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Moderated Mediation Model of Student Expectation and Satisfaction in Blended Learning: Context of Mathematics Learning in Chinese Higher education institutions

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Abstract: - With the continuous development of educational informatization, blended learning, which combines the advantages of online and offline teaching, has become a research hotspot in the field of education. This study aims to discuss the influencing factors of blended learning satisfaction. Using purposive sampling method, 529 undergraduate students majoring in mathematics from 16 higher education institutions in Guangxi were surveyed. Furthermore, validity and reliability tests, confirmatory factor analysis, correlation analysis, and structural equation modeling were employed to process the data. Empirical results indicate that in blended learning, student expectation and perceived value have significant positive effects on learning satisfaction. Student expectation also have a significant positive effect on perceived value. Moreover, perceived value plays a mediating role in the relationship between student expectation and learning satisfaction. Self-efficacy moderates the relationship between student expectation and learning satisfaction. This study contributes to enhancing the quality of blended courses and improving the satisfaction of university students with blended learning.

Keywords: Blended learning; Student expectation; Learning satisfaction; Self-efficacy

1. Introduction

With the rise of online education, traditional face-to-face teaching methods have undergone significant changes (Stahl, 2021). Online learning has fully utilized the advantages of wide network dissemination and rapid information updates, presenting diverse learning resources to learners, thus facilitating their learning. This provides opportunities for self-education, self-learning, and self-development (Attard & Holmes, 2020). The education and training industry has further promoted the combination of television distance "face-to-face" teaching and internet online teaching (Ho et al., 2021; Hori & Fujii, 2021). However, scholars have found inherent defects in online teaching while continuously exploring it as a replacement for traditional face-to-face teaching (Han, Wang, Zhang, & Cheng, 2015). It is evident that blended learning, as a continuum between traditional face-to-face teaching and online teaching, did not emerge out of nowhere but rather followed the wave of educational informatization, emerging as a natural product of practical exploration (Du et al., 2022;

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Tong et al., 2022). Blended learning not only leverages the flexible and autonomous nature of online teaching but also retains the dominant role of teachers in content, activities, and interactions in traditional offline teaching. This makes it an important trend in the future development of teaching, constructing new types of teacher-student relationships and deepening the concept of diverse interactions (Chen, 2019).

The United States was the first country to propose the concept of blended learning, with authoritative research reports such as the "Horizon Report" listing blended learning as one of the important trends in recent years. The report "Embracing the Digital University" mentions that blended education has attracted attention and application in higher education institutions as a new trend in educational reform (Han, Wang, Zhang, & Chen, 2015). In the same year, educational master John Daniel suggested that the future would depend on blended learning after comparing the advantages of online and face-to-face teaching, thus setting the tone for the development of blended learning (John et al., 2015). Research indicates that currently, more than two-thirds of educational training institutions in the United States employ blended learning, with half of the schools practicing blended teaching applications (Spanjers et al., 2015). Therefore, blended learning is expected to become the mainstream teaching model in future higher education institutions (Du et al., 2022; Yoshida et al., 2022).

In the blended learning environment, there exists a close relationship between student expectation and learning satisfaction, which holds significant implications for educational practices and instructional management. Student expectation refer to the anticipated outcomes and experiences students envision before engaging in blended learning (Jiang, 2018). These expectations may encompass various aspects such as learning quality, learning platforms, resources, and instructional design. The formation of student expectation is influenced by individual learning experiences, educational backgrounds, social and cultural factors, among others. On the other hand, learning satisfaction reflects students' evaluations and feedback on their actual experiences in blended learning, indicating their satisfaction with instructional content, methods, and teacher performance. When students feel satisfied, it implies that they perceive value in the knowledge and skills acquired from blended learning, indicating effective teaching outcomes that meet their expectations. High levels of learning satisfaction typically signify that students are content with the learning process and outcomes, leading to positive evaluations of instructional methods and quality (Chen & Yao, 2016). The relationship between student expectation and learning satisfaction can be explained through various mechanisms. Firstly, the degree to which student expectation are met directly influences their evaluations of the learning process. When students' expectations are fulfilled, they often express satisfaction and provide positive evaluations of the learning process. Secondly, learning satisfaction can be seen as a reflection of student expectation. When students experience satisfaction with blended learning, it indicates that their expectations have been largely met, resulting in positive attitudes and emotional experiences towards learning. Furthermore, the improvement of learning satisfaction may also promote students' engagement and involvement, further enhancing instructional effectiveness (Bacci et al., 2023). Students are more willing to actively participate in learning activities and interact with teachers and peers in an environment where their expectations are met, thereby deepening their understanding and mastery of instructional content.

In blended learning, understanding and meeting students' expectations are key to enhancing learning satisfaction. Educators and instructional managers should closely monitor students' expectations and strive to fulfill them through flexible instructional design and effective teaching strategies, thereby improving students' learning satisfaction and outcomes. Additionally, by regularly collecting and analyzing student feedback, educators can make timely adjustments and improvements to the teaching process, continuously optimizing the blended learning environment to enhance students' learning experiences and growth.

2. Literature review and Research hypotheses

2.1 Student expectation

Student expectation refer to a variable proposed within the context of blended learning, borrowing from the "customer expectations" variable in the American Customer Satisfaction Index (ACSI) model. Zhang and Lin (2014) define student expectation as students' anticipations of the school's educational characteristics and teachers' abilities and character, based on their own circumstances in learning, life, and the school environment. Jiang (2018) suggests that student expectation are the expectations students have regarding the quality of learning, learning platforms, learning resources, and instructional design before engaging in blended learning. In this study, student expectation are defined as students' expectations regarding the instructional design of a course before engaging in blended learning. Research on student expectation primarily focuses on students' expectations of courses and teaching, students' expectations of learning outcomes (Yin & Hu, 2023), and students' expectations of online learning and blended learning (Cicha et al., 2021).

2.2 Perceived Value

Perceived value primarily refers to the experiential sense of value that individuals have towards an object. Bi and Hong (2021) define perceived value as the feelings students have after comparing the costs and benefits of traditional classroom learning and online learning. In this study, perceived value is defined as the subjective evaluation of a blended learning course based on students' learning gains after participating in blended teaching. Research indicates that the perceived quality in online courses positively influences perceived value (Yin & Hu, 2023), and perceived value in flipped classrooms mediates the relationship between perceived quality and student satisfaction (Zhai, 2016).

2.3 Learning Satisfaction

The study of learning satisfaction originally stemmed from the concept of "customer satisfaction" proposed by American scholar Cardozo in 1965, and later this theory was widely promoted and applied in the field of education in various countries. Scholars from different countries have provided their definitions of learning satisfaction. Punyanunt-Carter et al. (2017) define college student satisfaction as the emotional state where students feel content, appreciative, or proud of their attending institution. Budur et al. (2019) describe learning satisfaction as the ability of students to compare the expected benefits of a particular product or service with the observed outcomes. Bi and Hong (2021) suggest that learner satisfaction mainly encompasses satisfaction with platform presentation, course resources, teacher professionalism, and instructional planning. In this study,

learning satisfaction is defined as the degree of satisfaction learners feel with the blended learning approach and its learning outcomes after participating in blended learning. Currently, research on learning satisfaction primarily focuses on online learning and blended learning (Gao et al., 2020). Particularly during the pandemic, numerous scholars have conducted more in-depth studies on the satisfaction levels of online and blended learning in various countries (Agyeiwaah et al., 2022; Al-Nasa'h et al., 2021).

2.4 Self-Efficacy

Self-efficacy, initially proposed by American psychologist Bandura in 1977, is one of the core concepts in Bandura's social cognitive theory. Bandura defined self-efficacy as an individual's judgment of their capability to perform specific tasks or behaviors in a given situation, reflecting their confidence in utilizing their existing skills to accomplish tasks or behaviors (Bandura, 1977). In this study, self-efficacy is defined as academic self-efficacy (Pintrich & De Groot, 1990), referring to students' confidence and perceived ability to successfully complete learning tasks assigned to them in blended learning environments.

In the field of education, both teachers' and students' self-efficacy are often studied. Researchers focus on how students develop and maintain self-efficacy in learning and how enhancing students' self-efficacy can improve their academic achievements. For example, some scholars have explored the relationship between online learning self-efficacy and academic emotions (Wang et al., 2022), the relationship between online learning self-efficacy and performance (Tang et al., 2022), the relationship among online learners' self-regulation, self-direction, and self-efficacy (Stephen et al., 2020), and the relationship among learning fatigue, learning self-efficacy, and learning engagement (Ma, 2022). Additionally, other scholars have investigated the impact of teachers' self-efficacy on teaching quality and student performance (Bourne et al., 2021), the mutual influence between teachers' job satisfaction and self-efficacy (Chavez, 2022), the effects of teachers' characteristics such as gender, age, educational background, teaching experience, and professional qualifications on their self-efficacy and job satisfaction (Shaukat et al., 2019), and the impact of teacher training on self-efficacy and job satisfaction (Gao, 2019).

2.5 Research hypotheses and framework

2.5.1 Student expectation and Learning Satisfaction

Student expectation have a positive direct impact on learning satisfaction (Yin & Hu, 2023). This is because the realization of expectations is typically associated with positive learning experiences and outcomes, including better understanding of course content, achieving higher academic grades, and a more enjoyable learning experience. This sense of satisfaction can significantly enhance students' learning satisfaction, as they feel that their investment and expectations are rewarded (Gopal et al., 2021). Therefore, this study proposes the following hypothesis:

H1: Student expectation have a significant positive impact on learning satisfaction.

2.5.2 Student expectation and Perceived Value

Student expectation can influence perceived value , especially in the context of online learning where expectations significantly affect the value of online learning (Yin & Hu, 2023). If learners have high expectations for their learning outcomes and performance, they will pay more attention to learning content and

activities, thereby engaging more seriously in their learning. In this scenario, learners will perceive the importance and significance of learning, enhancing their cognitive and evaluative processes regarding learning content and activities, consequently increasing perceived value (Cavallone et al., 2020). Neelam's study demonstrated a significant direct relationship between students' expectations of internship value and internship satisfaction (Neelam et al., 2019). Therefore, this study proposes the following hypothesis:

H2: Student expectation have a significant positive impact on perceived value.

2.5.3 Perceived Value and Learning Satisfaction

In the field of education, there is a positive relationship between learners' perceived value and satisfaction (Gao et al., 2020). Existing research has found that perceived value in online learning (Yin & Hu, 2023), blended learning (Rahman et al., 2015), and flipped classrooms (Zhai, 2016) positively influences learning satisfaction. This is because perceived value involves learners' subjective perceptions of the benefits between their investments (such as time, effort, and money) and the knowledge and skills they acquire. Therefore, this study proposes the following hypothesis:

H3: Perceived value has a significant positive impact on learning satisfaction.

2.5.4 Mediating Role of Perceived Value

Students often evaluate the impact of teaching competence on their learning experiences through perceived value. Once learners can acquire more knowledge and skills in less time, their overall satisfaction increases (Bi & Hong, 2021). When students feel they have gained valuable knowledge and skills through education, they are more likely to feel satisfied. Finally, students may evaluate the quality of educational services through perceived value. If they perceive the knowledge and skills they acquire as valuable, they are more likely to be satisfied with the educational services. Therefore, perceived value mediates the relationship between perceived quality and student satisfaction (Zhai, 2016). Thus, this study proposes the following hypothesis:

H4: Perceived value mediates the relationship between student expectation and learning satisfaction.

2.5.5 Moderating Role of Self-Efficacy

In the process of blended learning, students with high self-efficacy may set higher learning expectations. They may be more satisfied with their learning outcomes because they believe in their abilities. Additionally, they may better recognize and appreciate teachers' teaching competence, perceive the value of teachers' abilities and teaching methods, and possibly derive higher satisfaction from teachers' instruction (Ma, 2022). Furthermore, higher self-efficacy enables learners to believe in their ability to successfully complete learning tasks. Therefore, they are more likely to recognize the personal value of learning (Guo et al., 2023). When learners realize the value of learning tasks for themselves, they are more willing to invest time and effort in learning, thereby increasing the likelihood of entering a state of flow, further enhancing their learning satisfaction. Studies have found that in the SPOC environment, the influence of perceived ease of use, perceived usefulness, and perceived enjoyment on behavioral intention is moderated by self-efficacy (Wang, 2019). Additionally, academic self-efficacy can moderate the relationship between academic stressors and stress responses (Guo et al., 2023).

Therefore, this study proposes the following hypotheses:

H5a: Self-efficacy positively moderates the relationship between student expectation and learning satisfaction.

H5b: Self-efficacy positively moderates the relationship between perceived value and learning satisfaction.

H5c: Self-efficacy positively moderates the mediating effect of perceived value on the relationship between student expectation and learning satisfaction.

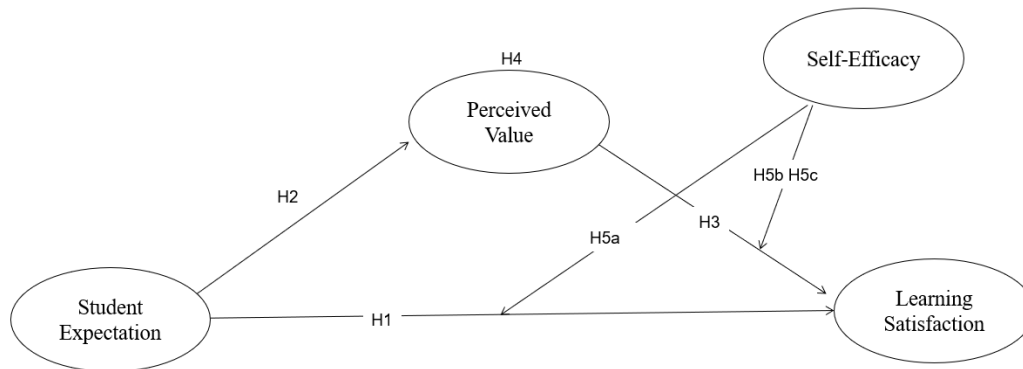Overall, the theoretical model of this study is illustrated in Figure 1.

Figure 1 Research framework

3. Research Method

This study utilized an electronic questionnaire created on the online platform "Wenjuanxing" and distributed to participants through social media platforms such as WeChat and QQ. Purposeful sampling was employed to survey 529 undergraduate students majoring in mathematics from 16 universities in Guangxi. After data cleaning, 466 valid responses were obtained. The measurement scales used in this study were adopted from mature scales found in academic journals. Student expectation were assessed using the scale developed by Gopal et al. (2021), consisting of 5 items. Perceived value was measured using the scale developed by Wu et al. (2008), comprising 3 items. Learning satisfaction was evaluated using the scale developed by Gao et al. (2020) for hybrid learning satisfaction, consisting of 4 items. Self-efficacy was assessed using the academic self-efficacy scale developed by Pintrich and De Groot (1990), which includes 9 items. A Likert 5-point scale was employed for scoring, ranging from "strongly disagree (1)" to "strongly agree (5)".

The data were initially subjected to data cleaning procedures, followed by descriptive statistical analysis, reliability analysis, common method bias test, normality test, and correlation analysis using SPSS 27 and AMOS 24 statistical software packages. Subsequently, confirmatory factor analysis was conducted to assess the fit of the latent variables (Wang et al., 2020). Finally, structural equation modeling (SEM) was employed to validate the research model and hypotheses, as well as to examine the mediating and moderating effects.

4. Data analysis

4.1 Demographic information

Based on 466 valid questionnaires, descriptive statistics were conducted regarding the demographics of the survey respondents, including gender, grade, and major. The results indicate that the proportion of male and female respondents is 29.4% and 70.6%, respectively. Regarding the distribution by grade, first-year, second-year, third-year, and fourth-year students account for 27.3%, 29.4%, 38%, and 5.4%, respectively. Additionally, the distribution of majors shows that mathematics and applied mathematics account for 81.8%, statistics for 13.5%, financial mathematics for 3.6%, and information and computing science for 1.1%.

4.2 Reliability, validity, and correlation

Table 1 presents the means, standard deviations, reliability estimates, factor loadings, Average Variance Extracted (AVE), and Composite Reliability (CR) of the constructs. The overall Cronbach's α value for the sample data is 0.92, exceeding the standard threshold of 0.7 for each latent variable (Hajjar, 2018). Additionally, the standard factor loadings of all measurement items are greater than 0.5, meeting the criterion (Hair, 2009). Moreover, the CR values are above 0.6, as per the standard requirement (Fornell & Larcker, 1981), indicating high reliability of the questionnaire scales.

This study also conducted Pearson correlation analysis to compute the correlation coefficients between variables and the square root of AVE. As shown in Table 1, all AVE values exceed 0.5 (Fornell & Larcker, 1981), indicating satisfactory convergent validity of the sample. The results, as presented in Table 2, demonstrate that the square root of AVE is greater than the correlation coefficients between each pair of latent variables, thereby confirming that the discriminant validity of the sample meets the required criteria.

Table 1 Reliability and Validity Analysis

Variables	Items	Mean	SD	Cronbach'sα	Factor loadings	AVE	CR
Student expectation	QW1	3.511	1.029	0.873	0.739	0.581	0.874
	QW2	3.472	1.037		0.798		
	QW3	3.472	1.018		0.72		
	QW4	3.476	0.973		0.765		
	QW5	3.470	1.001		0.787		
Perceived value	JZ1	3.318	1.125		0.775		
	JZ2	3.326	1.076	0.816	0.772	0.597	0.816
	JZ3	3.281	1.119		0.771		
Learning satisfaction	MYD1	3.472	1.220		0.817		
	MYD2	3.382	1.243	0.905	0.843	0.706	0.906
	MYD3	3.459	1.171		0.85		
	MYD4	3.442	1.161		0.851		
Self-efficacy	XNG1	3.858	0.935		0.793		
	XNG2	3.768	0.938		0.742		
	XNG3	3.828	0.935		0.789		
	XNG4	3.824	0.918	0.926	0.785	0.640	0.941
	XNG5	3.790	0.952		0.72		
	XNG6	3.775	0.945		0.816		
	XNG7	3.639	0.899		0.845		
	XNG8	3.723	0.945		0.85		
	XNG9	3.676	0.968		0.85		

Table 2   Pearson correlation and discriminant validity analysis

Variable	Student expectation	Perceived value	Self-efficacy	Learning satisfaction
Student expectation	**0.762**			
Perceived value	0.391**	**0.773**		
Self-efficacy	0.394**	0.406**	**0.800**	
Learning satisfaction	0.451**	0.443**	0.368**	**0.759**

Note: *P<0.05,**P<0.01, ***P<0.001. Bolded fonts are AVE root values.

4.3 Normality distribution detection

The data for the four variables: student expectation, perceived value, learning satisfaction, and self-efficacy, were subjected to statistical analysis using measures of skewness and kurtosis. The skewness values ranged from -0.688 to 0.085, while the kurtosis values ranged from -0.983 to 0.282. Clearly, the absolute values of the skewness coefficients are less than 2, and the absolute values of the kurtosis coefficients are less than 7. This indicates that while the data is not perfectly normally distributed, it is generally acceptable as normally distributed (Kline, 2005). Therefore, the data for all measurement items approximate a normal distribution and are suitable for structural equation modeling testing.

4.4 Path Analysis of Structural Equation Model

Before testing the hypotheses, this study employed AMOS 24 software to examine the hypothesis model. Fit indices were evaluated based on the empirical rule-of-thumb standards proposed by Kline (2005). The results indicate that CMIN/DF = 0.842, which falls within the excellent range below 3; RMR = 0.027, which is within the good range below 0.08; GFI = 0.985, AGFI = 0.977, NFI = 0.986, RFI = 0.981, all of which surpass the excellent level of 0.9. The structural equation model demonstrates a good fit.

According to the results in Table 3, in the path hypothesis testing, student expectation significantly and positively influence learning satisfaction ($\beta = 0.336$, p < 0.01); student expectation significantly and positively influence perceived value ($\beta = 0.460$, p < 0.001); perceived value significantly and positively influence learning satisfaction ($\beta = 0.362$, p < 0.001). Therefore, H1, H2, and H3 are all supported. The structural equation model is depicted in Figure 2.
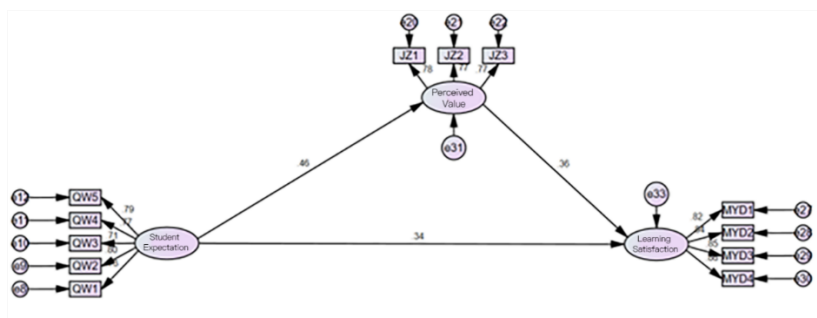

Figure 2 The path analysis for the model

Table 3 Results of structural model testing

Hypothesis	Path			Estimate	S.E.	C.R.	*p*	Results
H1	QW	→	MYD	0.336	0.072	6.137	***	supported
H2	QW	→	JZ	0.460	0.066	8.048	***	supported
H3	JZ	→	MYD	0.362	0.064	6.39	***	supported

Note: *P<0.05, **P<0.01, ***P<0.001, S.E.= standard error, C.R.= Critical Ratio. QW stands for student expectation, JZ stands for perceived value, MYD stands for Learning satisfaction.

4.5 Mediating effect test

In the AMOS program, this study employed Bootstrap technique to test the mediating effect of perceived value (Wen & Liu, 2020). The results are presented in Table 4. In the relationship between student expectation and learning satisfaction, the indirect effect of perceived value ($\beta = 0.166$, $p < 0.001$), direct effect ($\beta = 0.336$, $p < 0.001$), and total effect ($\beta = 0.503$, $p < 0.001$) are all significant. Both the Bias-Corrected and Percentile 95% confidence intervals of the indirect effect do not include 0, indicating the mediation effect exists. The 95% confidence interval of the direct effect also does not include 0, suggesting the direct effect is also established. Based on these results, perceived value significantly partially mediates the relationship in this path, thus supporting H4.

Table 4 Mediation effect test

Parameter	Path	Estimate	Bias-Corrected 95% confidence			Percentile 95% confidence interval			Results
			Lower	Upper	P	Lower	Upper	P	
Direct effect	QW→MYD	0.336	0.224	0.44	0.000	0.223	0.44	0.000	
Indirect effect	QW→JZ→MYD	0.166	0.11	0.242	0.000	0.107	0.238	0.000	supported
otal effect	QW→MYD	0.503	0.418	0.583	0.000	0.418	0.583	0.000	

4.6 Moderation Effect Testing

4.6.1 Moderation Effect Testing

In this study, we employed Model 1 of the PROCESS macro (Hayes, 2013) to examine the moderating effect of self-efficacy on the relationship between student expectation and learning satisfaction. The relevant variables were centered, and self-efficacy was manipulated by adding or subtracting one standard deviation to create two groups: low self-efficacy (M-1SD) and high self-efficacy (M+1SD). According to the results presented in Table 5, the interaction term between student expectation and self-efficacy ($\beta = 0.239$, $p < 0.001$), with a 95%

confidence interval of [0.093, 0.386], does not include 0. This indicates that self-efficacy positively moderates the relationship between student expectation and learning satisfaction. Therefore, H5a is supported.

Table 5 Test of the moderating effect of self-efficacy

predictor variable	β	SE	t	P	LLCI	ULCI
Student expectation	0.425	0.057	7.421	0.000	0.312	0.537
Self-efficacy	0.326	0.062	5.262	0.000	0.204	0.447
Student expectation×Self−efficacy	0.239	0.075	3.210	0.001	0.093	0.386

To provide a clearer understanding of the moderation effect, this study divided the sample into two groups based on self-efficacy: low self-efficacy and high self-efficacy. The moderation effect plots were generated for both groups. As shown in Figure 3, regardless of whether it is the low self-efficacy group (M-1SD) or the high self-efficacy group (M+1SD), as student expectation increase, individuals' learning satisfaction also increases. This indicates that self-efficacy positively moderates the relationship between student expectation and learning satisfaction. However, individuals with different levels of self-efficacy exhibit different degrees of moderation in learning satisfaction. Specifically, the moderation effect is more pronounced in the high self-efficacy group.
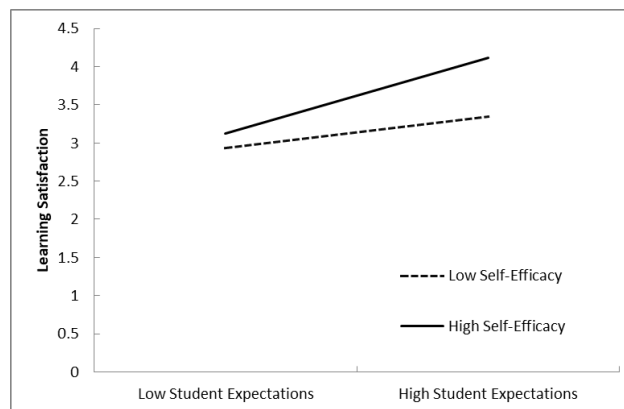

Figure 3 Plot of the relationship between student expectation and learning satisfaction at two levels of self-efficacy

4.6.2 Moderated Mediation Analysis

Since perceived value partially mediates the relationship between learning expectations and learning satisfaction, this study employs Model 14 of the PROCESS macro (Hayes, 2013) to examine whether the relationship between the mediator (perceived value) and the dependent variable (learning satisfaction) is moderated by self-efficacy.

As indicated in Table 6, the interaction effect between perceived value and self-efficacy significantly and positively predicts learning satisfaction (β = 0.289, t = 4.887, p < 0.001), with a 95% confidence interval of [0.173, 0.405], which does not include 0. This suggests that self-efficacy positively moderates the relationship between perceived value and learning satisfaction. Therefore, H5b is supported.

Table 6   Results of self-efficacy moderate the mediation process

Variables	Model 1 (Effectiveness criteria: Perceived value)				Model 2 (Effectiveness criteria: Learning satisfaction)			
	β	t	LICI	ULCI	β	t	LLCI	ULCI
Student expectation	0.449	9.146***	0.353	0.546	0.307	5.426***	0.196	0.418
Perceived value					0.332	6.835***	0.236	0.427
Self-efficacy					0.218	3.533***	0.097	0.339
Perceived value×Self-efficacy					0.289	4.887***	0.173	0.405

To provide a clearer interpretation of the moderation effect, this study divided the sample into two groups based on low and high levels of self-efficacy and plotted a moderation effect graph. For the low self-efficacy group, there is a significant positive correlation between perceived value and learning satisfaction. Similarly, for the high self-efficacy group, there is also a significant positive correlation between perceived value and learning satisfaction. However, individuals with different levels of self-efficacy exhibit varying degrees of prediction on learning satisfaction, with the high self-efficacy group showing a greater predictive effect, as illustrated in Figure 4.
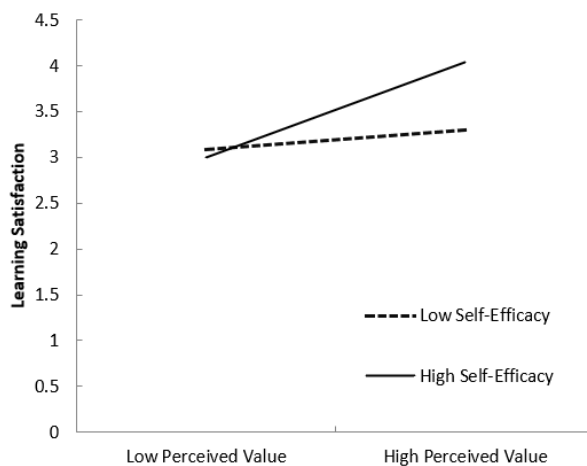

Figure 4   Plot of the relationship between perceived value and learning satisfaction at two levels of self-efficacy

Furthermore, this study further divided the sample into two groups based on the mean of self-efficacy plus or minus one standard deviation, and depicted the differences in the "conditional indirect effect" of learning satisfaction under different levels of self-efficacy. According to Table 7, the results indicate that for the low self-efficacy group (M-1SD), the "conditional indirect effect" of learning satisfaction under student expectation is significant (indirect effect = 0.053, SE = 0.027, 95% confidence interval: [0.002, 0.107], not including 0); for the high self-efficacy group (M+1SD), the "conditional indirect effect" of learning satisfaction under student expectation is significant (indirect effect = 0.246, SE = 0.046, 95% confidence interval: [0.159, 0.343], not including 0). This indicates that the mediation effects are significant under both conditions, and self-efficacy significantly moderates the mediating effect of student expectation on learning satisfaction through perceived

value. Additionally, we can examine the "Index of Moderated Mediation," which in this study is 0.130, with a 95% confidence interval of [0.073, 0.194], not including 0, reaching significance. This further supports the moderated mediation effect. Therefore, H5c is supported.

Table 7 Conditional indirect effect of self-efficacy when perceived value mediated between student expectation and learning satisfaction

Mediator	Self-efficacy	Effect	SE	LLCI	ULCI
Perceived value	M-1SD	0.053	0.027	0.002	0.107
	M	0.149	0.030	0.095	0.213
	M+1SD	0.246	0.046	0.159	0.343

5. Discussion and Implications

5.1 Research Conclusion

(1) Student expectation have a significant positive impact on learning satisfaction (H1). The findings of this study are consistent with the research by Yin and Hu (2023) and Bates and Kaye (2014), but contrary to the study by Jiang (2018). The realization of student expectation is typically associated with positive learning experiences and outcomes, including better understanding of course content, achieving higher academic grades, and enjoying a more pleasant learning experience. This sense of fulfillment can significantly enhance students' learning satisfaction.

(2) Student expectation have a significant positive impact on perceived value (H2). The results are consistent with the study by Yin and Hu (2023). Undergraduate students with higher expectations of their learning outcomes and performance are more likely to pay closer attention to learning content and activities, thus engaging more seriously in learning. Learners perceive the importance and significance of learning, leading to an enhanced cognitive and evaluative perception of learning content and activities, thereby increasing perceived value.

(3) Perceived value has a significant positive impact on learning satisfaction (H3). The findings are consistent with the research by Gao et al. (2020) and Rahman et al. (2015). When undergraduate students perceive that they can obtain more knowledge and skills with relatively less time and resources, they feel a higher efficiency, thereby increasing their satisfaction with learning.

(4) Perceived value mediates the relationship between student expectation and learning satisfaction (H4). This is one of the most important findings of this study. Scholars Jiang (2018) and Yin and Hu (2023) only studied the relationship between student expectation and perceived value, and between perceived value and learning satisfaction, but they did not investigate the mediating role of perceived value between student expectation and learning satisfaction. In blended learning, student expectation are closely related to the anticipation and value perception of the learning experience, while perceived value encompasses the practicality and relevance of academic content. When students perceive the actual value of learning tasks, they are more likely to connect

their personal expectations with actual learning outcomes. This connection directly shapes students' satisfaction with learning because fulfilling learning experiences reinforce satisfaction. Perceived value plays a crucial role in bridging the gap between student expectation and ultimate learning satisfaction, providing a bridge for expectations to translate into actual learning experiences and a sense of achievement. Therefore, perceived value plays an important role in shaping the relationship between student learning expectations and satisfaction, creating more meaningful and satisfying academic experiences for students.

（5）Self-efficacy not only positively moderates the relationship between student expectation and learning satisfaction but also positively moderates the relationship between perceived value and learning satisfaction, and even self-efficacy can positively moderate the mediating effect of student expectation on learning satisfaction through perceived value. Firstly, self-efficacy plays a significant role in moderating the relationship between student expectation and learning satisfaction, similar to the findings of Ma (2022). In blended learning processes, individuals with high expectations, if equipped with strong self-efficacy, are more likely to translate expectations into actual learning outcomes, thus enhancing learning satisfaction. High self-efficacy enables students to face academic challenges with confidence, actively pursue goals, and ultimately achieve expectations. Conversely, students lacking confidence in self-efficacy, even with high expectations, may encounter difficulties in learning, thereby reducing learning satisfaction. Therefore, self-efficacy has a moderating effect on whether individuals can effectively achieve expectations and ultimately affect learning satisfaction. This finding highlights the importance of self-efficacy in shaping learning experiences and emotional satisfaction, providing profound psychological support for enhancing students' learning achievements and satisfaction.

Secondly, self-efficacy is also crucial in moderating the relationship between perceived value and learning satisfaction. Students with high self-efficacy are better able to connect the actual value of learning with learning outcomes, thus more easily appreciating the significance and value of learning, thereby increasing learning satisfaction. On the other hand, students with lower self-efficacy may find it difficult to transform learning expectations into satisfactory learning experiences due to lack of confidence, thus affecting learning satisfaction, similar to the findings of Wang (2019). Furthermore, self-efficacy also positively moderates the mediating effect of student expectation on learning satisfaction through perceived value. Students with high self-efficacy tend to view challenges as opportunities and believe in their ability to overcome difficulties, thereby increasing expectations. When they perceive the importance and significance of learning tasks, they will invest more effort in learning and be more satisfied with the learning outcomes. Self-efficacy strengthens this positive chain of influence by enhancing confidence and willpower, prompting students to more actively evaluate task value, thereby indirectly enhancing learning satisfaction.

5.2 Implications

(1) Student expectation can lead to the generation of perceived value, which in turn promotes the generation of learning satisfaction. This suggests that in blended learning, managers should pay attention to and actively shape students' expectations. By setting clear learning goals, providing challenging tasks, and inspiring students' confidence, managers can help students develop positive expectations. This means that the educational environment should be encouraging and supportive, encouraging students to challenge themselves and believe

in their abilities, thereby motivating them to learn. Secondly, managers need to pay attention to students' perceived value of learning tasks. This means not only focusing on curriculum content and teaching methods but also on how to help students understand the importance, practicality, and relevance of learning. By providing meaningful learning experiences and practical opportunities, managers can enhance students' perceived value of learning tasks, thereby increasing their motivation and satisfaction. Third, managers should focus on establishing a supportive educational environment. This includes encouraging cooperation and mutual assistance among students, providing positive feedback and support, and providing necessary resources and assistance to students. A supportive educational environment can enhance students' self-efficacy, enabling them to confidently tackle learning challenges and thus more easily achieve learning satisfaction. Finally, managers need to recognize the relationship between student expectation and perceived value and consider and guide it in teaching practice. By understanding students' expectations and their perceived value of learning tasks, managers can design course content and teaching methods more targeted to meet students' needs and expectations, thereby increasing their learning satisfaction.

(2) Self-efficacy positively moderates the direct relationship between student expectation (perceived value) and learning satisfaction and the indirect relationship between student expectation and learning satisfaction. This suggests that in blended learning, managers should place the cultivation of students' confidence and self-efficacy at the core to foster students' positive expectations of tasks. First, provide support and encouragement to build students' confidence, ensuring they believe they can overcome challenges, and motivate them by creating challenging yet achievable learning opportunities. Secondly, design meaningful learning tasks related to students' personal goals and interests to enhance their perceived value of tasks and thereby increase their learning motivation. Finally, by providing positive feedback and support, help students recognize their progress and achievements, enhance their confidence and satisfaction, and provide necessary support and guidance to ensure they overcome difficulties and succeed. These measures will effectively increase students' learning satisfaction and make them more actively engaged in learning.

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