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Unraveling Success in Online Learning: Exploring Helpfulness, Usefulness, Compatibility, and Satisfaction Among College Students in Chengdu, China

Liu Chang*

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Abstract

Purpose: This study seeks to analyze the impact of online learning on 12 major universities in Chengdu, Sichuan Province, China. The primary research focuses on the helpfulness, perceived usefulness, compatibility, and satisfaction with online learning. **Research design, data, and methodology:** The sample data were gathered using a questionnaire survey. This study has a target population of 500 people. Before disseminating the questionnaire, the content's validity and reliability were assessed using Project Objective Consistency (IOC) and Cronbach's Alpha preliminary tests, with outstanding results. To examine the data, confirmatory factor analysis (CFA) and structural equation modeling (SEM) will be used to ensure the model's goodness of fit and confirm the causal relationship between the hypothesis testing variables. **Results:** Quality of experience significantly impacts helpfulness, and perceived ease of use significantly impacts perceived usefulness and compatibility. Product demonstrability was the strongest predictor of satisfaction, followed by product originality and perceived compatibility. **Conclusion:** Six of the eight hypotheses presented were supported and proved to achieve the research objectives. Therefore, developers should ensure the quality of experience, perceived ease of use, compatibility, product originality, and product demonstrability of online learning systems.

Keywords: Online learning, Helpfulness, Perceived usefulness, Perceived compatibility, Satisfaction

JEL Classification Code: E44, F31, F37, G15

1. Introduction

At present, education is gradually showing the characteristics of informatization. As an effective supplement to traditional learning, online learning has advantages, such as being virtual, open, interactive, and intelligent. Online learning has become a very important link in the informatization of college education. Especially under the influence of COVID-19 in recent years, online learning has been greatly promoted and developed. Online learning has been essential for educational continuity during the COVID-19 pandemic. Online learning's future relies on principles of openness and equality (Morales-Cevallos et al., 2020). Quality and student satisfaction are influenced by service quality, teacher engagement, and system functionality (Zheng et al., 2021). Digital competencies and online interactions play a role, though they are less critical than previously assumed (Alqahtani et al., 2021). While online learning is effective in maintaining educational activities during the crisis, it has been demonstrated that continuing interest in the quality of service and the role of teachers is important to maximize student satisfaction and expression.

During real online learning, personalized and adaptive learning environments are crucial for effective e-learning (Noesgaard & Ørngreen, 2015). When properly implemented, E-learning can be as effective as traditional classroom instruction (Bernard et al., 2014).

The concept of online learning is a technology-mediated learning strategy with significant educational potential, and it has been one of the primary research areas in Educational Technology in recent decades (Morales-Cevallos et al., 2020). According to Marín-Díaz et al. (2022), mobile apps and AI technologies significantly improve student

1*Liu Chang, College of Communication Engineering (College of Microelectronics), Chengdu University of Information Technology. Email: 199458158@qq.com

engagement and self-efficacy. Online learning offers significant benefits in terms of flexibility and accessibility, but it must be designed to address challenges like isolation and to keep students motivated. Integrating mobile educational applications and AI technologies enhances online learning's effectiveness, improving student engagement and self-efficacy.

With Internet technology's widespread adoption and advancement, online education in China has entered a new era. According to the "Online Education in China (2024)" report, China's online education business will be worth USD 45.06 billion in 2024. Expect a 0.15% annual growth rate (CAGR) from 2024 to 2029.

Due to policy support and technological advancements, online education in China has grown quickly. However, it still needs to overcome many obstacles, such as uneven access to resources, poor technical assistance, poor teacher-student interaction, inconsistent teaching quality, and network security threats. By addressing these concerns, online education can only progress to a higher standard and fully realize its potential in terms of educational equity and quality enhancement.

Online learning means that students have more freedom, requiring them to learn independently and evaluate their learning effects. Students who cannot effectively control their behavior will be less satisfied with online learning. Therefore, we hope to improve the Helpfulness, Perceived usefulness, Perceived compatibility, and satisfaction of online teaching through research on the quality of experience, helpfulness, perceived ease of use, perceived usefulness, perceived compatibility, product originality, product demonstrability of college students' online learning.

2. Literature Review

2.1 Quality of Experience

The Quality of Experience (QOE) is the subjective perception of the end-user's overall acceptability of an application or service. It encompasses the user's expectations, requirements, and satisfaction (Möller et al., 2014). It comprehensively assesses the user's perceived service efficacy (Fiedler et al., 2010). From the user's perspective, Quality of Experience (QOE) encompasses subjective and objective metrics that determine the perceived quality of a service. De Moor et al. (2010) defines it as a multidimensional construct encompassing aesthetics, usability, and satisfaction. It incorporates user perceptions and uses context with technical performance metrics (Laghari & Connelly, 2012). The interaction of device performance, network conditions, and application design determines the quality of experience in mobile applications. User context and expectations are also very important (Schatz & Egger, 2008).

H1: Quality of experience has a significant impact on helpfulness.

2.2 Perceived Ease of Use

Perceived ease of use is a person's belief that utilizing a specific system will be effortless (Davis, 1989). Perceived ease of use is the degree to which a person believes that using a system will need no physical or mental effort (Venkatesh & Davis, 2000). Perceived ease of use is the degree to which a person believes utilizing a given technology is simple (Williams et al., 2015). Perceived ease of use refers to an individual's belief that using a system requires little effort (Venkatesh, 2000). Perceived ease of use is the degree to which a person believes that utilizing a specific system will be effortless (Burton-Jones & Gallivan, 2007).

H2: Perceived ease of use has a significant impact on Perceived usefulness.

H3: Perceived ease of use has a significant impact on Perceived compatibility.

2.3 Helpfulness

Helpfulness is determined by how the content and style of online product reviews support consumers in making educated purchasing decisions, with clarity, detail, and relevancy being major variables (Pan & Zhang, 2011). In online reviews, helpfulness is defined as the extent to which a review supports consumers in making educated purchasing decisions. The number of helpful votes an online review obtains relative to total votes indicates its usefulness in assisting consumer decisions (Cheung & Thadani, 2012). Helpfulness is how peer feedback contributes to learning, as evaluated by improved knowledge transfer and educational outcomes (Yang et al., 2016). Helpfulness is the degree to which other consumers see an online review as valuable, frequently associated with extensive, balanced, and well-explained information (Forman et al., 2008). Helpfulness is measured by the influence of review sorting methods on sales, with more helpful reviews leading to higher sales (Yin et al., 2014). Helpfulness is a component of perceived usefulness that indicates how well an information system assists users in completing activities (Pavlou, 2003).

Markopoulos and Moschopoulos (2014) found that reviews with higher data quality are perceived as more helpful, as evidenced by more positive usefulness votes. Berkowitz and Conlon (2017) indicate that higher-quality reviews are more likely to be perceived as helpful, which positively impacts product sales. Many studies have examined the causal relationship between the quality of experience and usefulness and have proposed hypotheses

that the quality of experience significantly impacts usefulness, as shown in the following hypotheses.
H4: Helpfulness has a significant impact on satisfaction.

2.4 Perceived Usefulness

Perceived usefulness is "the extent to which a person believes that using a system will improve their performance or productivity." (Pavlou, 2003). Perceived usefulness is "the degree to which a person believes that using a particular system would enhance his or her job performance." (Davis, 1989). Perceived usefulness is "the extent to which a person believes that using a system will improve his or her job performance." (Venkatesh & Davis, 2000). Perceived usefulness is "the extent to which a person believes that using a digital library will enhance their academic performance." (Thong et al., 2002). Perceived usefulness is "the degree to which an individual believes that using a particular technology will enhance their job performance." (Igbaria et al., 1995).

Davis (1989) found that perceived ease of use positively influences perceived usefulness, supporting the notion that easier-to-use systems are also perceived as more useful. Oinas-Kukkonen and Harjumaa (2009) state that the easier the system is to use, the more useful it is, thus enhancing overall user acceptance. Al-Harbi (2011) highlights that ease of use is a pivotal factor that enhances the perceived usefulness of e-learning systems, thereby improving their effectiveness.
H5: Perceived usefulness has a significant impact on satisfaction.

2.5 Perceived Compatibility

Perceived compatibility is "the degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters." (Tornatzky & Klein, 1982). The degree to which a new idea, product, or practice is regarded to be compatible with the adopter's values, experiences, and requirements (Rogers, 1995). Perceived compatibility is "the degree to which an innovation fits with the potential adopter's existing values, previous experiences, and current needs." (Taylor & Todd, 1995). Perceived compatibility is "the degree to which a new product is consistent with the existing values, needs, and past experiences of the adopters." (Lin, 2011).

Venkatesh and Davis (2000) state that perceived ease of use positively influences perceived compatibility, suggesting that users find systems that are easier to use more compatible with their needs and values. Venkatesh et al. (2003a) explain that perceived ease of use significantly predicts perceived compatibility, affecting overall user acceptance. Lin and Jones (2015) indicate that Perceived ease of use enhances perceived compatibility, subsequently impacting the acceptance of new technology.
H6: Perceived compatibility has a significant impact on satisfaction.

2.6 Product Originality

Product originality is "the extent to which a product is perceived as novel and different from existing products in the market." (Im & Workman, 2004). Originality is "the quality of being novel and different from what is common or customary in the marketplace, often characterized by unique features or design." (Moreau & Dahl, 2005). The term "originality" implies "the perceived novelty and uniqueness of a product, often resulting from innovative design or features that distinguish it from competitors." (Keller & Lehmann, 2003). The extent to which a product is considered novel, innovative, and distinct from current items, frequently incorporating unique features or technology (Szymanski et al., 2007). Product originality is "the extent to which a product stands out in the market due to its unique and novel characteristics." (Carpenter & Nakamoto, 1989).

Keržič et al. (2021) highlight that original and engaging e-learning methods significantly enhance student satisfaction. Ma and Bennett (2021) suggest that product originality in academic engagement correlates with higher student satisfaction and lower stress levels. When users perceive a product's service as novel and unique, it can significantly improve user satisfaction. Wang and Ahmed's (2004) study emphasize that product originality and innovation are positively correlated with user satisfaction, as users tend to value and appreciate unique and innovative products.
H7: Product originality has a significant impact on satisfaction.

2.7 Product Demonstrability

Product demonstrability is "the extent to which the benefits and usage of a product can be effectively shown or demonstrated to potential customers, thereby facilitating their understanding and acceptance." (Rogers, 2003). Product demonstration is "the capability to clearly show and explain how a product works and its advantages, thus aiding in customer comprehension and purchase decisions." (Dube & Morgan, 1996). Product demonstrability is "the ease with which potential users can observe and understand the functionality and benefits of a new product or technology." (Davis, 1989). Product demonstrability is "the extent to which the features and advantages of a product can be effectively demonstrated to potential users, enhancing their perception and likelihood of usage." (Shimp & Andrews, 2013). Product demonstrability is "the ability to show potential customers how a product works and the benefits it

provides, thereby influencing their satisfaction and loyalty." (Oliver, 1999). Product demonstrability is "the degree to which a product's features, benefits, and performance can be demonstrated to and understood by potential customers." (Henard & Szymanski, 2001).

Johnson and Martin (2020) explain that product demonstrability in e-learning significantly contributes to higher student satisfaction and performance. Product demonstrability plays an important role in user satisfaction. Moore and Benbasat's (1991) study suggest that when users can see and understand the advantages of a technology, they are more likely to be satisfied with its use. Therefore, the following hypothesis is proposed in this study:

H8: Product demonstrability has a significant impact on satisfaction.

2.8 Satisfaction

Satisfaction is characterized by "a consumer's overall contentment with a product or service, often resulting from a comparison of expectations with actual performance." (Oliver, 1980). "The extent to which a customer's expectations are met or exceeded by a company's product or service" is satisfaction. (Westbrook & Oliver, 1991). The definition of satisfaction is "a post-consumption evaluative judgment concerning a specific product or service." (Anderson & Srinivasan, 2003). Satisfaction is a "feeling of pleasure or disappointment resulting from comparing a product's perceived performance (or outcome) about his or her expectations." (Churchill & Surprenant, 1982). Satisfaction is "the degree to which the consumption experience is perceived as meeting or exceeding customer expectations." (Heskett et al., 1997).

3. Research Methods and Materials

3.1 Research Framework

A conceptual framework is a specific approach to thinking about a research problem, usually represented as a diagram to show important concepts and processes.

The conceptual framework supporting this Ph.D. dissertation was built on earlier conceptualizations and contained nearly all the eight latent variables used in the present study.

The project aims to identify the factors influencing online learning among college students in Chengdu, including helpfulness, usefulness, compatibility, and satisfaction. Das et al. (2019) developed the first conceptual framework for studying the use of pre-class videos in undergraduate business information system management courses to improve student learning outcomes and satisfaction. Therefore, we cited three variables: quality of experience, helpfulness, and satisfaction. Ifinedo (2017) developed a comprehensive conceptual framework, and we cited three variables: perceived usefulness, perceived ease of use, perceived compatibility, and satisfaction. Al Natour and Woo (2021) also provided a third theoretical framework, showing the relationship between product originality, satisfaction, and product demonstrability. We referenced two variables: product originality, and product demonstrability.

The theoretical framework for this study was ultimately formed. The independent variables of the paper are quality of experience and perceived ease of use, product originality, and product demonstrability. In addition, the mediating variables are helpfulness, perceived usefulness, and perceived compatibility. Finally, the single dependent variable in this academic study is satisfaction.

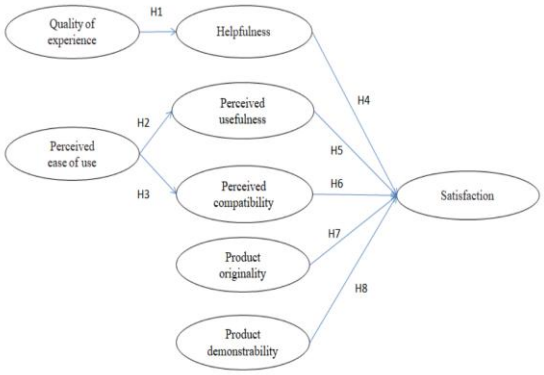

Figure 1: Conceptual Framework

H1: Quality of experience has a significant impact on helpfulness.

H2: Perceived ease of use has a significant impact on Perceived usefulness.

H3: Perceived ease of use has a significant impact on Perceived compatibility.

H4: Helpfulness has a significant impact on satisfaction.

H5: Perceived usefulness has a significant impact on satisfaction.

H6: Perceived compatibility has a significant impact on satisfaction.

H7: Product originality has a significant impact on satisfaction.

H8: Product demonstrability has a significant impact on satisfaction.

3.2 Research Methodology

This study's primary goal is to identify the variables affecting Chengdu college students' perceptions of helpfulness, usefulness, compatibility, and satisfaction with

online learning. The conceptual framework includes Quality of Experience, Helpfulness, Perceived ease of use, Perceived usefulness, Perceived compatibility, Product originality, Product demonstrability, and the dependent variable Satisfaction. Using the target population and sample size, choose 500 college students with prior experience in online learning from Chengdu's 12 major schools. A sampling technique consists of multiple processes, such as purposive, stratified random, and convenience sampling.

The consistency of project goals (IOC) was maintained to do preliminary analysis, and the outcomes of expert ratings were utilized to verify the content's efficacy. Implementing a pilot test with 30 participants to verify the data's dependability before adopting reliability testing. The questionnaire comprised three elements: screening questions, demographic information, and scale items. Descriptive analysis was done to assess the normalcy of the data and its demographic features. Measurement models or confirmatory factor analysis (CFA) verify the goodness of fit index, discriminant, and convergent validity. Use structural equation modeling, or SEM, to verify important linkages and test theories.

3.3 Population and Sample Size

The target population refers to the entire group of individuals or elements the researcher is interested in studying, from which a sample will be drawn for the research study." (Trochim, 2005). "The target population is the larger group that the researcher wishes to draw conclusions about and to whom the research results will be applicable." (Babbie, 2016). The researchers considered students from twelve universities in Chengdu who had experience using e-learning in this study. According to Sedgwick's (2015) study, the sampling method consists of three sampling units used to determine the "what" and "who" for statistical selection. The sample unit of this study involves three aspects: the student group studying in 12 major universities in Chengdu and the students who have been using online learning during COVID-19. This study collected data from 500 participants using an online questionnaire distribution method.

In the research, 500 participants are undergraduates and postgraduates from 12 major universities in Chengdu, China. They have all participated in online learning organized by their universities for at least one semester. In order to obtain better statistical results, the recommended minimum sample size is 444. Therefore, 500 respondents are designated for this research.

3.4 Sampling Technique

To study specific groups that share common characteristics with the target population, this study used quantitative methods (Creswell, 2014). Nonprobability sampling is when researchers randomly select samples based on their preferences, needs, or judgments. Students from the top twelve schools in Chengdu will receive a questionnaire as part of the sampling process. A sampling technique consists of multiple processes, such as purposive sampling, stratified random sampling, and convenience sampling. This study divides the sampling process into three steps.

In the first step, purposive sampling was used to select 12 universities. These 12 universities are the most influential and representative in Chengdu, and their students are also the most representative.

In the second step, the stratification random sampling method was used.

"Stratified random sampling is a method that involves dividing the population into distinct subgroups, or strata, based on specific characteristics, and then randomly sampling from each subgroup. This technique is used to ensure that all segments of the population are represented in the sample." (Cochran, 1977).

The third step used purposive and convenient sampling of college students from 12 universities using visual and convenience sampling. It was ensured that the sample had at least one semester of e-learning experience.

The researchers will distribute electronic and paper questionnaires to students who have learned online at these 12 universities.

Table 1: Sample Units and Sample Size

Universities	Population	Sample Size
1	64000	74
2	34000	39
3	45000	52
4	23000	26
5	40000	46
6	44000	51
7	36000	41
8	41000	47
9	26000	30
10	26000	30
11	25000	29
12	30000	35
Total	**434000**	**500**

4. Results and Discussion

4.1 Demographic Information

The questionnaire was distributed to 500 students from 12 selected universities in Chengdu. Table 2 shows the demographics of the participants.

Among the respondents, 43.2% were male and 56.8% were female. There are 206 students aged 18-20, accounting for 41.2%; 152 students aged 21-22, accounting for 30.4%;

51 students aged 23-24, accounting for 10.2%; 91 students aged over 24, accounting for 18.2%. 331 people used e-learning once a day, accounting for 66.2 %; 111 people used it once a week, accounting for 22.2 %; 32 people used it once every two weeks, accounting for 6.4%; and 26 people used it once a month, accounting for 5.2%. The main groups of respondents were undergraduates, with first-year college students accounting for 24.8%, sophomores accounting for 15.8%, juniors accounting for 26.4%, seniors accounting for 19.8%, and the remaining 13.2% were graduate students. Among those more accustomed to online learning, 298 people chose mobile apps, accounting for 59.6%; 151 people chose computer web pages, accounting for 30.2%; and 51 people chose everything depends, accounting for 10.2%. Regarding the efficiency of online learning, 9.8% of students think it is just so-so, 32.8% think it is good, 38.6% think it is very good, and 18.8% think it is excellent.

Table 2: Demographic Profile

Demographic and General Data (N=500)		Frequency	Percentage
Gender	Male	216	43.2%
	Female	284	56.8%
Age	18 to 20 years old	206	41.2%
	21 to 22 years old	152	30.4%
	23 to 24 years old	51	10.2%
	More than 24 years old	91	18.2%
Duration of daily e-learning usage	Once a day	331	66.2%
	Once a week	111	22.2%
	Once every two weeks	32	6.4%
	Once a month	26	5.2%
Grade of a student	First year college	124	24.8%
	Sophomore	79	15.8%
	Junior	132	26.4%
	Senior	99	19.8%
	postgraduate	66	13.2%
More accustomed to using in online learning	Mobile APP	298	59.6%
	Computer webpage	151	30.2%
	Everything depends	51	10.2%
Think of the efficiency of online learning	Just so-so	49	9.8%
	Good	164	32.8%
	Very good	193	38.6%
	Excellent	94	18.8%

4.2 Confirmatory Factor Analysis (CFA)

"CFA is used to verify the factor structure of a set of observed variables. It allows researchers to test the hypothesis that a relationship exists between observed variables and their underlying latent constructs." (Jim, 2023). "The steps include defining constructs, developing the measurement model, specifying the model, and assessing model fit. Model fit is evaluated using indices such as Chi-square, RMSEA, GFI, and CFI." (Statistics Solutions, 2013). CFA is used to test whether measures of a construct are consistent with a researcher's understanding of the nature of that construct. The objective is to test whether the data fit a hypothesized measurement model (Wikipedia, 2023). "Good model fit is indicated by indices such as a low RMSEA (≤ 0.06) and a high CFI (≥ 0.95)." (Science Direct, 2023).

As shown in Table 3, survey data from 500 participants were analyzed in this study, and Cronbach's alpha test results were all above 0.7. The factor loadings for each item were above 0.70. The CR (composite reliability) values obtained were all above 0.7, ranging from 0.902 to 0.966. the AVE values were greater than 0.5, reflecting high construct and convergent validity.

Table 3: Confirmatory Factor Analysis Result, Composite Reliability (CR) and Average Variance Extracted (AVE)

Variables	Source of Questionnaire (Measurement Indicator)	No. of Item	Cronbach's Alpha	Factors Loading	CR	AVE
Quality of experience (QOE)	Möller et al. (2014)	3	0.951	0.923-0.936	0.951	0.866
Helpfulness (HF)	Pan and Zhang (2011)	3	0.932	0.899-0.916	0.932	0.821
Perceived Ease of Use (PEOU)	Venkatesh and Davis (2000)	4	0.908	0.800-0.872	0.909	0.714
Perceived Usefulness (PUSS)	Davis (1989)	4	0.914	0.828-0.871	0.914	0.726
Perceived compatibility (PCMT)	Tornatzky and Klein (1982)	4	0.957	0.870-0.946	0.958	0.850
Product originality (PO)	Im and Workman (2004)	3	0.901	0.851-0.901	0.902	0.754
Product demonstrability (PD)	Rogers (2003)	4	0.929	0.782-0.936	0.931	0.772
Satisfaction (SATI)	Oliver (1980)	5	0.965	0.799-0.975	0.966	0.852

As Table 4 shows, the values of the goodness of fit indicators of the original measurement model in this study are consistent with the standard requirements, indicating a state of model fit.

Table 4: Goodness of Fit for Measurement Model

Fit Index	Acceptable Criteria	Statistical Values
CMIN/DF	< 5.00 (Al-Mamary & Shamsud din, 2015; Awang, 2012)	965.943/377 or 2.562
GFI	≥ 0.85 (Sica & Ghisi, 2007)	0.887
AGFI	≥ 0.80 (Sica & Ghisi, 2007)	0.861
NFI	≥ 0.80 (Sica & Ghisi, 2007)	0.963
CFI	≥ 0.80 (Bentler, 1990)	0.940
TLI	≥ 0.80 (Sharma et al., 2005)	0.957
RMSEA	< 0.08 (Pedroso et al., 2016)	0.056
Model Summary		**Acceptable Model Fit**

Remark: CMIN/DF = the ratio of the chi-square value to degree of freedom, GFI = goodness-of-fit index, AGFI = adjusted goodness-of-fit index, NFI = normalized fit index, CFI = comparative fit index, TLI = Tucker Lewis index, and RMSEA = root mean square error of approximation

Discriminant validity refers to the degree to which measures of different constructs are unrelated. It is demonstrated when a test does not correlate strongly with measures from which it is supposed to differ, indicating that the constructs are distinct. (Campbell & Fiske, 1959). By comparing the variance of the mean AVE between two constructs, discriminant validity can be measured. (Bove et al., 2009). As shown in Table 5, extracting the square root of the mean-variance revealed that all correlations were greater than the corresponding correlation value for that variable.

Table 5: Discriminant Validity

	QOE	HF	PEOU	USS	PCMT	PO	PD	SATI
QOE	**0.931**							
HF	0.380	**0.906**						
PEOU	0.482	0.372	**0.845**					
PUSS	0.273	0.612	0.359	**0.852**				
PCMT	0.542	0.281	0.439	0.223	**0.922**			
PO	0.474	0.383	0.425	0.303	0.352	**0.868**		
PD	0.474	0.325	0.409	0.269	0.385	0.598	**0.879**	
SATI	0.453	0.319	0.404	0.287	0.409	0.445	0.601	**0.923**

Note: The diagonally listed value is the AVE square roots of the variables
Source: Created by the author.

4.3 Structural Equation Model (SEM)

"Assessing model fit is crucial in SEM, with various indices like RMSEA, CFI, and TLI used to evaluate how well the model corresponds to the data." (Hu & Bentler, 1999). "The structural model in SEM specifies the relationships among latent variables, outlining the direct and indirect paths between them." (Hoyle, 2012). The chi-square statistic (CMIN/df), goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), Normed fit index (NFI), comparative fit index (CFI), Tucker-Lewis index (TLI), and root-mean-square error of approximation (RMSEA) were chosen to assess the relationship between eight latent variables of quality of experience, perceived ease of use, helpfulness, perceived usefulness, perceived compatibility, product originality, product demonstrability, and satisfaction.

For better model fitting, the model was examined using SEM and corrected based on the results. In this study, the results are CMIN/DF = 3.341, GFI = 0.851, AGFI = 0.811, NFI = 0.924, CFI = 0.945, TLI = 0.935 and RMSEA = 0.068, as shown in Table 6.

Table 6: Goodness of Fit for Structural Model

Fit Index	Acceptable Criteria	Statistical Values
CMIN/DF	< 5.00 (Al-Mamary & Shamsuddi n, 2015; Awang, 2012)	3.341
GFI	≥ 0.85 (Sica & Ghisi, 2007)	0.851
AGFI	≥ 0.80 (Sica & Ghisi, 2007)	0.811
NFI	≥ 0.80 (Sica & Ghisi, 2007)	0.945
CFI	≥ 0.80 (Bentler, 1990)	0.924
TLI	≥ 0.80 (Sharma et al., 2005)	0.935
RMSEA	< 0.08 (Pedroso et al., 2016)	0.068
Model Summary		**Acceptable Model Fit**

Remark: CMIN/DF = the ratio of the chi-square value to degree of freedom, GFI = goodness-of-fit index, AGFI = adjusted goodness-of-fit index, NFI = normalized fit index, CFI = comparative fit index, TLI = Tucker Lewis index, and RMSEA = root mean square error of approximation

4.4 Research Hypothesis Testing Result

Regression and standard path coefficients were used to test the significance of each variable and the appropriateness of the hypothesis. The results in Table 7 show that six of the eight hypotheses were supported. Among them, perceived ease of use has the most significant impact on perceived compatibility. Among the direct impacts on satisfaction, product demonstrability is the most significant—the impact of helpfulness and perceived usefulness on satisfaction needed to be suppor

Table 7: Hypothesis Results of the Structural Equation Modeling

Hypothesis	(β)	t-value	Result
H1: QOE→HF	0.316	7.619*	Supported
H2: PEOU→PUSS	0.358	8.078*	Supported
H3: PEOU→PCMT	0.584	10.070*	Supported
H4: HF→SATI	0.024	0.581	Not supported
H5: PUSS→SATI	0.071	1.745	Not supported
H6: PCMT→SATI	0.238	5.755*	Supported
H7: PO→SATI	0.307	7.870*	Supported
H8: PD→SATI	0.377	8.930*	Supported

Note: * $p<0.05$
Source: Created by the author

The results in Table 7 are analyzed in detail:

H1 proves that the quality of experience significantly impacts helpfulness. The standard coefficient value in the structural path is 0.316. This confirms the statement of Lee and Tan (2013) that high-quality content in online reviews, characterized by clarity, detail, and accuracy, is strongly correlated with higher perceived helpfulness. It also confirms the theory of Das et al. (2019) that the quality of experience positively impacts students' perception of helpfulness. High-quality experience is more likely to benefit students.

In the case of H2, the analysis results support the hypothesis that perceived ease of use significantly impacts perceived usefulness, with a standard coefficient value of 0.358. According to Kim and Park (2012), perceived ease of use significantly enhances perceived usefulness, contributing to higher satisfaction and continued use intentions.

H3 Perceived ease of use has a significant impact on perceived compatibility, which was also supported with a standard coefficient value of 0.584. According to Venkatesh and Davis (2000), perceived ease of use positively influences perceived compatibility, suggesting that users find systems that are easier to use more compatible with their needs and values.

Among the direct impacts on satisfaction are perceived compatibility, product originality, and product demonstrability. That is, H6 perceived compatibility has a significant impact on satisfaction, H7 product originality has a significant impact on satisfaction, and H8 product demonstrability has a significant impact on satisfaction. The standard path coefficients were 0.377, 0.307, and 0.238, respectively, indicating that product demonstrability most impacted satisfaction. This also validates Moore and Benbasat's (1991) findings that perceived compatibility has significantly affected user satisfaction. When users perceive a system to be compatible with their existing work and personal values, they are more likely to feel higher satisfaction. It also supports Wang and Ahmed's (2004) emphasis that product originality and innovation are positively correlated with user satisfaction, as users tend to value and appreciate unique and innovative products. Finally, it also supports Moore and Benbasat's (1991) findings that when users can see and understand the advantages of a technology, they are more likely to be satisfied with its use.

Furthermore, in H4, the standard path coefficient is 0.024, and no direct impact of helpfulness on satisfaction is found; therefore, H4 is not supported. Similarly, the standard path coefficient of H5 is 0.071, and in this case, satisfaction is not found to be impacted by perceived usefulness; therefore, H5 is not supported.

5. Conclusion and Recommendation

5.1 Conclusion

This study focuses on the significant impact of online learning on students at 12 major universities in Chengdu, Sichuan Province, China. Eight hypotheses are proposed to examine the direct or indirect relationships between quality of experience, helpfulness, perceived ease of use, usefulness, compatibility, product originality, product demonstrability, and satisfaction. The questionnaire was developed and distributed to students from 12 major universities in Chengdu, Sichuan Province, China. Choose 500 college students with prior experience in online learning from Chengdu's 12 major schools. The data analysis explores the factors that impact online learning helpfulness, perceived usefulness, compatibility, and satisfaction. This study's sampling technique combines nonprobability and probability sampling, including purposive, stratified random, and convenience sampling. To measure and test the validity and reliability of conceptual models through confirmatory factor analysis (CFA). The structural equation model (SEM) was used to analyze the factors impacting the helpfulness, perceived usefulness, perceived compatibility, and satisfaction of online learning. Six of the eight hypotheses presented were supported. The study's results can be summarized in three main findings: first, quality of experience is a strong predictor of helpfulness. The perceived helpfulness of online learning is significantly enhanced by the quality of experience, with detailed and informative content playing a crucial role (Sun & Morwitz, 2010).

Secondly, perceived ease of use significantly impacts perceived usefulness and compatibility, among which the impact on perceived compatibility is the most significant. That ease of use is a pivotal factor that enhances the perceived usefulness of e-learning systems, thereby improving their effectiveness (Al-Harbi, 2011). That perceived ease of use enhances perceived compatibility, subsequently impacting the acceptance of new technology (Lin & Jones, 2015). In addition, perceived ease of use indirectly impacts student satisfaction with online learning. Thus, perceived ease of use is crucial for improving perceived usefulness and compatibility and indirectly impacts satisfaction.

Finally, of the three factors directly impacting satisfaction, namely perceived compatibility, product originality, and product demonstrability, product demonstrability was the strongest predictor of satisfaction. Moore and Benbasat (1991) study suggest that when users can see and understand a technology's advantages, they are more likely to be satisfied with its use. Johnson and Martin (2020) found that product demonstrability in e-learning

significantly contributes to higher student satisfaction and performance. This also validates the conclusion Al Natour and Woo (2021) proposed in the third theoretical framework, that the product demonstrability of online learning is a key determinant of learner satisfaction. Therefore, it is important to ensure that the product is demonstrable to increase satisfaction.

In conclusion, the objectives of this study have been achieved. That is, the direct impacting factor of college students' online learning helpfulness is quality of experience, the direct impacting factor of perceived usefulness and perceived compatibility is perceived ease of use, and the direct impacting factors of satisfaction are perceived compatibility, product originality, and product demonstrability. The indirect impacting factor of satisfaction is perceived ease of use.

5.2 Recommendation

The researchers found that student helpfulness in online learning was significantly impacted by the quality of the experience at 12 major universities in Chengdu, Sichuan Province, with perceived ease of use having a significant impact on perceived usefulness and perceived compatibility, with the most significant impact on perceived compatibility, and perceived compatibility, product originality, and product demonstrability significantly impacting satisfaction, with product demonstrability being the strongest predictor of satisfaction. Based on the above results, to ensure that an online learning system truly serves students' learning needs and improves learning efficiency and satisfaction, it is necessary to focus on and optimize its quality of experience, perceived ease of use, perceived compatibility, product originality, and product demonstrability. Therefore, it is recommended that personalized learning path planning be provided based on the student's learning progress and abilities to ensure that each student receives the most suitable learning solution for him/her.

Establish efficient teacher-student and student-student interaction mechanisms as a way to improve the quality of the experience. Adopt a simple and clear interface design to reduce redundant information and ensure that students can get started quickly and find the resources they need so that they feel that the system is easy to use. Technicians should make careful considerations from a professional point of view when developing the system to ensure that the online learning system runs smoothly on various devices (e.g., computers, tablets, mobile phones) and operating systems and make appropriate localized adjustments to the online learning system according to the cultural background of the Chengdu region and the needs of students as a means of enhancing students' perceived compatibility with online learning. Establish an incentive mechanism to encourage teachers and students to upload original teaching videos, case studies, practical projects, etc., to enrich the learning resource library, thus enhancing product originality. Optimize live and recorded broadcasting functions to support HD video, PPT synchronous playback, real-time interaction, etc., and create virtual LABS and simulated operating environments so that students can learn and practice in a near-real environment, thereby improving product demonstrability. Overall, it is recommended that the helpfulness, perceived usefulness, perceived compatibility, and satisfaction of online learning for Chengdu University students be enhanced through technical support measures, the production of high-quality content, the enhancement of practice and application orientation, and the improvement of cross-platform compatibility, to build a more efficient, friendly and inclusive online learning environment.

In summary, this study explains the factors affecting the helpfulness, perceived usefulness, perceived compatibility, and satisfaction of online learning for college students. It provides a reference for building a more efficient, useful, comfortable, and popular online learning environment to promote the overall development of college students.

5.3 Limitation and Further Study

The limitations of this study lie in the following:

The study is limited to college students in Chengdu. Differences in educational resources and technological support levels among regions may limit the research results.

The research focuses on four variables: helpfulness, perceived usefulness, perceived compatibility, and satisfaction, but the influencing factors of online learning experience may be more complex.

Government policies, support from educational institutions, and changes in the socio-economic environment may all affect online learning. Due to changes in the external environment, the research results may lose their timeliness.

In further research, in addition to college students in Chengdu, it is also possible to consider including college students from other regions as samples to more comprehensively reflect Chinese college students' online learning experiences and attitudes. It is possible to refer to existing studies in related fields to understand which variables significantly impact online learning experience and attempt to include these variables in the study. Predictive models can be established to predict the potential impacts of future policies and environmental changes on online learning and to consider them in the study.

The above methods can improve the comprehensiveness and timeliness of the research.

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