

Research Article

An Empirical Study on the Factors Influencing Users' Continuance Intention of Using Online Learning Platforms for Secondary School Students by Big Data Analytics

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During the new coronavirus epidemic in 2020, the number of online learning platform users grew explosively, with secondary school students becoming the main group of online learning platform users. Especially the virtual clinical learning environment of online learning platform for secondary school students, as one of the main factors affecting users' sustained use, has become an important issue companies and researchers are faced with. This paper, taking secondary school student users as the research object, constructed a model of factors influencing users' intention to continuously use the online learning platform for secondary school students. The model, based on TAM model and ECM model, consisted of 10 variables, including TP-Teaching presence, resource quality, system quality, perceived usefulness, perceived ease of use, academic identity, self-efficacy, users' satisfaction, teacher-student relationship, and behavioral intention. Results of this study empirically showed that TP-Teaching presence had the most significant effect on perceived usefulness, which in turn indirectly influenced users' continuance intention of using the platform; secondary school student's self-efficacy has the most significant impact on users' continuous intention. Therefore, when developing the platform, enterprises should pay attention to the construction of the platform learning environment and enhance the self-efficacy of secondary school students.

1. Introduction

Online education is an integrated product of traditional education and information technology, with information technology as a carrier to carry out teaching and learning activities. With the continuous development of information technology and mobile Internet, online education has gradually become the main mode of education in the future. According to the 47th Statistical Report on the Development of China's Internet released by China Internet Network Information Center (CNNIC), the scale of online education users in China reached 342 million as of December 2020 [1]. The 2020 Research Report of China's Online Education Industry by IResearch showed that in the first quarter of 2020 alone, the market scale of China's basic online educa-

tion industry reached 21.3 billion yuan; that the proportion increased from 21.3% in the same period to 31.4%; and that in 2020, the market scale of China's online education industry reached 257.3 billion yuan, with a growth rate of 35.5% [2]. As the main battlefield of online education, the share and growth rate of basic education also far exceeded those of early childhood education, interest education, language learning, and other segments, and the basic online education accounted for 42.4%, nearly half of the total in 2020. The epidemic in 2020 has catalyzed the development of online education, leading online learning for secondary school students into an era of normalized development.

Despite the large number of online learning platforms for primary and middle schools, there is a common phenomenon of poor users' experience and high customers'

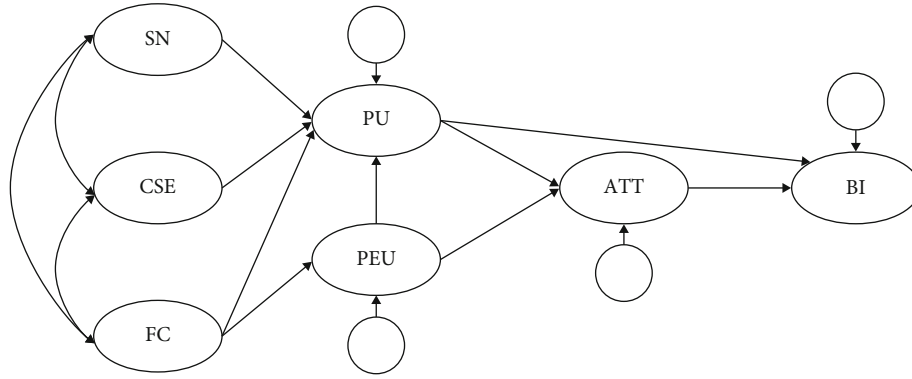


FIGURE 1: TAM with and without external variables.

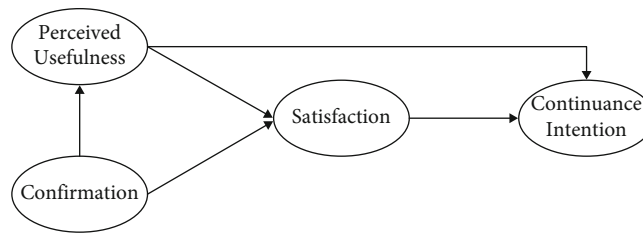


FIGURE 2: Expectation Confirmation Model.

churn. For this problem, there are two reasons. On one hand, pursuing short-term profit does not achieve precise positioning and characteristic development, without a clear understanding of its own ecological position; on the other hand, the platforms fail to grasp what the profit-related groups are concerned most in the design of virtual environments, functions, and interfaces, making it difficult to form sustained use.

To overcome the above problems, this study, combining the contributions of other researchers and taking secondary school students as the research object, verified the factors influencing users' intention of sustained use, with users' satisfaction as the mediating variable. For this purpose, this study fully explored TAM model by taking into consideration its core variable and three external potential variables as well as three internal variables of users' factors.

2. Related Literature Review

2.1. Technology Acceptance Model (TAM). The Technology Acceptance Model, first proposed by Davis, includes motivation-based core variables (perceived ease of use, perceived usefulness, and attitude toward technology) and outcome variables (behavioral intention) [3]. Of these variables, perceived usefulness (PU) and perceived ease of use (PEU) are considered key variables that can directly or indirectly support the outcome [4]. These variables are usually accompanied by external variables that can explain changes in perceived usefulness and ease of use. Among them, subjective norms (SN) [5], self-efficacy (CSE) [6], and facilitation conditions (FC) [7] have been found to be significantly correlated, to different extent, with the TAM's core variables [8,

9]. These external variables refer to personal competence and, to a lesser extent, environmental factors.

Perceived ease of use and perceived usefulness are the most important factors in TAM [10]. Perceived ease of use and perceived usefulness are directly related to another core variable of the TAM model, namely, attitude toward technology (ATT) [11].

In summary (as shown in Figure 1), by replicating, comparing, and integrating studies related to TAM, it is found that perceived ease of use (PEU), perceived usefulness (PU), and behavioral intention (BI) are the basic predictors of users' acceptance and sustained use of the technology.

2.2. Expectation Confirmation Model (ECM). In Expectation Confirmation Model (as shown in Figure 2), expectation confirmation was originally used to predict consumers' repurchase behavior. Oliver [12] argued that users' repurchase behavior was determined by their satisfaction with the use of the product, which was based on their expectations of the product prior to use and the extent to which this expectation was confirmed after using the product for a period of time. From the perspective of the Technology Acceptance Model (TAM), satisfaction reflects users' attitude toward using a technology after being exposed to it, while expectation reflects the users' perceived ease of use and perceived usefulness of the technology. The link between perceived usefulness and satisfaction based on the theory of ECM and TAM has been validated in many interdisciplinary studies on technology sustainability. Bhattacharjee used the ECM to test the sustained use of information system, proposing a post-acceptance model of information system sustainability, namely, the Information

System Sustainability Model (ISSM) [13]. By integrating the constructs of the ECM and the TAM, the ISSM used perceived usefulness as an antecedent variable for satisfaction and continued intentions. In this model, perceived usefulness also represented users' expectations based on their using experience during the actual use phase. The results of Bhattacharjee showed that satisfaction was the most significant predictor of sustained intention, and that perceived usefulness had a significant and direct effect on users' satisfaction.

Following many studies that have confirmed that the effect of users' satisfaction is an important indicator of online learners' intention of sustained use [14]. Based on the above literature review, hypotheses are proposed as follows:

2.3. Continuance Intention (CI). In this study, continuance intention (CI) refers to the online education platform users' intention to continuously use the chosen online education platform for the purpose of online learning. The level of continuance intention is an expression of users' perception of whether they will frequently use the online education platform in the future, as well as a key to the issue whether platform users are loyal to the chosen online education platform to form a sticky usage. In the model proposed by this study, the CI is the core dependent variable, directly or indirectly influenced by other potential variables. Users' continuance intention of using the platform will be measured by whether users are willing to continue using it, whether they will frequently use it, and whether they are willing to recommend to others the platform they use. Therefore, this study put forward the following hypothesis:

Hypothesis H8: Users' satisfaction has a significant positive effect on users' Continuance Intention.

2.4. Satisfaction (SA). Satisfaction, in this paper, refers to users' overall evaluation of using experience and effects after using the online learning platform. Baron and Kenny [15] suggested that moderating effects could influence the strength of the relationship between the independent and dependent variables. Based on the above discussion, this study argued that perceived teacher-student relationship should have a moderating effect on secondary school students' continuance intention of using the platform (see teacher-student relationship hypothesis H10 in the part of 2.12).

2.5. Perceived Usefulness (PU). Perceived usefulness, in this study, refers to the extent to which users perceive the online education platform to be useful in improving their learning performance when using the online education platform. Perceived usefulness not only influences users' initial adoption of an information system, but also is an important factor that influences users' satisfaction and intention to continue using it [16]. Therefore, this study proposed the following hypothesis:

Hypothesis H5: Perceived usefulness has a significant positive effect on users' satisfaction.

2.6. Perceived Ease of Use (PEU). Perceived ease of use, defined as the ease of use that users perceive when using an information system, was found to have a significant positive effect on users' perceived usefulness and intention to use [17, 18]. In this study, it refers to users' perceived evaluation of the ease in using the online education platform. Therefore, this study proposed the following hypotheses:

Hypothesis H4a: Perceived ease of use has a significant positive effect on perceived usefulness.

Hypothesis H4b: Perceived ease of use has a significant positive effect on users' satisfaction.

2.7. Resource Quality (RQ). Perceived quality, defined as the buyer's subjective and objective evaluation of a product, is a specific judgment of overall quality established based on the product or product service. In the virtual market, perceived quality is considered the asset of an enterprise. Perceived quality influences the purchase intention of any product. Mohd et al. emphasized that the factor behind product sales is perceived quality, pointing out buyers' extra attention should be paid to the product quality [19]. A study of green products by Allah Wasaya et al. also found that the perceived quality was one of the influencing factors for the purchase intention of green products [19]. This showed that the perceived quality of a good product could stimulate the desire to make a purchase.

Resources of online learning platforms, as a special commodity, also have attributes of other products. Taking perceived quality as one dimension concerning product quality, Guomin's study confirmed that the perceived quality of online learning resources had a significant effect on users' purchase intention [20]. Therefore, this study proposed the following hypothesis:

Hypothesis H2: Resource quality has a significant positive effect on perceived usefulness.

2.8. Self-efficacy (SE). Abdullah and Ward claimed that self-efficacy (SE) was the most common external factor in the TAM [20]. 45 out of 51 studies using this variable confirmed its relationship with the TAM. Self-efficacy refers to "an individual's perception of his or her ability to organize and execute a course of action to achieve a given accomplishment" [21]. In various situations, a learner could be found to be able to use the possessed skills to accomplish the task [22, 23]. Liaw found that higher self-efficacy, in an online learning platform environment, was effective in strengthening behavioral inhibition [24]. In addition, his study showed that learners' self-efficacy influenced their attitudes toward and capability of skill acquisition, activity selection, and continued action in the learning environment.

Regarding the interpretation of students' self-efficacy, Pintrich and DeGroot (1990) maintained that self-efficacy consisted of two relatively independent dimensions, namely, learning ability self-efficacy and learning behavior self-efficacy. It can be inferred that secondary school students' perceptions of self-efficacy have an effect on learning behaviors. Therefore, this study proposed the following hypotheses.

Hypothesis H6: Self-efficacy has a significant positive effect on users' satisfaction.

Hypothesis H7: Self-efficacy has a significant positive effect on users' continuance intention.

2.9. Teaching Presence (TP). TP-Teaching presence, defined as a convincing feeling in a mediated virtual environment [25], means how a user feels about being part of the environment created by the medium [26]. In various tasks that use computers as a medium, TP-Teaching presence is considered one of the important factors that enable people to focus on computer-based tasks. If students are unable to focus their attention in a computer-mediated learning environment, they will be distracted, resulting in their inability to concentrate on learning. Thus, it is evident that TP-Teaching presence is crucial to create a good sense of experience in online learning platforms. In order to lead students to a better learning online, it is necessary to establish a virtual environment for the online platform that students can be immersed in [27]. A more highly simulated TP-Teaching presence in the online learning platform could bring about a better learning experience, which in turn can influence students' learning status, learning effect, and intention to use the platform [28]. Therefore, this study proposed the following hypothesis.

Hypothesis H3: TP-Teaching presence has a significant positive effect on perceived usefulness. TP-Teaching presence has a significant positive effect on perceived usefulness.

2.10. System Quality (SQ). In many studies on the intention to use information systems, system compatibility is often used as an external variable to measure the technical design characteristics of the system. Combined with the online education context, system compatibility (SC) in this study, based on the perception level after users' experience, mainly reflects whether the technical environment of the online education platform used by users is compatible with the dual-ended learning services of PC and mobile (e.g., dual-ended support, data commonality, service fluency). The following hypotheses were proposed accordingly:

Hypothesis H1a: System quality has a significant positive effect on perceived usefulness.

Hypothesis H1b: System quality has a significant positive effect on perceived ease of use.

2.11. Academic Identity (AI). Consumers are driven not only by internal feelings of uniqueness but also by external motivations of social identity [29]. Thus, students possess achievement motivation in the sense that the activities they want to engage in are important and challenging for them. Achievement motivation is an intrinsic driving power. It is well known that secondary school students, under pressure to advance to higher education, are eager to obtain the approval of their teachers, parents, and peers through their improved grades; therefore, online learning platforms are used as one of the important learning tools for students to achieve such improved grades. This dependence on online learning platforms has an important significance for students who have a strong motivation of academic identity,

and as shown by the research team's field research, students with higher academic identity motivation have stronger behavior intention when learning online. It is found that a higher academic identity motivation often comes along with a strong intention of online learning. Therefore, the hypothesis was proposed as follows:

Hypothesis H9: Academic identity has a significant positive effect on users' continuance intention.

2.12. Teacher-Student Relationship (T-SR). A good teacher-student relationship can contribute to the efficiency and effectiveness of students' learning in the classroom, creating a positive learning atmosphere [30, 31]. A teacher-student relationship showing approval toward students can improve students' attitudes towards learning, motivate and engage them, and increase their motivation [32].

It follows that a harmonious teacher-student relationship brings students into a mutually reinforcing learning atmosphere, enhancing students' engagement in and motivation for class and creating a virtuous interactive learning process in the course. Thus, the following hypothesis was proposed in this study.

H10: With regard to the positive effect of users' satisfaction on their continuance intention, perceived teacher-student relationship plays a moderating role.

3. Research Methodology

Both TAM model and ECM model are used to explore psychological variables, and the two models have common psychological measurement items, perceived usefulness, and similar dependent variables, namely, behavioral intention and continuous use intention. This paper explores the influencing factors of continuous use intention of online learning platform based on perceived usefulness. Therefore, this study will combine TAM model and ECM model to build a conceptual model.

This study takes perceived usefulness as the starting point, adds the systematic factors of online learning platform, teaching presence, resource quality, and system quality, as the independent variables affecting perceived usefulness and perceived ease of use, takes the satisfaction of middle school students' online learning as the regulatory variable, and adds self-efficacy, academic identity and perceived teacher-student relationship. In order to explore the impact of these variables on Users' Continuance Intention of Using Online Learning Platforms for Secondary School Students. Based on the above literature review and hypotheses, the conceptual model was proposed in this study as shown in Figure 3.

Multiple measurement items were developed for each construct in this study through the following procedure. First, all the constructs and corresponding measurement items were adapted and developed based on a review of relevant existing literature to fit the topic and context of this study. Then, after the draft design was completed, pre-tests were conducted on secondary school students and experts (30 in total) who were familiar with online learning. All measures were administered on a five-point Likert scale,

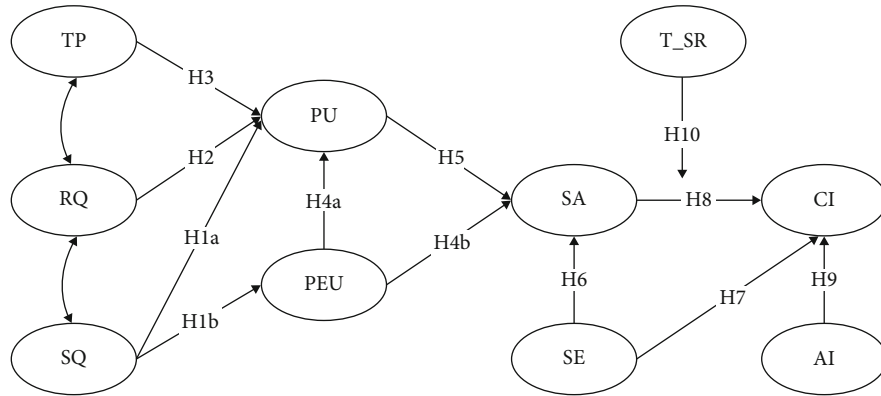


FIGURE 3: Framework of the study. Note 1: RQ=resource quality; SQ=system quality; PU =perceived usefulness; CI =continuance intention; TP=teaching presence; SA =satisfaction; PEU =perceived ease of use; AI =academic identity; SE =self-efficacy; T-SR =teacher-student relationship.

TABLE 1: Operational definition of constructs and measurement items.

Construct	Definition	Source
Perceived usefulness (PU)	Extent to which middle school students use the e-learning platform to improve their learning performance	Krishna Moorthy et al. (2019) [16]
Perceived ease of use (PEU)	Extent to which middle school students perceive using the e-learning platform as an effortless way to learn	Yoon (2016) [33]
Satisfaction (SA)	Extent to which middle school students are satisfied with the use of the e-learning platform	Oliver R L (1980) [12]
Teaching presence (TP)	Feeling of being in an offline classroom when using the e-learning platform	Secil Caskurlu, Yukiko Maeda, Jennifer C.(2020) [26]
Resource quality (RQ)	Ability of users in online learning platforms to perceive the merits and demerits of resources through studying	Allah Wasaya et al.(2021) [34]
System quality (SQ)	System of the online learning platform can be judged by users through studying on it	Khan & Qutab(2016) [35]; Chang et al.(2015) [36]
Academic identity (AI)	Academic identity is an individual’s judgment of academic value, while its extension reflects the individual’s beliefs about academics under the influence of various factors on the academic institution and social level	GUOMIN CHEN (2020) [30]
Self-efficacy (SE)	Self-efficacy consists of two separate dimensions, namely, self-efficacy of learning ability and self-efficacy of learning behavior	Fazil Abdullah (2016) [37]
Teacher-student relationship (T-SR)	The teacher-student relationship that users can experience during the learning on the online learning platform	Opdenakker, Maulana, den Brok (2012) [31]
Continuance intention (CI)	Consumers’ willingness to use or purchase an e-learning platform	Hai Min Dai(2020) [38]

TABLE 2: CMV analysis.

Model	Single-factor CFA	Multi-factor CFA
df	405	360
Δ df		45
χ^2	2855.842	734.588
$\Delta\chi^2$		2121.254

ranging from strongly disagree (1) to strongly agree (5). The core variables in this study included perceived usefulness (PU, 3 items), perceived ease of use (PEU, 3 items), and behavioral continuance intention (CI, 3 items). Three exter-

nal potential variables included teaching presence (TP, 3 items), resource quality (RQ, 3 items), and system quality (SQ, 3 items). Three variables on the side of users included academic identity (AI, 3 items), self-efficacy (SE, 3 items), and teacher-student relationship (T-SR, 3 items). Table 1 shows the question items, operational definitions, and the sources of the measurement constructs.

After completing the questionnaire design, this study first conducted a pre-test. The subjects of the pre-test survey were junior and senior high school students who had used the online learning platform. 200 questionnaires were distributed and 176 valid questionnaires were recovered. Exploratory factor analysis and reliability test were carried out on the pre-survey data. The results showed that 10 common factors were

TABLE 3: Results for the measurement model.

Construct	Indicator	Sig. Test of parameters				Std.	Cronbach's α	Composite reliability CR	Convergence validity AVE
		Unstd.	S.E.	z-value	p				
	RQ1	1				0.775			
RQ	RQ2	1.153	0.067	17.237	***	0.918	.874	0.876	0.704
	PRQ3	0.98	0.059	16.578	***	0.817			
	SQ1	1				0.708			
SQ	SQ2	1.073	0.092	11.608	***	0.805	.794	0.795	0.565
	SQ3	0.948	0.082	11.604	***	0.738			
	PU1	1				0.846			
PU	PU2	1.033	0.054	19.296	***	0.865	.889	0.889	0.728
	PU3	0.987	0.052	19.017	***	0.849			
	CI1	1				0.825			
CI	CI2	0.975	0.052	18.629	***	0.871	.885	0.885	0.720
	CI3	0.98	0.053	18.332	***	0.849			
	TP1	1				0.757			
TP	TP2	0.988	0.068	14.6	***	0.759	.849	0.853	0.660
	TP3	1.272	0.084	15.191	***	0.912			
	SA1	1				0.753			
SA	SA2	1.279	0.069	18.618	***	0.911	.900	0.904	0.760
	SA3	1.305	0.07	18.765	***	0.939			
	PEU1	1				0.658			
PEU	PEU2	1.318	0.107	12.285	***	0.853	.818	0.823	0.610
	PEU3	1.215	0.098	12.378	***	0.818			
	AI1	1				0.616			
AI	AI2	1.362	0.12	11.363	***	0.806	.801	0.809	0.590
	AI3	1.395	0.125	11.139	***	0.860			
	SE1	1				0.856			
SE	SE2	1.074	0.048	22.495	***	0.910	.911	0.911	0.774
	SE3	1.07	0.05	21.515	***	0.872			
	T-SR1	1				0.795			
T-SR	T-SR2	1.203	0.062	19.397	***	0.927	.895	0.896	0.743
	T-SR3	1.06	0.057	18.673	***	0.859			

Note 1: RQ = resource quality; SQ = system quality; PU = perceived usefulness; CI = continuance intention; TP = teaching presence; SA = satisfaction; PEU = perceived ease of use; AI = academic identity; SE = self-efficacy; T-SR = teacher-student relationship. Note 2: Unstd. = unstandardized factor loading; S.E. = standard Error; z-value = Z-test statistics; Std. = standardized factor loading. Note 3: *** $p < 0.01$ (two-tailed); $N = 381$.

extracted from 30 measurement items, Cronbach's α of 10 common factors. The values are greater than 0.7, indicating that the questionnaire has good reliability and validity and can be distributed as a formal questionnaire.

4. Analysis Results

This study designed on the questionnaire star platform an online questionnaire, which was sent to the users of the online learning platforms through the Cooperative School of Beijing NO.4 Middle School. With the help of Weinan branch, Dalian branch, and Beijing Fengtai No.2 Middle School, the online questionnaire was delivered through a variety of channels. A three-week online sampling survey was conducted. A total of 600 questionnaires were sent

out, with 552 valid questionnaires returned, all submitted by mobile phones. Finally, after an elimination of redundant and incomplete questionnaires, the effective sample size was 381. Generally speaking, the number of effective questionnaires should be 5~10 times of the total number of measurement variables, and the minimum number should not be less than 200 samples. In this study, there are 30 measurement variables and the effective sample size is 381, which meets the requirements of the structural equation for the sample size.

4.1. External Model Analysis. Because this study contains the measurement of psychological variables, including both latent variables and measurement variables, the structural equation model (SEM) can consider both latent variables

TABLE 4: Discriminant validity for the measurement model.

Construct	RQ	SQ	PU	CI	TP	SA	PEU	AI	SE	T-SR
RQ	.704									
SQ	.360	.565								
PU	.466	.298	.728							
CI	.411	.303	.461	.720						
TP	.520	.205	.381	.402	.660					
SA	.605	.282	.483	.484	.745	.760				
PEU	.456	.375	.341	.276	.266	.381	.610			
AI	.392	.572	.334	.329	.209	.325	.366	.590		
SE	.537	.306	.518	.691	.573	.640	.348	.300	.774	
T-SR	.569	.255	.319	.286	.445	.449	.266	.204	.489	.743

Note: The items on the diagonal represent the AVE; off-diagonal elements are the square of the correlation estimates.

TABLE 5: Model-fit indices.

Fit indices	Values	Recommended guidelines
χ^2	426.871	Non-significant
χ^2/DF	1.373	≤ 3
GFI	0.945	0.9
AGFI	0.941	0.9
RMSEA	0.029	≤ 0.08 (fair fit) ≤ 0.05 (good fit)
TLI	0.982	≥ 0.9
IFI	0.985	≥ 0.9
CFI	0.984	≥ 0.9
PNFI	0.838	≥ 0.5
PGFI	0.778	≥ 0.5

Note: Goodness of fit of the model in 2000 bootstrapped. Note: * $p < .05$, ** $p < .01$, *** $p < .001$ (two-tailed); number of samples (N) =381.

and measurement models, reduce the analysis error, and estimate the structural coefficient. Therefore, this paper uses the structural equation model (SEM) to test the model.

Before confirmatory factor analysis (CFA), considering the error caused by measurement tools, this paper first carries out common method deviation (CMV) analysis to eliminate the influence of measurement error on the relationship between latent variables. As shown in Table 2, the chi-square value of single factor confirmatory factor analysis is 2855.842 and the degree of freedom is 45; the chi-square value of multi factor confirmatory factor analysis is 734.588 and the degree of freedom is 360; $\Delta\chi^2 = 2121.254$, $\Delta DF = 45$. The significant difference between the two models was analyzed by Excel software. The results showed that $p < 0.01$, indicating that the original hypothesis was rejected, indicating that there was no common method deviation (CMV) between the two models.

In this study, the structural equation model (SEM) was used to test the model; statistical analysis softwares, SPSS 21 and Amos 24, were used to test and verify the reliability of the model. This method is advantageous in that it can simultaneously consider and measure the evaluation of the model as well as estimating the structural coefficient.

To evaluate the external model of these factors and to test their internal model and related research hypotheses, this study followed the two-stage approach recommended by Anderson and Gerbing [39], by first conducting a confirmatory factor analysis (CFA) to assess convergent and discriminant validity, followed by a structural equation model to provide path coefficients. The measurement model was evaluated using maximum likelihood (ML) estimation, which included single item loading, measured reliability, and convergent and discriminant validity. Maximum likelihood estimation was used to calculate various goodness-of-fit indices and to test the significance of loadings and correlations between factors. In this study, SPSS 24 software was used to conduct the reliability analysis for the internal consistency of the constructs; AMOS 24 software was used to analyze the factor loadings of the measured questions. Based on the standardized factor loadings, the combined reliability (CR) values and average variance extracted (AVE) values were calculated. The estimation of Cronbach’s α coefficients, standardized factor loadings, combined reliability, and variance extracted values are summarized in Table 3. Fornell and Larcker [40] proposed three criteria that could be used to assess the convergent validity of measured items: (1) the reliability of each measured item; (2) the combined reliability of each construct; (3) the mean variance of the extracts. In terms of item reliability, the standardized loadings exceeded 0.6 in this study, all between 0.616 and 0.939, within the threshold suggested by Gefen, Straub, and Boudreau (2000) [41], demonstrating that convergent validity existed on the item level. All values of Cronbach’s α exceeded 0.7, indicating a satisfactory reliability for all 10 constructs. For the compositional reliability, all values exceeded 0.7, between 0.795 and 0.911, and the threshold suggested by Nunnally and Bernstein [42]. Finally, the extracted values of the mean variance all exceeded 0.5, ranging between 0.565 and 0.760. Based on these three criteria, the convergent validity of the measured constructs proposed in this study was found adequate.

For discriminant validity, the extracted value of the average variance (AVE) or the square root of the extracted value of the average variance (AVE) of a given construct was compared with the correlation coefficient or the square of the correlation coefficient between that construct and other

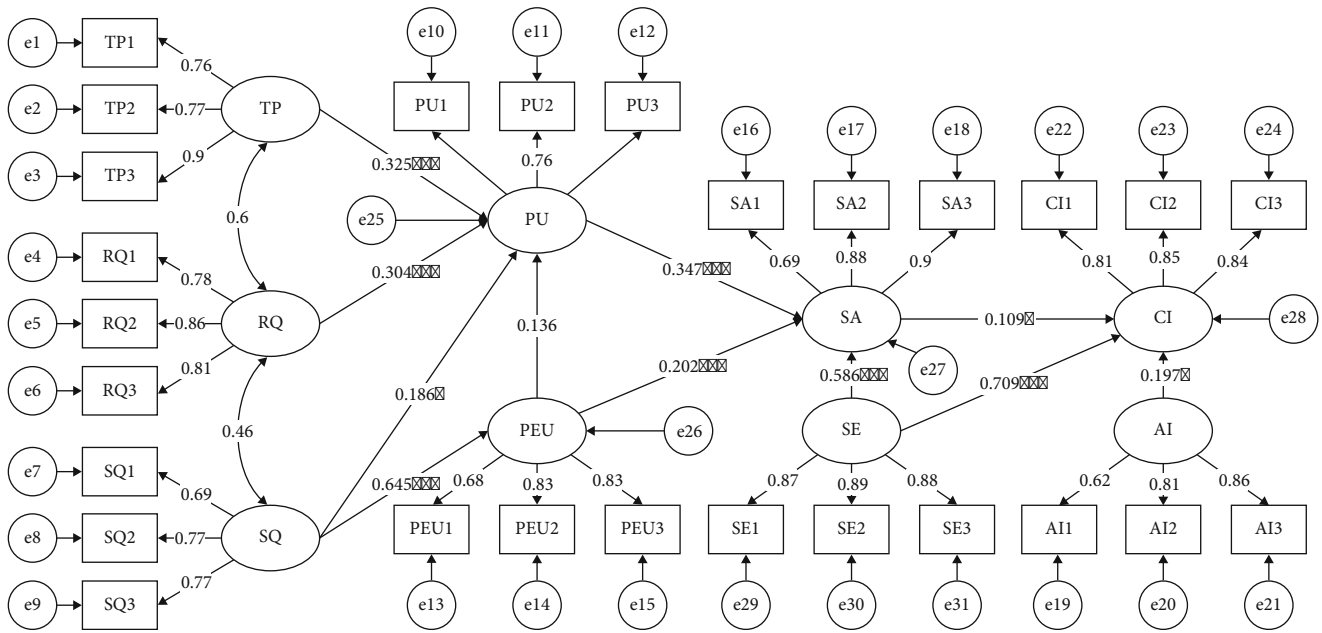


FIGURE 4: Illustration of path coefficient results.

constructs. If the square root of the average variance extracted value or the square of the average variance extracted value of a construct was greater than the square of the non-diagonal or non-diagonal elements in its corresponding rows and columns, it indicated that the construct was more closely related to its indicators than other constructs, i.e., it had discriminant validity. As shown in Table 4, the diagonal elements in the matrix were the mean variance extracted values, which meant that the mean variance extracted values of all the constructs were higher than the square of their corresponding row and column values, except for the mean variance extracted values of proximity, which were slightly lower than the square of their correlation coefficients with users' satisfaction. Since the AVE method was a more rigorous method for determining the discriminant validity, the discriminant validity was satisfactory for all the constructs in this study.

4.2. Internal Model Analysis. In this study, the proposed structural model was estimated based on the maximum likelihood method, using AMOS 24 software. Model fit determined the extent to which the sample variance-covariance data fit the structural equation model. According to Kline [43] and Schumacker and Lomax [44], who put forward a variety of model fit criteria for determining the model fit of a structural model, all models except χ^2 met the acceptable fit levels they recommended. Since χ^2 was susceptible to large samples, Bollen and Stine [45] suggested that the Bollen-Stine p -value correction method be applied to correct the model for χ^2 and test its model fit using a take-out-and-put-back resampling technique. In this study, after 2000 resampling analyses were performed, the model fit was found good. Table 5 shows the fit of some models corrected by Bollen-Stine p -values and the recommended thresholds.

4.3. Hypothesis Testing. Figure 4 shows the graphical illustration of the path coefficient results, where the system quality ($\beta=0.186$), resource quality ($\beta=0.304$), and TP-teaching presence ($\beta=0.325$) of the online learning platform for secondary school students were found to have a significant positive effect on perceived usefulness. It was consistent with hypotheses H1a, H2, and H3, with TP-teaching presence having the greatest effect, followed by perceived resource quality and perceived system quality; perceived ease of use ($\beta=0.202$), perceived usefulness ($\beta=0.347$), and secondary school students' self-efficacy ($\beta=0.586$) had a significant positive effect on users' satisfaction. This result supported hypotheses H4b, H5, and H6. Specifically, secondary school students' self-efficacy had the most significant effect on satisfaction ($\beta=0.686$). The effect of system quality on perceived ease of use was found significantly higher than that on perceived usefulness ($\beta=0.645$), which supported hypothesis H1b. In addition, secondary school students' self-efficacy ($\beta=0.709$), users' satisfaction ($\beta=0.109$), and academic identity ($\beta=0.197$) all showed a significant positive effect on users' continuance intention. These results confirmed hypotheses H7, H8, and H9. Lastly, it can be found that perceived ease of use ($\beta=0.136$) had a positive but not significant effect on perceived usefulness ($p=0.053$). The analysis results of the internal model are listed in Table 6.

To test hypothesis 10, the present study analyzed the moderating role of T-SR. With AMOS 24, a parsimonious latent variable interaction technique proposed by Ping [46] was used, which was a more parsimonious method for estimating potential interactions and quadratic variables than those previously proposed by Kenny and Judd [47] and Hayduk [48]. Ping suggested using the product of the sum of the relevant indicators as the only indicator of the potential product. For example, suppose that two potential variables

TABLE 6: Summary of the internal model analysis.

Hypothesis	Standardized path coefficient	Unstandardized path coefficient	Standard error	z -value	p -value	Result
Hypothesis 1a: SQ → PU	0.186	0.194	0.090	2.154	*	Supported
Hypothesis 1b: SQ → PEU	0.645	0.622	0.072	8.583	***	Supported
Hypothesis 2: RQ → PU	0.304	0.289	0.081	3.581	***	Supported
Hypothesis 3: TP → PU	0.325	0.285	0.064	4.443	***	Supported
Hypothesis 4a: PEU → PU	0.136	0.147	0.076	1.932	0.053	Not supported
Hypothesis 4b: PEU → SA	0.202	0.197	0.049	4.054	***	Supported
Hypothesis 5: PU → SA	0.347	0.313	0.046	6.735	***	Supported
Hypothesis 6: SE → SA	0.586	0.434	0.041	10.697	***	Supported
Hypothesis 7: SE → CI	0.709	0.701	0.061	11.575	***	Supported
Hypothesis 8: SA → CI	0.109	0.146	0.070	2.073	*	Supported
Hypothesis 9: AI → CI	0.197	0.258	0.059	4.403	***	Supported

Note 1: RQ = resource quality; SQ = system quality; PU = perceived Usefulness; CI = continuance intention; TP = teaching presence; SA = satisfaction; PEU = perceived ease of use; AI = academic identity; SE = self-efficacy. Note 2: *** $p < 0.01$; * $p < 0.10$ (two-tailed); $N = 381$.

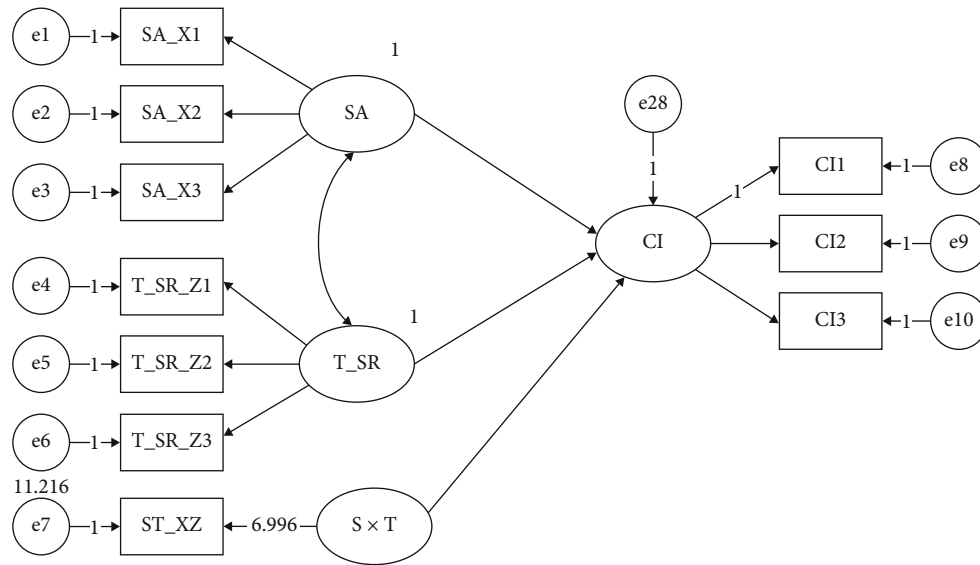


FIGURE 5: Perceived teacher-student regulation analysis model. Note: CI = continuance intention; SA = satisfaction; T-SR = teacher-student relationship; SxT = the interaction term of SA and T_SR.

X and Z with indicators x_1 and x_2 and z_1 and z_2 , respectively, interact with a third potential variable Y represented by a single observed variable y . Thus, as he argued, the indicator of the potential product could be represented by the calculated variable $(x_1 + x_2)(z_1 + z_2)$. If the potential product effect of the dependent variable was significant, it was considered to have an interference effect. According to the analysis of single-indicator interference effect proposed by Ping, the following steps were taken in this study: (1) first, centralizing the explicit variables included in user satisfaction and perceived T-SR by subtracting their mean values corresponding to each explicit variable before naming them as “SA_X1~SA_X3” and “T-SR_Z1~T-SR_Z3,” respectively;

(2) multiplying the mean scores of the three question items included in the decentered customer satisfaction by the mean scores of the three question items included in the perceived T-SR to obtain the cross product term “ST_XZ”; (3) calculating the factor loadings and residual values of the potential product SxT indicator ST_XZ, where the factor loading was 6.996 and the residual value was 11.216. The perceived T-SR analysis model proposed in this study is shown in Figure 5.

Table 7 demonstrates the results of the analysis. The results showed that the effect of the critical product (SxT) on the dependent variable (CI) was not significant ($\beta = 0.042$). The perceived T-SR did not play a moderating role

TABLE 7: Testing results of the moderating effects.

Hypotheses	Standardized path coefficient	Standard error	z-value	p-value	Result
SA → CI	.560	.062	9.048	***	
T-SR → CI	.106	.057	1.867	.062	
S×T → CI	.042	.029	1.436	.151	Not supported

Note 1: CI = continuance intention; SA = satisfaction; T-SR = teacher-student relationship; CxP = the interaction term of SA and T-SR. Note 2: *** $p < 0.01$ (two-tailed); $N = 381$.

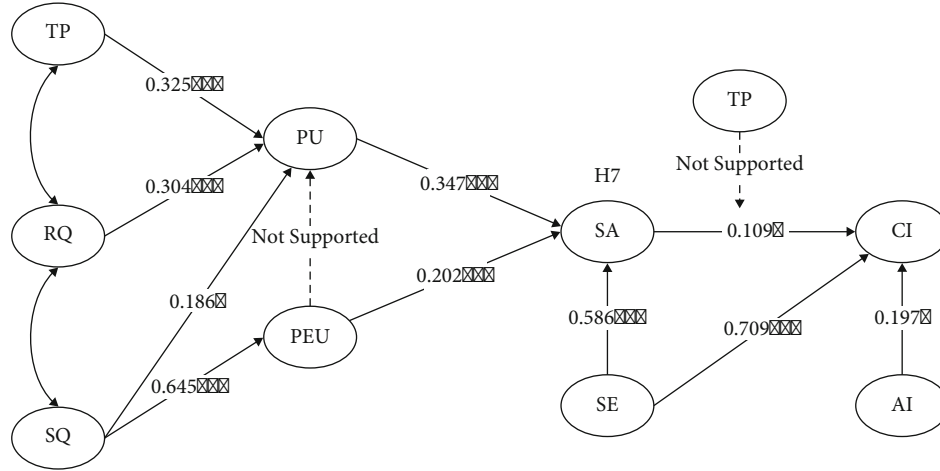


FIGURE 6: Diagram of model hypothesis test and path coefficient results.

in the positive relationship between users' satisfaction and behavioral intention of secondary school students, indicating that the moderating effect did not hold. Therefore, hypothesis 10 was not supported.

The structural equation model is an acceptance support model, and the statistical test power is very low, which will make it impossible to reject the null hypothesis. Therefore, this study carries out statistical verification force analysis after completing the research hypothesis analysis. In this study, R language is used to test the statistical test power of theoretical model, and the sample number $n = 381$ and confidence interval are set $\epsilon = 0.05$, the degree of freedom of the model is 337, nihil hypothesis and opposition hypothesis. The execution results show that the statistical test power is 0.99, so the correctness of the research results in this paper is reliable.

According to the results of path analysis, this study outlined the result model of path verification for the factors influencing the continuance intention of middle school students using online learning platform, as shown in Figure 6. The potential variable "perceived ease of use" marked by dotted line did not hold for perceived usefulness; the dotted line path of moderating variable "teacher-student relationship" indicated that the theoretical path hypothesis was rejected, and that its path influence relationship did not hold, either. The path between other variables was marked with standardized path coefficient and significance level.

5. Conclusions

Based on 381 valid sample data to analyze the model of factors influencing the continuance intention of secondary

school students using online learning platform, the study found that 8 of 10 potential variables had path relationships between them with varying degrees of significance. In testing the hypotheses, the significant and positive effect of perceived ease of use on perceived usefulness was not found; teacher-student relationship did not demonstrate a moderating role in the positive effect of users' satisfaction on users' continuance intention. All the other hypothesized paths were verified.

5.1. The Enlightenment of the Study. The following implications were obtained from this study. First, instead of paying attention to the quality of resources and teachers' fame, etc., existing online learning platforms for secondary school students should attach importance to the learning environment of the platform which has the greatest effect on students; a variety of ways are needed for students to communicate with peers, draw attention from teachers and other students, and participate in group discussions in addition to learning.

The conclusions of this study also confirm that the presence of platform learning environment has the most significant impact on the perceived usefulness of middle school students. Enhancing online education experience has become the key to improve middle school students' sustainable use intention. The most effective educational experience is usually designed around the social constructive learning method, which needs to complete the actual task with others in the simulated real environment. Therefore, enhancing the on-the-spot experience will be the direction of future research on online education.

Second, in learning, middle school students' factors are also important. As reflected in this study, secondary school students' SE had the most significant impact on their learning, and therefore, students should be guided and trained in this regard for better learning. The SE of secondary school students mainly stems from the individual experience of success, alternative experience, and other people's language. The more successful experience, the stronger self-efficacy; middle school students' alternative experience is an indirect experience, which makes observers believe that they can achieve the same level of achievement when they are in a similar activity situation; others' language refers to changing people's sense of self-efficacy through others' guidance, advice, explanation, and encouragement, especially the platform teacher's verbal encouragement is more important to the improvement of middle school students' sense of self-efficacy.

5.2. Consideration on Platform Construction for Enterprises

- (1) Enhancing the sense of TP-Teaching presence. Designers of online learning platform should pay attention to the construction of platform learning environment, and study the application of immersive virtual reality technology to secondary school students' learning platform, so as to enhance the sense of presence of secondary school students
- (2) Enhancing the sense of self-efficacy of secondary school students. The sense of achievement of secondary school students' online learning should be enhanced, for example, the platform designer should pay attention to the development of the answer plates, by appropriately controlling the difficulty of the questions, increasing students' successful experience of giving correct answers, and enhancing the alternative experience of middle school students. When promoting the online learning platforms, enterprises should publicize the successful platform-based cases of secondary school students as well as encouraging students to share their successful experience of using the learning platform
- (3) Improving the language persuasion. Compared with face-to-face teaching, the persuasion of online teachers is obviously relatively weak. Therefore, improving the language persuasion of online teachers should also be considered so that students' self-efficacy will be enhanced when they can always obtain the external care and support

5.3. *Limitations and Future Work.* As for the limitations, this study only observed users' intention to use. Due to the users' typicality and the customers' separation that characterize the online learning platforms for secondary school students, this study was conducted without considering the customer context, including that students' continuance intention of using the platforms is also influenced by the perception of their parents (customers). Accordingly, the future study should take more of customers' influence into consideration.

5.4. *Future Work.* Online learning, an important part in the education field in the future, has an increasing number of consumers. It is also faced with some problems. To overcome them, interdisciplinary and multi-perspective studies are needed in the future to explore the teaching presence of online learners, and provide more valuable research for other scholars and enterprises of online learning platform.

Data Availability

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Authors' Contributions

Guomin Chen (first author) contributed to the research design. Cao Shuo (author 2) contributed to the questionnaire design. Pengrun Chen (author 3) contributed to the data collection and analysis. Yongchuang Zhang (corresponding author) contributed to the data analysis and modeling verification.

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