The research on the influencing factors of college students' willingnessto use blended learning based on UTAUT model

Hao Wei and Deng Lei

Panyapiwat Institute of Management, Thailand

Corresponding Author, E-mail: haowei_cdu@163.com

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Abstract

Background: This study is based on the Unified Theory of Acceptance and Use of Technology (UTAUT) model to explore the influencing factors of Chinese university students' willingness to use blended learning. With the rapid development of online education and the increasing integration of information technology in higher education, blended learning has gained attention as an effective teaching method. Understanding the factors that influence students' willingness to engage with this learning model is crucial for improving its effectiveness.

Aims: The primary aim of this study is to identify and analyze the key factors affecting college students' willingness to use blended learning. Specifically, it focuses on platform quality, perceived quality, expected quality, facilitating conditions, and satisfaction, examining their relationships and impact on students' intentions to use blended learning.

Methodology: A questionnaire survey was conducted among university students in four comprehensive universities in China's S province. The survey measured students' perceptions of blended learning across various dimensions, including platform quality, satisfaction, and willingness to use. The collected data were analyzed using internal consistency reliability, exploratory factor analysis, and t-test analysis to identify significant factors.

Results: The statistical results indicate that students generally have a positive perception of blended learning, with variability across different student identities (grades, majors, and experience). The findings show that platform quality, expected quality, and perceived quality significantly affect student satisfaction. Moreover, perceived quality, facilitating conditions, and satisfaction have a positive and significant effect on the willingness to use blended learning.

Conclusion: This study suggests that universities should focus on enhancing the quality of online learning platforms, optimizing the combination of online and offline course content, and improving the overall learning experience. Recommendations include building a mechanism for course resource delivery, strengthening process management, and reviewing the alignment of teaching goals with student expectations. These efforts could help improve students' satisfaction and increase their willingness to use blended learning in the future.

Keywords: College Students Willingness; Blended Learning; UTAUT Model

Introduction

In recent years, as the booming development of online education has triggered major changes in the field of education globally, the trend of digital transformation of education has increased in attention year by year, posing completely new challenges to the education system and methods. After the Internet technology and information technology and the education industry began to integrate and apply, the United States took the lead and began to try to use online courses for lectures, which emerged in the world after 1998 and rapidly expanded from the United States and Europe to Asia. China's online education began at the end of the 20th century, and formally entered the era of multimedia networks around 2000. Since the Ministry of Education approved the pilot colleges and universities of modern distance education in China, the development of online education has been on the right track. With the deep integration of the Internet and all walks of life, the education industry in the field of technological innovation in the online education sector from 2012 into a period of rapid development, and to this day still has a far-reaching impact on teaching reform. Online education makes the traditional form of education from teachers using traditional teaching methods to modernization, networking, multimedia teaching methods, but also makes the one-time school education towards the direction of lifelong education.

In recent years, the field of education has been expanding and deepening the deep integration of education and information technology, giving rise to an emerging educational ecosystem. Blended teaching as a new teaching method has also been utilized in higher education in various countries. Its development has promoted the extensive sharing of educational resources and innovation, and how to continuously use and carry out blended teaching has become a topic of study for many college educators. Pan Wenwen & Zhu Jianing (2015) suggested that there is a need to start research from the perspective of influencing factors to improve the effectiveness of online teaching.

Research Objectives

Based on existing research by domestic and foreign scholars, this study focuses on the empirical analysis of the performance of college students in China's Sichuan province under blended teaching. The specific research objectives are as follows:

1. To construct a model of college students' willingness to use blended instruction based on the integrated technology acceptance theory model (UTAUT), considering platform quality, expected quality, perceived quality, and other factors affecting the use of blended teaching.

2. To explore the differences in attitudes and perspectives of undergraduate students in Region S towards blended online and offline teaching under various individual characteristics (such as gender, grade level, major, and prior experience), and analyze the impact these differences have on their willingness to use blended learning.

Research Methodology

1. Population and sample

In this study, one comprehensive undergraduate university in Sichuan Province, China, was selected as the research object with first- to fourth-year undergraduates, and a stratified random sample was used, which included humanities and social sciences majors, natural sciences majors, and arts and physical education majors in majors; and in terms of learning experience, it consisted of students who had the experience of participating in at least one (including more than one) blended learning course, as shown in the table below.

Table 1 Demographic characteristics of the Willingness to Use Scale

Category	Title	Frequency	Percent(%)	Cumulative percent(%)
Your gender	Male	161	41.18	41.18
	Female	230	58.82	100.00
Your grade level	first-year	97	24.81	24.81
	second-year	92	23.53	48.34
	third-year	106	27.11	75.45
	fourth-year	96	24.55	100.00
Your specialty	natural sciences	157	40.15	40.15
	Humanities and Social Sciences	161	41.18	81.33
	Arts and Sports	73	18.67	100.00
You have participated in a blended learning experience	less participation experience (1-2 courses)	107	27.37	27.37
	some experience (3-4 courses)	178	45.52	72.89
	Extensive experience (more than 4 courses)	106	27.11	100.00
Total		391	100.0	100.0

2. Research tools

In this study, Questionstar was used as an online questionnaire platform and SPSS 26.0 (Statistical Package for the Social Sciences) software was utilized for data analysis to ensure the validity and reliability of the study.

3. Data collection

The questionnaire method is mainly adopted in this research. With the help of relevant literature review, reference to different scholars' relevant studies on students' satisfaction and willingness to use under blended teaching, based on the UTAUT model to define the maintenance, and the design of the scale to carry out a preliminary mapping of blended teaching carried out by four universities in Sichuan Province, to form a formal scale. In the formal survey, the formal survey, this study recovered a total of 412 questionnaires, which are valid 391 questionnaires, using software to test the reliability of the data, exploratory factor analysis, ANOVA.

Since the Employability Scale of the questionnaire of this study was scored on a Likert scale, the reliability test was conducted using the Cronbach's alpha coefficient test method, while the reliability of all dimensions was higher than 0.8 indicating high internal consistency and high measurement reliability.

Table 2 Cronbach's alpha coefficient reliability test for each dimension

math.	Number of items	sample size	Cronbach α
Platform quality	8	391	0.924
Expected quality	5	391	0.885
Perceived Quality	8	391	0.928
Facilitating conditions	5	391	0.879
Satisfaction	5	391	0.891
Usage Intention	5	391	0.891

Exploratory factor analysis was conducted through SPSS26.0 software and the results were obtained as shown in the table, the KMO value was 0.950, which proved that the validity of the research data was good and very suitable for extracting information, and the significance level of the Bartlett's test of sphericity was $0.000 < 0.05$, which showed that the structural validity was good and it was very suitable for exploratory factor analysis.

Table 3 KMO and Bartlett's test

KMO		0.950
Bartlett's test of sphericity	Approximate Chi-squared value	8772.525
	df	630
	p value	0.000

Factor loadings greater than 0.40 were rearranged after factor rotation, and the commonality of all items ranged from 0.635 to 0.719, indicating that the common factor explained most of the variance in the variable, and the factor extraction, as well as the factor extraction of the informativeness of the factor, was analyzed. As can be seen from the table below: factor analysis extracted a total of six factors with eigenroot values greater than 1. The variance explained values of these six factors are 14.957%, 14.811%, 9.710%, 9.538%, 9.482%,9.446%, and the rotated cumulative variance explained is 67.944%>50%. The amount of information in the study items can be extracted efficiently and the dimensions do not need to be adjusted. The six factors were also named separately: Platform quality (PT1-PT8 totaling 8 items), expected quality (YQ1-YQ5 totaling 5 items), perceived quality (GZ1-GZ8 totaling 8 items), facilitating conditions (CJ1-CJ5 totaling 5 items), satisfaction (MY1-MY5 totaling 5 items), and willingness to use (YY1-YY5 totaling 5 items).

4. Data analysis

In this study, data on students' feelings of use, satisfaction, and willingness to use blended learning were collected from July 2023 to January 2024 through a questionnaire method from freshmen to seniors and from different majors. The questionnaire design ensured that direct student feedback on the instructional model was captured. After data collection, descriptive statistical analysis was first performed to outline the basic

characteristics of the data. Differential analyses, such as t-tests and ANOVA, were then used to explore differences between student populations of different grades and majors.
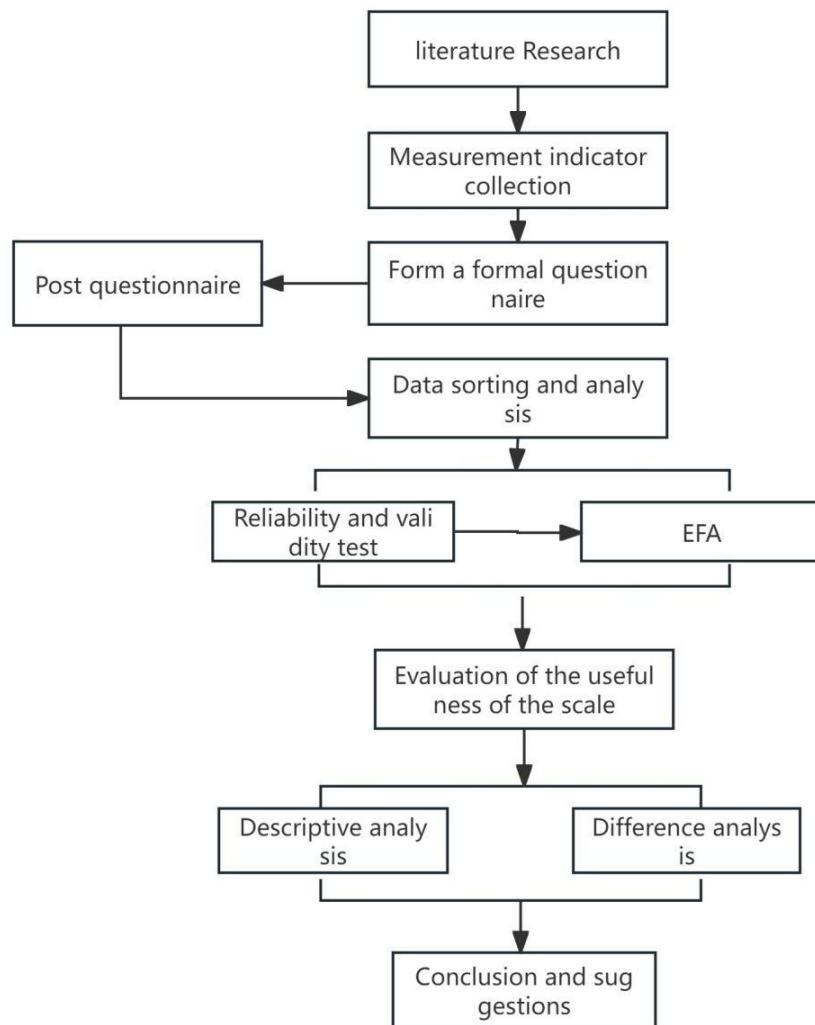
Conceptual framework

Figure 1 Conceptual Framework
(Source: Constructed by the researcher, 2024)

Research Findings
        1. Modeling college students' willingness to use blended instruction based on the Information Systems Success Model Integrated Technology Acceptance Theory Model (UTAUT)
        This study first organized and analyzed the background of the development of blended teaching and learning, as well as interpreted and studied the relevant theories and variables in the Theoretical Model for the Acceptance and Use of Integrated Technology (UTAUT), and designed the research architecture model. Through the questionnaire survey, it was verified that different factors (platform quality, expected quality, and perceived quality) would have an impact on students' satisfaction; different factors (perceived quality, facilitating conditions, and satisfaction) would have an impact on the willingness to use, and it was finally concluded that the platform quality, expected quality, and perceived quality all had a positive impact on satisfaction; and that the perceived quality, facilitating conditions, and satisfaction all had a positive impact on willingness to use.
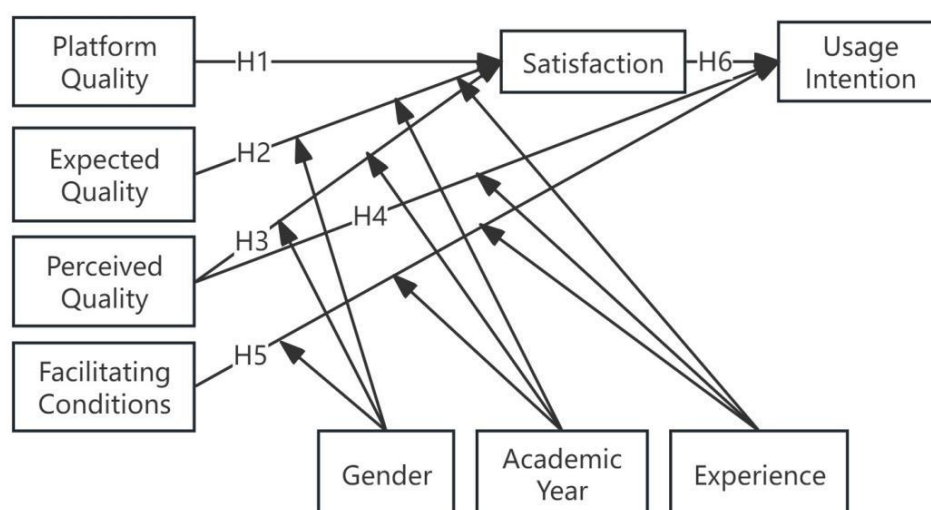

Figure 2 Theoretical model
(Source: Constructed by the researcher, 2024)

        2. Undergraduate students of comprehensive universities in Sichuan region have some differences in their attitudes and views on hybrid online and offline teaching and learning under different individual characteristics, with less variability in the gender factor, and significant variability under the factors of grade level, major, and participation experience.
        In terms of gender, there are some differences in the proportion of male and female subjects, with 161 male students (41.18%) and 230 female students (58.82%); in terms of grade level, 97 freshmen students accounted for 24.81% of the total, 92 sophomores accounted for 23.53% of the total, 106 juniors accounted for 27.11% of the total, and 96 seniors accounted for 24.55% of the total. 24.55%, which is more average overall, with the highest percentage of juniors. In terms of majors, there were 157 students majoring in natural disciplines, accounting for 40.15% of the total number of students, 161 students majoring in humanities and social sciences, accounting for 41.18% of the total number of students, and 73

students majoring in arts and sports, accounting for 18.67% of the total number of students, which is a better match with the types and number of majors and the number of people enrolled in the comprehensive university where the respondents are studying.

Whether the respondents have participated in online and offline blended courses is a decisive factor for this questionnaire, so in the pre-screening, the questionnaires that have not participated in online and offline blended courses have been eliminated to ensure the reliability and validity of the questionnaire, so that the "yes" option is 100%. Among the students who had participated in blended teaching, 107 students, or 27.37% of the total, had little experience (1-2 courses), 178 students, or 45.52% of the total, had experience (3-4 courses), and 106 students, or 27.11% of the total, had experience (more than 4 courses).

The scale is a five-point scale, with a minimum score of 1 indicating "very non-compliant" and a maximum score of 5 for each question indicating "very compliant". The table below shows that the mean score for all questions was above 3.2, indicating an overall good situation.

Table 4 Blended Learning Experience status

Title	N	Mean	S.D.	Median value
PT1	391	3.292	1.133	3.000
PT2	391	3.276	1.153	3.000
PT3	391	3.294	1.187	3.000
PT4	391	3.343	1.166	3.000
PT5	391	3.353	1.185	3.000
PT6	391	3.307	1.176	3.000
PT7	391	3.299	1.130	3.000
PT8	391	3.284	1.180	3.000
YQ1	391	3.294	1.160	3.000
YQ2	391	3.279	1.144	3.000
YQ3	391	3.335	1.171	3.000
YQ4	391	3.325	1.143	3.000
YQ5	391	3.317	1.203	3.000
GZ1	391	3.327	1.144	3.000
GZ2	391	3.407	1.114	4.000
GZ3	391	3.404	1.190	4.000
GZ4	391	3.412	1.175	4.000
GZ5	391	3.455	1.171	4.000
GZ6	391	3.407	1.146	4.000
GZ7	391	3.422	1.154	4.000
GZ8	391	3.297	1.116	3.000
CJ1	391	3.343	1.135	3.000
CJ2	391	3.335	1.136	3.000
CJ3	391	3.286	1.159	3.000

CJ4	391	3.358	1.170	4.000
CJ5	391	3.312	1.143	3.000
MY1	391	3.317	1.243	3.000
MY2	391	3.286	1.192	3.000
MY3	391	3.363	1.222	3.000
MY4	391	3.289	1.177	3.000
MY5	391	3.279	1.222	3.000
YY1	391	3.307	1.206	3.000
YY2	391	3.376	1.179	3.000
YY3	391	3.373	1.191	3.000
YY4	391	3.292	1.173	3.000
YY5	391	3.350	1.178	4.000

(1) Differential analysis of the learning situation of students of different genders

Understanding the differences in online and offline blended learning among college students of different genders was analyzed using the independent samples t-test, and as can be seen from the table below, no significance was demonstrated in the quality of the platform, the expected quality, the perceived quality, the conditions of facilitation, the level of satisfaction, and the willingness to use ($p > 0.05$)

Table 5 Analysis of Differential Learning in Online and Offline Blended Courses (Gender Factor)

	Your gender(Mean±S.D.)		t	p
	Male (n=161)	Female (n=230)		
Platform quality	3.25±0.90	3.34±0.97	-0.916	0.360
Expected quality	3.29±1.00	3.33±0.94	-0.395	0.693
Perceived Quality	3.34±0.98	3.43±0.91	-0.862	0.389
Facilitating conditions	3.30±0.96	3.35±0.93	-0.503	0.615
Satisfaction	3.28±1.05	3.33±0.98	-0.489	0.625
Usage Intention	3.29±0.99	3.37±0.99	-0.756	0.450

(2) Differential Analysis of Student Learning at Different Grade Levels

As can be seen from the table below, the analysis of variance (one-way ANOVA) was used to analyze the differences between students of different grades on six items: quality of platform, expected quality, perceived quality, facilitating conditions, satisfaction, and willingness to use, with the quality of the platform presenting a level of significance at the 0.01 level (F = 27.678, p = 0.000), expected quality presenting a level of significance at the 0.01 level (F = 19.368, p=0.000), perceived quality showed 0.01 level of significance (F=25.824, p=0.000), facilitating conditions showed 0.01 level of significance (F=18.806, p=0.000), satisfaction showed 0.01 level of significance (F=30.742, p=0.000), and willingness to use showed 0.01 level of significance (F=19.082, p=0.000), the different grade samples showed significant differences for platform quality, expected quality, perceived quality, facilitating conditions, satisfaction, and willingness to use all. It can be concluded

that the sample of students from different grades showed significant differences (p<0.05) for all the components.

Table 6 Differential Analysis of Student Learning at Different Grade Levels

	Your grade level (Mean±S.D.)				**F**	**p**
	first-year（n=97）	second-year (n=92)	third-year (n=106)	fourth-year (n=96)		
Platform quality	2.72±0.72	3.20±0.72	3.77±1.03	3.49±0.88	27.678	0.000**
Expected quality	2.87±0.78	3.08±0.78	3.76±1.08	3.48±0.91	19.368	0.000**
Perceived Quality	2.86±0.74	3.29±0.85	3.91±0.93	3.45±0.90	25.824	0.000**
Facilitating conditions	2.92±0.82	3.07±0.80	3.75±0.99	3.52±0.90	18.806	0.000**
Satisfaction	2.71±0.72	3.15±0.93	3.92±0.99	3.37±0.98	30.742	0.000**
Usage Intention	2.86±0.76	3.17±0.87	3.79±1.03	3.50±1.01	19.082	0.000**

From the above table, it can be seen that the average values of platform quality, expected quality, perceived quality, promotion conditions, satisfaction, and willingness to use of students in different grades show a trend of increasing from freshman year to sophomore year to junior year and decreasing in the fourth year, but all the values are higher than the sophomore year values in the senior year. Combined with consideration of the distribution of credits and class hours from freshman to junior year, this is consistent with the increasing trend from freshman to junior year. As students progress through the grades from freshman to junior year, their cognitive abilities and learning strategies typically mature. Senior students may be more aware of how to effectively utilize the resources of a blended learning platform and how to combine online and offline learning for optimal learning outcomes. This may lead to a cascading increase in their satisfaction with and willingness to use blended learning. In contrast, the senior stage mainly completes the graduation internship, the production of graduation design and the writing of graduation thesis (design statement), which requires the integration of four years of knowledge, and the demand for and courses appears to be reduced. This is reflected in the fact that students in the fourth year may participate in the public recruitment examination, graduate school examination, relevant qualification examination, etc. The overall trend of change is more in line with the reality of four years of undergraduate study. Overall analysis shows that the changing trends of students' attitudes, perceptions and behavioral willingness towards blended learning in different grades may be influenced by various factors such as cognitive development, technological proficiency, course requirements, future planning and facilitating conditions.

(3) Differential analysis of students' learning in different majors

As can be seen from the table below, the analysis of variance (one-way ANOVA) was used to analyze the differences between students of different majors on six items: quality of platform, expected quality, perceived quality, facilitating conditions, satisfaction, and willingness to use, with the quality of the platform showing a level of significance at the 0.01 level (F = 38.915, p = 0.000), expected quality showing a level of significance at the 0.01 level (F = 23.407, p=0.000), perceived quality showed 0.01 level of significance (F=37.559, p=0.000), facilitating conditions showed 0.01 level of significance (F=26.588, p=0.000), satisfaction showed 0.01 level of significance (F=35.494, p=0.000), and willingness to use showed 0.01 level of significance (F=21.404, p=0.000), and it can be concluded that the

sample students of different grades showed significant differences (p<0.05) for all the contents.

Table 7 Differential analysis of students' learning in different majors

	Your specialty(Mean±S.D.)			F	p
	natural sciences (n=157)	Humanities and Social Sciences (n=161)	Arts and Sports(n=73)		
Platform quality	3.71±0.98	3.21±0.78	2.66±0.73	38.915	0.000**
Expected quality	3.68±1.05	3.13±0.82	2.90±0.79	23.407	0.000**
Perceived Quality	3.81±0.92	3.24±0.83	2.82±0.78	37.559	0.000**
Facilitating conditions	3.70±0.95	3.17±0.87	2.86±0.78	26.588	0.000**
Satisfaction	3.74±1.03	3.17±0.91	2.67±0.74	35.494	0.000**
Usage Intention	3.68±1.06	3.24±0.89	2.84±0.76	21.404	0.000**

From the above table, it can be seen that students of different majors show a trend of natural sciences＞humanities and social sciences＞art and sports in terms of platform quality, expected quality, perceived quality, facilitating conditions, satisfaction and willingness to use. From the perspective of matching the characteristics of disciplines and teaching modes, natural science majors usually emphasize empirical research and experimental operation, while humanities and social sciences majors focus on theoretical exploration and text analysis, and arts and sports majors focus on the cultivation of practical skills. The blended teaching mode combines the flexibility of online and the interactivity of offline, which may be more suitable for the needs of natural science majors, as these majors can use online resources for experimental simulation and data analysis, while conducting practical operations and discussions offline; analyzing from the perspective of students' adaptability and acceptance of technology, natural science students may be more accustomed to using technological tools and online resources for learning, which makes it easier for them to adapt to the blended learning platform. In contrast, students in humanities and social sciences and arts and sports may be more accustomed to traditional teaching methods and less dependent on online teaching platforms, so their expected and perceived quality may not be as high as that of natural science students. Meanwhile, various aspects such as the quality of teaching resources, teachers' teaching strategies, and learning environments may also appear to be in different states due to differences in specialties.

(4) Differential Analysis of Learning for Students with Different Experiences

level of significance (F=19.874, p=0.000), for perceived quality (F=36.913, p=0.000), for facilitating conditions (F=19.388, p=0.000), for satisfaction (F=35.591, p= 0.000), for willingness to use presented a 0.01 level of significance (F=21.210, p=0.000), and it can be concluded that the sample students of different grades presented significant differences (p<0.05) for all the contents.

Table 8 Differential Analysis of Learning for Students with Different Experiences

	You have participated in a blended learning experience (Mean±S.D.)			F	p
	less participation experience (1-2 courses) (n=107)	some experience(3-4 courses) (n=178)	Extensive experience (more than 4 courses) (n=106)		
Platform quality	2.75±0.73	3.36±0.83	3.78±1.02	38.090	0.000**
Expected quality	2.91±0.78	3.31±0.88	3.71±1.10	19.874	0.000**
Perceived Quality	2.90±0.79	3.37±0.88	3.92±0.90	36.913	0.000**
Facilitating conditions	2.94±0.79	3.33±0.90	3.71±1.00	19.388	0.000**
Satisfaction	2.77±0.75	3.31±0.96	3.84±1.04	35.591	0.000**
Usage Intention	2.92±0.77	3.35±0.96	3.76±1.06	21.210	0.000**

From the above table, it can be seen that students with different experiences on platform quality, expected quality, perceived quality, facilitating conditions, satisfaction, and willingness to use all show the trend of the higher the number of times they use blended learning, the higher the use of each indicator. As students use the blended learning platform more often, they become more familiar with the platform's interface, functions, and operating procedures, which increases their ease of use and satisfaction. Increased familiarity also helps students to utilize the platform resources more effectively, thus improving learning efficiency and outcomes, which is reflected in increased perceived quality and willingness to use. Meanwhile, as students become more proficient in the use of technology, they are able to engage in online learning activities more efficiently, increasing learning satisfaction and recognition of the quality of the platform. In terms of expected quality, as they gain experience, their expectations may gradually adjust to a more realistic level, which contributes to their perceived quality and satisfaction. In the process, they will also develop a set of blended learning methods and strategies that suit them, understand how to communicate and interact and get feedback from teachers through online and offline blended learning, which in turn improves students' self-efficacy, which is clearly reflected in the changes in perceived quality and various data.

Discussion

According to this model and the study, it can be clarified that platform quality, perceived quality, and expected quality have a positive effect on satisfaction, which fully indicates that a stable, efficient, and easy-to-use online teaching platform is a key factor in enhancing students' satisfaction, while the quality of course content and students' expectations of teaching also have a positive effect on satisfaction. This echoes the view of Professor He Kexiang (2004), who emphasized that blended teaching should combine the advantages of traditional teaching and the advantages of networked teaching to achieve better teaching and learning results, and the online platform acts as a very important role compared to the traditional teaching mode. In Yen (2024), the key factors that significantly affect learner satisfaction in a blended learning environment are studied, among which satisfaction, teaching resources and content, platform and technical support, and teacher-student interaction are all important factors that affect satisfaction.

Among the effects of the variables on willingness to use, satisfaction, facilitating conditions, and perceived quality were confirmed to have a significant positive correlation, which is in line with the findings of Venkatesh (2012), the founder of the UTAUT model, and emphasizes the central role of satisfaction in the model of technology acceptance. Facilitating conditions, such as technical support and the availability of course resources, also positively influenced willingness to use, but their influence ranked behind that of satisfaction. Perceived quality, including subjective evaluations of content and teaching methods, also positively affects willingness to use, but its influence is less strong than that of satisfaction and facilitating conditions. In Jiang Fengjuan's (2021) study, based on the UTAUT extended model, it was also concluded that mobile self-efficacy, performance expectancy, effort expectancy, social influence, and achievement motivation had a significant effect on behavioral intention to learn among college students. In Zhang Xiaolei's (2024) study, it was proposed that blended learning adoption behavior involves not only attitudes toward technology, but also the profound influence of contextual factors related to blended learning implementation, such as teachers' teaching job characteristics, school organizational context, internal and external teaching communities, and the policy environment, which echoed the facilitating conditions and perceived quality in this study.Lyu Wanqing & Ge xufeng(2020) found that perceived ease of use and perceived usefulness affect willingness to use by influencing attitude toward use. Shao Meijun (2022) found through empirical analysis that performance expectations, social influence, perceived enjoyment, and facilitating conditions had a significant positive effect on college students' willingness to use online instruction.

Suggestions

1. Theoretical suggestions

Based on the conclusions of this study, it is suggested that future theoretical research further explore the impact mechanisms of platform quality, perceived quality, and expected quality on learners' satisfaction when constructing blended learning models. Additionally, it would be valuable to investigate how these factors, through satisfaction and facilitating conditions, influence learners' intention to use. Future theoretical models could also incorporate various academic backgrounds, grade levels, and individual student characteristics to examine their specific roles in blended learning, thereby providing theoretical support for improving students' learning experiences..

2. Policy suggestions

At the policy level of higher education, it is recommended that education authorities and university administrators focus on supporting and resource allocation for blended learning models. Firstly, relevant policies should be formulated to promote the deep integration of information technology and education, encouraging universities to build high-quality blended learning platforms that meet the needs of students from various disciplines and grade levels. Secondly, universities should adopt policies and funding support to encourage instructors to integrate online and offline teaching content effectively, optimizing course designs and teaching strategies to improve teaching quality and student engagement. Lastly, both government and universities should focus on teacher training and professional development, enhancing teachers' digital literacy and online teaching skills to meet the needs of modern educational models.

3. Further Research suggestions

Although this study provides valuable insights into the theory and practice of blended learning, the results are limited by the sample size and scope. Future research could expand the sample to include more universities and diverse student populations to increase the generalizability of the findings. Additionally, further studies could explore the long-term effects of blended learning on students' academic performance and personal development, as well as investigate how different technological tools and platforms influence student learning outcomes. Finally, the role of instructor-student interaction in blended learning environments should be examined more deeply, as this could offer valuable insights into improving both the design and implementation of blended teaching strategies.

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