student learning (Clark, 2002). Moreover, evaluating learning outcomes can enable identification of the factors affecting college students' online learning.

Factors such as education level, distance e-learning satisfaction, and students' perceptions regarding the instructor's role can affect online learning outcomes (Kim and Park, 2021; Wang et al., 2021; Yu, 2021). Kumar et al. (2023) found that perceived school support was effective in promoting online learning among college students. Other studies have identified students' perceived school support as a substantial factor affecting student achievement (Niehaus and Adelson, 2014). In addition to family support, school support serves as an essential source of social support, and upon school entry, teachers and classmates become significant others in the students' lives. School support may include teacher and classmate support (Day et al., 2020; Guo et al., 2020). Students' perceived teacher–student and classmate relationships are positively associated with their learning outcomes (Bradley et al., 2021). Teacher support exerts a significant positive effect on learning outcomes (Košir and Tement, 2014; Wentzel, 2002). Classmates can share academically relevant information, provide knowledge- and skill-based guidance and judge the rightness or wrongness of particular answers to questions (Ryan and Shim, 2012). The aforementioned findings suggest that college students' perceived school support significantly affects online learning outcomes. Therefore, this study explores the impact of college students' perceived school support on online learning outcomes in hopes of obtaining more empirical evidence.

Bandura et al. (1999) identified self-efficacy as an individual's prediction of his or her ability to complete a task successfully. Several researchers have explored the fact that ASE is very important in the field of education (Chen et al., 2021; Gutiérrez and Tomás, 2019; Zeinalipour, 2022). Robbins et al. (2004) indicated that ASE is a positive predictor of college students' learning outcomes. Students who perceive more teacher support in an online learning environment have higher self-efficacy (Han et al., 2021). Furthermore, ASE significantly and positively affects learning outcomes in an online learning environment (Hanham et al., 2021). Therefore, we hypothesized that college students' perceived school support would affect online learning outcomes by influencing their ASE.

Learning engagement refers to a student being in a positive, fulfilling, and learning-related psychological state (Schaufeli et al., 2002). Online learning engagement refers to a student's psychological state during online learning activities (Chen et al., 2010). Teacher support can enhance students' learning engagement (Doll et al., 2014). Students tend to demonstrate greater learning engagement when they perceive greater teacher support (Fredricks et al., 2004; Jin and Wang, 2019; Strati et al., 2017). Furthermore, in an online learning environment, learning engagement is a significant predictor of learning outcomes (Northey et al., 2018; Zhang, 2021). Online learning engagement contributes to learning outcomes (Lu and Cutumisu, 2022). Therefore, college students' perceived school support is likely to indirectly affect the online learning outcomes of college students through online learning engagement. ASE has a significant positive impact on learning engagement in online learning activities (Alamri, 2022). Moreover, self-efficacy can indirectly affect online learning outcomes through online learning engagement (Zapata-Cuervo et al., 2023).

Therefore, this study infers that ASE and online learning engagement are important mediating variables between perceived school support and online learning outcomes.

Past research has found that teacher support and peer support can increase students' ASE (Burke et al., 2019; Gutiérrez and Tomás, 2019; Liu et al., 2018) and online learning engagement (Luan et al., 2020). ASE, online learning engagement improves online learning outcomes (Hanham et al., 2021; Lu and Cutumisu, 2022). And self-efficacy can enhance learning engagement (Alemayehu and Chen, 2021; Heo et al., 2021). However, fewer studies have explored the mediating role of ASE and online learning engagement in the relationship between perceived school support and online learning outcomes, as well as the serial mediation between the two. Therefore, this study investigates the mediating roles of ASE and online learning engagement in the relationship between college students' perceived school support and online learning outcomes, respectively, as well as the serial mediating roles of ASE and online learning engagement to fill this gap. This study will lead to a greater understanding of the important factors that influence online learning outcomes, thereby improving our knowledge of the mechanisms that potentially influence this process and providing new directions for how college teachers can improve online learning outcomes more effectively. Therefore, the objectives of this study include:

(1) Exploring the relationship between college students' perceived school support on online learning outcomes;

(2) Exploring the mediating role of college students' ASE between perceived school supports and online learning outcomes;

(3) Exploring the mediating role of college students' online learning engagement between perceived school supports and online learning outcomes;

(4) Exploring the serial mediating role of college students' ASE and online learning engagement between perceived school support and online learning outcomes.

Theoretical background and hypotheses

Social cognitive theory (SCT)

Bandura's (1986) Social Cognitive Theory (SCT) posits that both environmental and individual factors influence individual behavior. This theory has found extensive application in studies examining learning outcomes (Li et al., 2022; Wang and Zhang, 2020; Zysberg and Schwartzberg, 2021). In alignment with social cognitive theory, Wang and Zhang (2020) classified perceived teacher feedback as an environmental factor and learning engagement as an individual factor. Their findings demonstrated that both perceived teacher feedback and learning engagement positively and significantly influenced learning outcomes. Li et al. (2022) applied social cognitive theory and reported parent–child relationships to be an environmental factor and gratitude and psychological capital to be personal factors. The authors determined that all three variables were significant predictors of learning outcomes. On the basis of social cognitive theory, Zysberg and Schwabsky (2021) viewed school climate as an environmental factor and ASE as a personal factor; the results of their study indicated that school climate and ASE could significantly influence academic achievement. In the present study, we considered college students' perceived school support to be environmental factors, ASE and online learning engagement to be a personal factor. The study explores the relationship between the direct impact of perceived school support on online learning outcomes and the mediating role of ASE and online learning engagement in this impact.

College students' perceived school support and online learning outcomes

School support involves support from teachers and classmates which serve as the two dimensions of such support (Moreira and Lee, 2020; Torsheim and Wold, 2001). Teachers are the primary agents who provide various forms of support within the school (Lei et al., 2018), whereas classmates represent individuals with similar experiences and are crucial others in an individual's school life. Thoits (2011) reported that teachers and classmates offer students emotional support and positive coping assistance. Learning support provided by teachers and classmates significantly positively affects students' learning processes and outcomes (Rumberger and Rotermund, 2012). With appropriate assistance and direction from teachers, students feel comfortable with online learning (Reimers and Schleicher, 2020).

School support for learning can affect learning outcomes (Moreira et al., 2018). Students' learning outcomes are generally proportional to their perceived teacher support (Košir and Tement, 2014; Midgley et al., 1989; Wentzel, 2002).

Kashy-Rosenbaum et al. (2018) conducted an empirical study that included 1641 students and determined that teacher support significantly positively affected learning outcomes. Bradley et al. (2021) conducted an empirical study involving 754 students and determined that classmate support significantly positively affected learning outcomes. In their study that included 2328 students, Fang et al. (2020) revealed that both teacher and classmate support significantly positively affected learning outcomes. Therefore, the following hypotheses were formulated for this study:

Hypothesis 1: College students' perceived school support significantly and positively predicts online learning outcomes.

Mediation of ASE

ASE refers to an individual's self-efficacy beliefs in specific academic domains (Bong and Skaalvik, 2003). Liang (2004) developed a specialized scale to assess Chinese students' ASE, which has been widely used in empirical studies (Chen et al., 2020; Luo et al., 2021; Zhang, 2022). Research has shown that teacher support can enhance ASE. (Bai and Gu, 2022; Eakman et al., 2019; Gutiérrez and Tomás, 2019; Liu et al., 2018). Therefore, college students' perceived school support can significantly and positively predict ASE. Zysberg and Schwabsky (2021) surveyed 1641 students by using a questionnaire and determined that the higher ASE is, the greater academic achievement. Shoval et al. (2021) conducted a questionnaire survey on 491 students and the results showed that ASE enhances academic achievement. The results of another study on online learning also found that the higher the ASE, the better the learning outcomes (Hanham et al., 2021).

A study demonstrated that teacher autonomy support indirectly affects learning outcomes through ASE (Gutiérrez and Tomás, 2019). The above findings suggest that perceived school support may indirectly influence online learning outcomes through ASE. Therefore, the following hypotheses were formulated for this study:

Hypothesis 2: ASE mediates between college students' perceived school support and online learning outcomes

Mediation of online learning engagement

In education research, online learning engagement has become a topic of substantial interest (Park and Yun, 2018). Teacher and classmate support significantly and positively affect the three dimensions of online English learning engagement (Luan et al., 2020). Yoon et al. (2020) surveyed 121 students in flipped classrooms and determined that teacher autonomy support was a significant predictor of learning engagement. Therefore, this study infers that college students' perceived school support might positively affect online learning engagement. The results of a questionnaire survey conducted by Zapata-Cuervo et al. (2023) among 523 college students revealed that learning engagement can significantly and positively predict learning outcomes. Bayoumy and Alsayed (2021) conducted an empirical study with 425 college students and showed that learning engagement significantly predicted learning outcomes.

Past research has pointed out that social networking site addiction can indirectly affect learning outcomes through learning engagement (Li et al., 2019). The above findings suggest that perceived school support may increase engagement in online learning, which in turn has an impact on online learning outcomes. Thus, the following hypotheses were formulated for this study:

Hypothesis 3: Online learning engagement mediates between college students' perceived school support and online learning outcomes

Serial mediation effects of ASE and online learning engagement

ASE can positively predict learning engagement (Sökmen, 2021). Similar findings have been obtained for online learning. For example, Heo et al. (2021) surveyed 1205 college students who participated in online learning and discovered that self-efficacy in an online learning environment significantly and positively affected learning engagement.

Alemayehu and Chen (2021) conducted a questionnaire survey among 354 college students who participated in online learning and reported that higher self-efficacy was associated with greater learning engagement. Another study found that students with higher ASE were more able to actively and effectively participate in online courses (Bates and Khasawneh, 2007). In addition, a study indicated that students' self-efficacy significantly affected their online learning engagement and thus their online learning outcomes (Zapata-Cuervo et al., 2023). The aforementioned findings provide an empirical foundation for investigating the serial mediation effects of ASE and online learning engagement. Thus, the following hypotheses were formulated for this study:

Hypothesis 4: ASE and online learning engagement serial mediate the relationship between college students' perceived school support and online learning outcomes.

METHODS

Participants and procedures

This cross-sectional study employed the convenience sampling method to collect data. Pretest samples were collected from a university in the Hainan Province of China from March 7 to 9, 2022. A total of 150 valid questionnaires were received from 109 males (72.67%) and 41 females (27.33%) participants. In the formal test, college students from five universities in Hainan were recruited. A total of 1169 formal questionnaires were distributed and recovered from May 16 to 20, 2022. A total of 959 valid questionnaires were received from 314 males (32.74.67%) and 645 females (67.26%) participants.

Two batches of electronic questionnaires were distributed with the help of college counsellors through the Questionnaire Star platform (www.wjx.cn). First, the college counsellors who distributed the electronic questionnaire were provided with professional training; the criteria for participation (that is, being a college student interested in the study and willing to volunteer to participate) and questionnaire items were explained in detail. Second, participants completed the questionnaire under the supervision of college counsellors. Before completing the questionnaire, students were informed that it would be collected and analysed anonymously. After the participants provided informed consent, the questionnaires were distributed and collected through Questionnaire Star.

Measures

Scale for perceived school support

Perceived school support was scaled using Torsheim et al. (2000). This scale consists of two dimensions with a total of 8 items. The item analysis results of the pre-test sample revealed that the correlation coefficients between the items after correction and the total score were >0.4; therefore, all 8 items could be retained. The EFA results indicated that the KMO = 0.836 ($P < 0.001$). Subsequently, the varimax rotation method for analysis was used. The results showed that 2 factors with an eigenvalue of >1.0 were generated, and the factor loadings of these 2 factors were between 0.657 and 0.807, which met the requirement of a factor loading being >0.4 (Guadagnoli and Velicer, 1988). The Cronbach's alpha values for teacher and classmate support were 0.742 and 0.809, respectively; both exceeded the threshold of 0.7 (Nunnally, 1978). Therefore, the scale's validity and reliability were favourable.

Scale for ASE

This study used a scale developed by Liang (2004) to measure ASE. The scale consists of two dimensions with 22 items. The item analysis results showed that four items on the scale had correlation coefficients with a total score of <0.4 after correction; thus, these four items were deleted from the formally distributed questionnaires, and 18 items were retained. The EFA results indicated that one item was loaded in another dimension, which is inconsistent with the rule that variables loaded in the same dimension should have

the same conceptual construct. Thus, the item was deleted (Hatcher, 1994; Schönrock-Adema et al., 2009). Finally, 17 items were retained. The EFA results revealed that the KMO = 0.905 ($P <$ 0.001). Subsequently, this study employed the varimax rotation method for analysis. The results showed that two factors with an eigenvalue of >1.0 were generated, and their factor loadings were between 0.411 and 0.823, which met the standard that factor loadings should be >0.4. The Cronbach's alpha values for the two dimensions of the scale were 0.866 and 0.831, respectively. Therefore, the scale had high reliability and validity.

Scale for online learning engagement

The student engagement in distance education scale revised by Sun and Rueda (2012) was used. The scale consists of three dimensions and 15 items. The results of the item analysis of the pretest samples revealed that one item on the scale had a correlation coefficient with a total score of <0.40 after correction; therefore, this item was eliminated. Finally, 14 items were retained. The EFA results revealed that the KMO = 0.869 ($P <$ 0.001). Subsequently, the varimax rotation method for analysis was used. The results showed that three factors with an eigenvalue of >1.0 were generated, and their factor loadings were between 0.422 and 0.901, which met the requirement that factor loadings should be >0.4. The Cronbach's alpha values for behavioural, cognitive, and emotional engagement were 0.861, 0.912, and 0.879, respectively. Therefore, the scale has high validity and reliability.

Scale for online learning outcomes

The online learning outcomes use scales developed by Li et al. (2016) were employed in this study. The scale consists of four dimensions and 19 items. The item analysis results showed that one item had a correlation coefficient with a total score of <0.4 after correction; therefore, this item was eliminated. Furthermore, the EFA results indicated that three items were loaded in another dimension and thus could be deleted (Hatcher, 1994; Schönrock-Adema et al., 2009).

Finally, four items were eliminated from this study, and 14 items were retained. After the deletion, the EFA results revealed that the KMO = 0.820 ($P <$ 0.001). Subsequently, the varimax rotation method for analysis was performed. The results showed that four factors with an eigenvalue of >1.0 were generated, with factor loadings between 0.427 and 0.852, which met the requirement that factor loadings should be >0.4. The Cronbach's alpha values for learning cognitive, communicative, self-management, and interpersonal abilities were 0.694, 0.618, 0.776, and 0.842, respectively; all exceeded the threshold of 0.6 (Nunnally and Bernstein, 1994; Stylidis et al., 2014). Therefore, the scale had high validity and reliability.

CMV test

Since all four scales used in this study relied on self-report measures, there was a potential risk of common method variance (CMV) in the survey. To assess the severity of CMV, we conducted Harman's one-factor test, and the results indicated that the first factor accounted for 31.515% of the variance. Consequently, the level of CMV in this study was determined to be not severe (Harris et al., 2009).

Data analysis

First, we used SPSS 22.0 to conduct a pre-test analysis of the instruments, to modify or eliminate scale items to ensure each scale item achieved a qualified factor loading, and to evaluate the reliability (Cronbach's alpha) of each scale in the pre-test samples. Second, the CMV problem was investigated using Harman's one-factor test. Third, SPSS 22.0 and Amos 23.0 were used to test Cronbach's alpha and conduct CFA to assess the reliability and validity of the 4 scales in the formal test samples. Fourth, for each variable, descriptive statistics and correlation analysis were performed; the descriptive statistics were used to determine the means and standard deviations for each variable, and Pearson's correlation coefficients were calculated to analyse the correlation between variable dimensions. Fifth, Amos 23.0 was used to test the hypothetical model. Finally, the Bootstrap method (repeated samples set at 5000) was used to test the mediation effect of the hypothesis model.

RESULTS

Descriptive statistics and correlation analysis

The dimensions of teacher support, peer support, and self-efficacy for learning ability were positively correlated. Their correlation coefficients were between 0.154 and 0.745 (Table 1), indicating the absence of collinearity in this study.

Measurement model

The CFA results of the perceived school support scale revealed that the value of χ^2/df was 8.045. This value was high, which was possibly because of the large size of the sample; in such cases, other fitting indices should be calculated (Hu and Bentler, 1998). RMR = 0.026, CFI = 0.952, IFI = 0.952, and PGFI = 0.506. The average variance extracted (AVE) values of teacher and classmate support was 0.420 and 0.570, respectively, and their construct reliability (CR) values were 0.743 and 0.843, respectively. If a scale's AVE value is <0.5 and CR value is >0.6, the scale's convergent validity is acceptable (Fornell and Larcker, 1981). The Cronbach's alpha values for teacher and classmate support were 0.734 and 0.839.

The CFA results of the ASE scale revealed that the χ^2/df value was 8.573; this value was high because of the large sample size. RMR = 0.039, CFI = 0.907, IFI = 0.907, and PGFI=0.682. The AVE values of the learning ability and learning behaviour self-efficacy dimensions were 0.543 and 0.503, respectively, and their CR values were 0.922 and 0.875, respectively, indicating that all dimensions of the scale had satisfactory convergent validity. The Cronbach's alpha values for the learning ability and learning behaviour self-efficacy dimensions were 0.920 and 0.872.

The CFA results of the online learning engagement scale revealed that the χ^2/df value was 6.442, which may have been high because of the large sample size. RMR = 0.044, CFI = 0.956, IFI = 0.956, and PGFI = 0.658 The AVE values of behavioural, cognitive, and emotional

Table 1. Descriptive statistics and correlations.

	TS	CS	LA	LB	BE	EE	CE	LCA	CA	SA	IA
TS	1										
CS	0.573***	1									
LA	0.374***	0.332***	1								
LB	0.350***	0.333***	0.745***	1							
BE	0.251***	0.283***	0.413***	0.478***	1						
EE	0.207***	0.204***	0.287***	0.324***	0.324***	1					
CE	0.280***	0.298***	0.519***	0.588***	0.510***	0.532***	1				
LAC	0.352***	0.279***	0.698***	0.613***	0.433***	0.358***	0.561***	1			
CA	0.264***	0.254***	0.428***	0.463***	0.361***	0.232***	0.389***	0.489***	1		
SA	0.187***	0.154***	0.366***	0.427***	0.318***	0.190***	0.354***	0.377***	0.450***	1	
IA	0.273***	0.329***	0.476***	0.516***	0.475***	0.292***	0.455***	0.528***	0.586***	0.339***	1
M	3.917	3.736	3.326	3.454	4.096	3.391	3.561	3.437	3.779	3.227	3.923
SD	0.599	0.613	0.676	0.654	0.557	0.848	0.651	0.698	0.642	0.902	0.566

***$p < 0.001$. TS=teacher support; CS=classmate support; LA=learning ability self-efficacy; LB=learning behaviour self-efficacy; BE=behavioural engagement; EE=emotional engagement; CE=cognitive engagement; LCA=learning cognitive ability; CA=communicative ability; SA=self-management ability; IA=interpersonal ability.
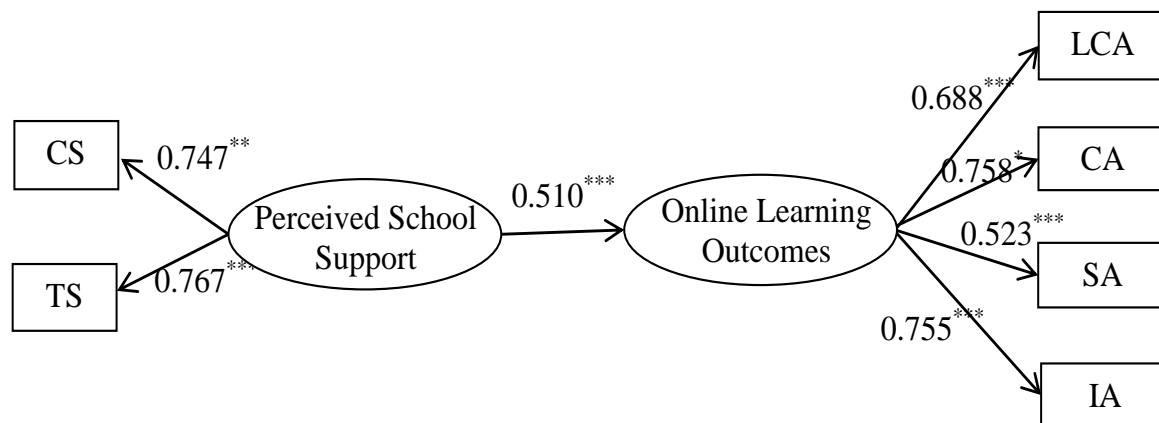

Figure 1. Main effect of the school support on academic achievement. **$p<0.01$, ***$p<0.001$; TS=teacher support; CS=classmate support; LCA=learning cognitive ability; CA=communicative ability; SA=self-management ability; IA=interpersonal ability.

engagement were 0.539, 0.723, and 0.570, respectively, and their CR values were 0.778, 0.939, and 0.869. The Cronbach's alpha values for behavioural, cognitive, and emotional engagement were 0.776, 0.935, and 0.868.

The CFA results of the online learning outcome scale revealed that the χ^2/df value was 7.084, which may have been be high because of the large sample size. RMR = 0.048, CFI = 0.932, IFI = 0.932, and PGFI=0.629. The AVE values of learning cognitive ability, communicative ability, self-management ability, and interpersonal ability were 0.647, 0.383, 0.608, and 0.585, respectively, and their CR values were 0.846, 0.644, 0.821, and 0.876. The Cronbach's alpha values for the learning cognitive ability, communicative ability, self-management ability, and

interpersonal ability dimensions were 0.842, 0.609, 0.814, and 0.875.

Structural model

First, a structural equation model was used to test the main effect of college students' perceived school support on online learning outcomes (Figure 1). The model fit indices were as follows: χ^2 = 60.177, df = 8, χ^2/df = 7.522, GFI = 0.980, NFI = 0.963, RMR = 0.015, SRMR = 0.032, and PNFI = 0.513. The results indicate that college students' perceived school support significantly and positively predicted the online learning outcomes of
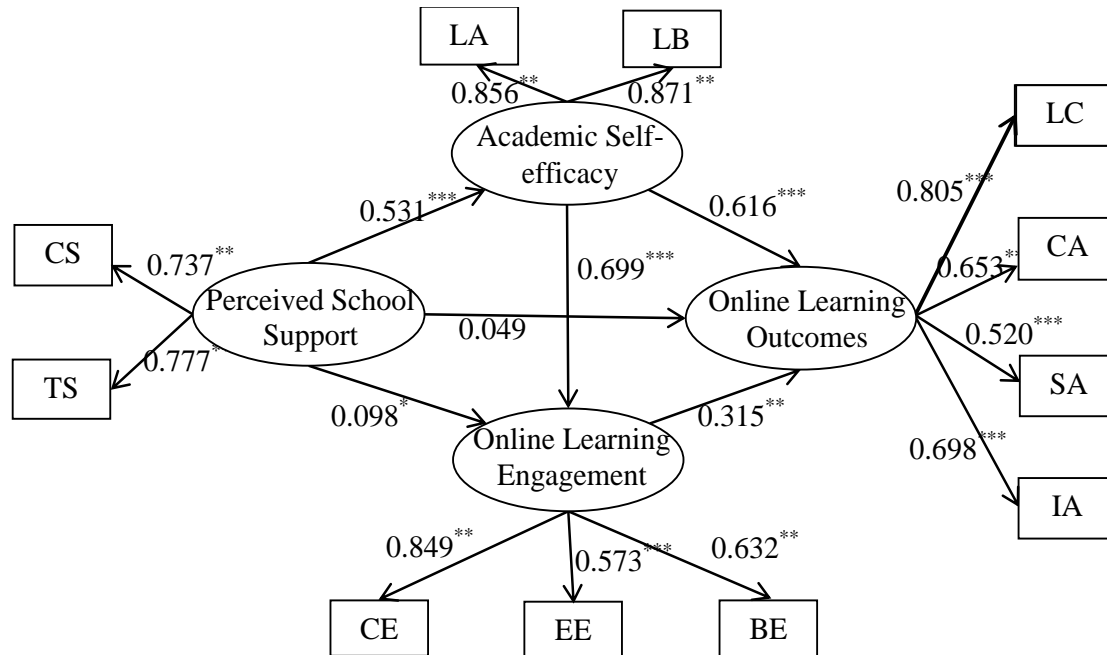
Figure 2. The final standardized parameter estimation value of the model. *$P<0.05$, **$P<0.01$, ***$P<0.001$. TS=teacher support; CS=classmate support; LA=learning ability self-efficacy; LB=learning behaviour self-efficacy; BE=behavioural engagement; EE=emotional engagement; CE=cognitive engagement; LCA=learning cognitive ability; CA=communicative ability; SA=self-management ability; IA=interpersonal ability.

college students ($\gamma = 0.510$, $p < 0.001$), thus supporting H1.

Second, ASE and online learning engagement were included as mediation variables to test the serial mediation model (Figure 2). The model fit was good: χ^2 = 330.420, df =38, χ^2/df = 8.774, GFI = 0.939, NFI = 0.927, RMR = 0.019, SRMR = 0.042, and PNFI = 0.640. ASE partially mediated the relationship between college students' perceived school support and online learning outcomes ($\beta = 0.327$, $P < 0.001$), supporting H2. Online learning engagement partially mediated the relationship between college students' perceived school support and online learning outcomes ($\beta = 0.031$, $P < 0.05$), supporting H3. ASE and online learning engagement exerted a serial mediation effect on college students' perceived school support and online learning outcomes ($\beta = 0.117$, $P < 0.01$), supporting H4. College students' perceived school support had no significant effect on online learning outcomes when ASE and online learning engagement were included as mediators ($\beta = 0.049$, $P > 0.05$). Therefore, there was a complete serial mediation relationship between college students' perceived school support and online learning outcomes with the mediation of ASE and online learning engagement.

According to Preacher and Hayes (2008), the bootstrapping method can be utilized to test the stability of a model. The total mediating effect was 0.475, and the total indirect effect was manifested through three pathways (Table 2):

Indirect effect path 1: College students' perceived school support → ASE → online learning outcomes (indirect effect 1 = 0.327, LLCI=0.233, and ULCI=0.436).

Indirect effect path 2: College students' perceived school support → online learning engagement → online learning outcomes (indirect effect 2 = 0.031, LLCI = 0.003, and ULCI = 0.073).

Indirect effect path 3: College students' perceived school support→ASE→online learning engagement → online learning outcomes (indirect effect 3 = 0.117, LLCI = 0.051, and ULCI = 0.201).

The 95% CI value of the indirect effects did not contain 0, indicating that all the three indirect effect paths were significant. The 95% CI value of the direct effect of college students' perceived school support on online learning outcomes contained 0, indicating that the direct effect path was not significant (direct effect = 0.049, LLCI = −0.026, and ULCI = 0.117). Therefore, ASE and online learning engagement independently and partially mediated the effect of college students' perceived school support on online learning outcomes, and school support exerted a complete mediation effect on online learning outcomes through ASE and online learning engagement. The findings of this study supported H2, H3, and H4.

DISCUSSION

First, college students' perceived school support

Table 2. Path effects.

Indirect effects	Effect	95% LLCI	95% ULCI
Direct effect	0.049	−0.026	0.117
Total indirect effect	0.475***	0.408	0.548
Indirect effect 1	0.327***	0.233	0.436
Indirect effect 2	0.031*	0.003	0.073
Indirect effect 3	0.117***	0.051	0.201

*$P<0.05$, **$P<0.01$, ***$P<0.001$; Bootstrapping random sampling 5,000 times; Indirect effect 1=college students' perceived school support→ASE→online learning outcomes; Indirect effect 2=college students' perceived school support→online learning engagement→online learning outcomes; Indirect effect 3=college students' perceived school support→ASE→online learning engagement→online learning outcomes.

significantly and positively affects online learning outcomes, similar to previous findings (Bradley et al., 2021). Thus, the more college students' perceived school support students perceive, the better are their online learning outcomes. Teacher support is an essential indicator of the closeness of teacher–student interactions (Hughes and Im, 2016; Lei et al., 2016), which is among the most crucial factors affecting individual development (Hughes et al., 2014).

The closer students perceive teacher–student and classmate relationships to be, the more support they perceive and the better are their learning outcomes (Konishi et al., 2010). When individuals receive support from their social network or perceive supportive behaviour, they receive a general benefit that promotes their mental health and growth (Berkman and Syme, 1979). In addition, support provided by teachers and classmates significantly affects students' learning process and outcomes (Rumberger and Rotermund, 2012). Furthermore, a supportive learning environment is crucial for enhancing learning outcomes (Wang and Holcombe, 2010). Therefore, when students receive more school support, their online learning outcomes improve.

Second, Academic Self-Efficacy (ASE) partially mediates the relationship between college students' perceived school support and online learning outcomes, consistent with prior research findings (Boahene et al., 2019; Eakman et al., 2019; Gutiérrez and Tomás, 2019). Given that ASE plays a critical role in achieving elevated levels of learning outcomes (Schunk et al., 2010; Yokoyama, 2019), students with higher ASE levels exhibit greater confidence and a heightened likelihood to persevere when confronted with academic challenges (Bandura et al., 1996; Gore, 2006). Research shows that the more school support students receive, the higher their self-efficacy (Werner et al., 2021), and the higher their ASE, the better their learning outcomes (Shoval et al., 2021; Travis et al., 2020). Therefore, the more perceived

school support, the higher students' ASE and the better their online learning outcomes will be.

Third, our findings suggest that perceived school support can indirectly influence online learning outcomes through online learning engagement, similar to previous findings (Wang and Zhang, 2020; Wu et al., 2020). Teacher support is the most crucial factor for increasing online learning engagement (O'Shea et al., 2015). Teachers providing behavioural and strategy support to students enhances their sense of social existence and promotes their learning engagement (Shea and Bidjerano, 2009). In addition, learning engagement is associated with student retention and satisfaction in online courses (Choo et al., 2020) as well as affects learning outcomes (Fisher et al., 2021). The higher the perceived support from teachers and peers students perceive in online educational activities, the higher the learning engagement (Luan et al., 2020). Moreover, learning engagement helps to improve students' online learning outcomes (Northey et al., 2018). Thus, perceived school support can influence online learning engagement, which in turn enhances online learning outcomes.

Fourth, our findings indicate that Academic Self-Efficacy (ASE) and online learning engagement serially mediate the relationship between college students' perceived school support and online learning outcomes. In line with social cognitive theory, our study highlights the impact of both individual and environmental factors on online learning outcomes (Li et al., 2022; Wang and Zhang, 2020; Zysberg and Schwartzberg, 2021). These findings align with previous research results (Wu et al., 2020; Zapata-Cuervo et al., 2023). A student's sense of self-efficacy influences their decisions, the amount of psychological effort they exert, and the length of time they persist with a task (Schunk and Pajares, 2005). This study extends previous research on online learning outcomes.

This study has some practical implications. First,

perceived school support significantly and positively affects online learning outcomes. Therefore, colleges and universities should increase college students' perceived school support for college students, ensure that students feel they have received fair treatment in educational activities, and instruct students on how they can have harmonious relationships with and be helpful to their classmates. Second, college students' perceived school support can affect online learning outcomes through the serial mediation effects of ASE and online learning engagement. Therefore, college teachers can encourage positive student development by communicating adequate expectations and assisting students in facing academic challenges. Furthermore, methods for implementing online learning engagement training and consistently enhancing the emotional, cognitive, and behavioural factors that affect college students should be explored.

Limitations and future research

There are certain limitations to this study, which provide suggestions for future research. First, this study used a cross-sectional study and all causal explanations can only be hypothesized on the basis of previous studies and not derived from the data. Therefore, future longitudinal studies on this topic are warranted. Second, this study was conducted only in the Hainan Province of China, but online education has been utilized worldwide. Therefore, a cross-cultural study can be conducted in the future to compare whether there are differences in the online learning outcomes of college students between Western and Chinese countries. Third, only the serial mediation model was discussed in this study, but whether other variables moderate the serial mediation process remains to be further explored in future research.

Conclusion

In conclusion, this study demonstrates that college students' perceived school support significantly and positively affects online learning outcomes; ASE partially mediates the relationship between college students' perceived school support and online learning outcomes; online learning engagement partially mediates the relationship between college students' perceived school support and online learning outcomes; and college students' perceived school support exerts a complete mediation effect on online learning outcomes through ASE and online learning engagement.

The findings provide theoretical and practical implications. Theoretically, this study highlights the significance of environmental and personal factors in enhancing online learning outcomes for college students.

Research has shown that perceived school support (environmental factors) can indirectly influence online learning outcomes through ASE and online learning engagement (personal factors). From a practical perspective, this study identifies environmental and personal factors that influence online learning outcomes, as well as their potential mechanisms of influence. The findings provide new directions for universities to effectively improve online learning outcomes for college students.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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