Factors Influencing the Online Learning Success of Adults in Open and Distance Education in Southwest China

Li Yuebo, Siti Hajar Halili*, and Rafiza Abdul Razak

***Abstract*—This study aims to identify the factors that influence adult learners' perceived satisfaction, continued use, and benefits of online learning to seek ways to promote adult learners' success in online learning. The study integrated multiple theoretical frameworks, including the Information System Success (ISS) Model, Expectation Confirmation Model for Information Systems Continuance (ECM-ISC), Technology Acceptance Model (TAM), and Technological Pedagogical Content Knowledge (TPACK) to develop a theory of Online Learning (OL) success for adults. The proposed model emphasizes the utilization of technology to enhance pedagogical practices for the delivery of online content. A total of 675 adult learners were randomly selected from five learning centres at a provincial branch of the Open University of China in Southwest China. This quantitative research study utilized Partial Least Squares-Structural Equation Modeling (PLS-SEM) for data analysis. Analysis of the results indicated that TPACK's impact was more clearly perceived by the adult learners in this study. Further study needs to expand the scope of this investigation and verify the effectiveness and reliability of the model. The model of adult online learning success in Southwest China is the first integrated model combining TPACK theory with the Information System Success (ISS) Model, Technology Acceptance Model (TAM), and Expectation Confirmation Model (ECM). Future studies should explore teacher and administrator perspectives to determine the success factors of adult online learning from a multi-faceted approach.**

***Index Terms*—Adult education, online learning success, open and distance education, Technological Pedagogical Content Knowledge (TPACK)**

I. Introduction

Information technology has expanded possibilities for learning [1]. The growth of online programs, accessible internet-based virtual learning, and affordable opportunity offered through higher education for Adult Learners (AL), provide evidence of a need being met by this form of education. Therefore, Open and Distance Education (ODE) is fast becoming a recognized mainstream source of educational reform that offers a quality learning experience that meets the needs of adult learners. Online learning isn't an experiment or a substitute for face-to-face learning, but a viable source for educational delivery of career and professional programs across China. In 2023 Open and Distance Education (ODE) is a stand-alone system of educational delivery that requires a pedagogical approach adapted to virtual delivery of instruction. This study presents evidence for improving the online experience for adult learners.

China has a large adult learning population that is underserved by the traditional higher educational system. The form of ODE initiated by the Open University of China (OUC) system provides more opportunities for members of the public to advance their own knowledge or academic qualifications. Due to the COVID-19 pandemic, all offline adult teaching at the OUC was switched to online, which was continued after the pandemic. Online learning has been welcomed by adult Chinese students seeking accessible high-quality knowledge/training to enhance professional skills and advance careers [2].

Because online learning transcends the limitation of teaching time and space, adult learners can choose learning content and program delivery according to their conditions and needs (which facilitates the pursuit of advanced training while maintaining one's job). The pursuit of professional training by virtual program delivery is especially suitable for part-time students who are "on-the-job" employees. The benefits of online learning—which became apparent during the pandemic—were accentuated as adult learners embraced the convenience and cost of quality program delivery [2, 3].

The net benefits of ODE are still in a formative stage of evolution, particularly for adult learners. Many participants in this study were working adults who faced numerous challenges in balancing work, family, and other daily responsibilities while pursuing their education. These individuals often struggled to prioritize learning when confronted with competing demands.

One key issue was that ODE institutions often failed to provide appropriate teaching methods and tailored learning support to address the unique circumstances of students who were juggling work and study commitments [4]. This misalignment between the educational offerings and the practical needs of adult learners hindered the potential and utility of ODE as a high-quality alternative to face-to-face learning.

The net benefits of ODE are still emerging as researchers and institutions strive to develop effective strategies that address the specific challenges faced by adult learners. Further research and improvements in instructional design, learner support mechanisms, and personalized learning approaches are necessary to optimize the benefits of ODE for working adults and their learning experiences.

For the past few years, many studies have used the Information System Success (ISS) model to study factors affecting online learning [5–8] and the evaluation of Online Learning (OL) systems [9, 10]. Yengin and Karahoca *et al.* [11] proposed that with the continuous development of the era of information technology (IT), more consideration should be given to the degree of technology

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acceptance of learners in the learning process when studying the impact of OL on students. Lin and Wang [12] described that perceived ease of use had a greater impact on attitude and willingness to continue using technology in low-experience user groups, whereas attitude and willingness to continue using technology were primarily influenced by the perceived usefulness of the technology to enhance the learner experience.

Al-Fraihat and Joy *et al.* [13] integrated the Information System Success (ISS) Model, Technology Acceptance Model (TAM), user satisfaction models, and other theories/models to put forward a successful evaluation model for online learning systems. The success model for OL has been identified as relatively complete for this set of learners [5, 13–18].

However, these models are generalized and need to be reconsidered as online learning becomes a mainstream learning platform. In the empirical research on the success of OL, there is almost no literature that takes a teacher's TPACK ability into account as a pedagogical/instructional variable. This study was conducted specifically for AL of ODE and included TPACK factors in addition to the conventional determinants of success in OL. At the same time, it reviewed and measured the OL success model for Chinese adults participating in ODE. This research focused on the factors that influenced the OL success model for AL in ODE.

II. Conceptual Model Derived from This Study

This research investigates the net benefits of online learning by "perceived satisfaction with the use of an online learning system" and "intention to continue to use an online learning system" after having utilized and experienced online learning for academic or career advancement. This study is based on the evaluation of theoretical models of adult OL instruction used in the delivery of multiple programs within the Chinese context.

This research has proven to be valid and reliable with a strong theoretical and pedagogical foundation. The conceptual model is based on the integration of the Information System Success (ISS) Model by DeLone and McLean [19], Technology Acceptance Model (TAM) by Davis [20], the Expectation Confirmation Model of IS Continuance (ECM-ISC), and Technological Pedagogical Content Knowledge (TPACK) theory by Mishra and Koehler [21]. The integrated model proposed is based on an extensive literature review. This review included a thorough examination of empirical studies, scholarly articles, and authoritative publications related to these theories. The consensus among researchers in the field is that these theories are widely recognized, well-established, and have been extensively validated in various contexts.

A rigorous evaluation of the individual theories incorporated in the conceptual model was conducted. This evaluation involved an in-depth examination of the conceptual frameworks informing the study, empirical evidence grounding the study, and the practical applications that informed the data analysis. The results of this analysis revealed that these theories have consistently demonstrated strong predictive power and explanatory capabilities in explaining technology acceptance, information systems success, and the integration of technology into pedagogy.

Additionally, potential obstacles or limitations associated with the selected theories were carefully considered. Although no significant obstacles were identified in the literature, every theory has its boundaries and may not fully capture all aspects of the complex phenomenon under investigation. Nevertheless, the extensive empirical support and the wide acceptance of these theories within the research community strengthen the confidence in their applicability and reliability in this study.

To summarize, this research is supported by a comprehensive literature review that confirms the validity and reliability of the integrated theories. While the inherent limitations of any theoretical framework can be overly scrutinized and critiqued, the extensive empirical evidence and widespread acceptance of these theories provide a robust foundation for this conceptual model. The conceptual model is shown in Fig. 1.

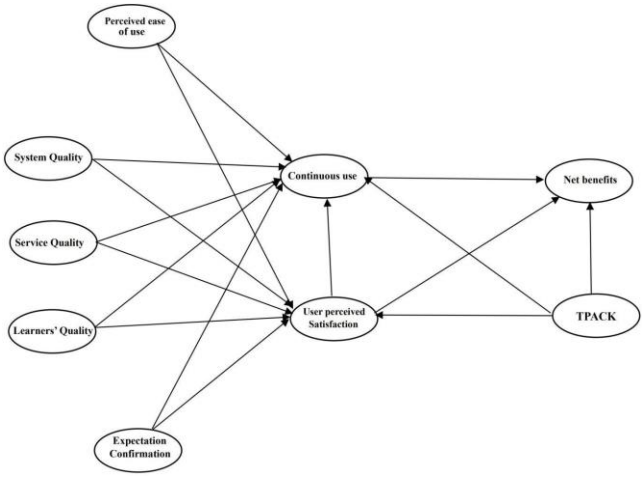

Fig. 1. Adult online learning success model proposal.

III. Constructs Outlined By This Study

This research model includes nine structures identified as System Quality (SQ), Service Quality (SEQ), Learner Quality (LQ), Perceived Ease of Use (PEU), Expectation Confirmation (EC), Technological Pedagogical Content Knowledge (TPACK), User Perceived Satisfaction (US), Continuous Use (USE), and Net Benefit (NB).

The SQ is based on the degree of system support and efficiency brought to users in the process of using an OL platform. Good system quality can provide more convenience for network platform users, enhance user privacy, and shorten the time of online information acquisition [13, 22]. SEQ is the user's requirement for engaging with an OL platform [22, 23]. LQ refers to the ability of learners to learn by using online learning systems [15].

PEU refers to whether learners feel it is convenient and easy to use the functions of the OL system during the learning process [24]. EC refers to the gap between learners' expectations of OL outcomes and the results after the online learning experience [20]. USE refers to the willingness of learners to continuously use an OL platform [25]. US refers to the mental state of learners to evaluate whether their efforts

and benefits using the system are reasonable [26].

TPACK, which stands for Technological Pedagogical Content Knowledge, refers to the knowledge that teachers should possess to effectively integrate teaching content, teaching methods, and information technology [21, 27]. For example, in the context of language learning, a teacher with TPACK combines content knowledge of the target language with pedagogical strategies that promote language acquisition. The teacher understands the unique challenges and learning needs of language learners and employs suitable instructional methods, such as communicative language teaching or task-based learning. Additionally, the teacher integrates technology effectively by utilizing language learning apps, online language resources, or digital collaboration tools that provide authentic language practice opportunities and fosters interactive communication among students. TPACK enables the teacher to create a language-rich environment that integrates technology seamlessly into language learning activities.

TPACK encompasses the intersection of content knowledge, pedagogical knowledge, and technological knowledge, enabling any teacher to create meaningful and effective learning experiences through the integration of technology. By integrating technology strategically, instructors can enhance their pedagogical approaches and support student learning in diverse subject areas.

The implementation of TPACK comes from the teachers. Thus, in the process of implementing and applying TPACK training programs, it is necessary to emphasize the active participation of classroom teachers in the design and implementation of sound pedagogical practice in a technology-rich teaching and learning experience. Teachers as well as administrators play a role in the examination of best practice when critiquing online teaching. In teacher education programs TPACK training must emphasize the integration of technology—in its many forms—as part of a dynamic approach to designing and implementing pedagogical practice in the delivery of instruction for the adult learner.

TPACK involves three knowledge elements: subject content, teaching method, and technology. It is not a simple combination of three elements of pedagogical practice, but a sophisticated understanding of how knowledge is communicated through the teacher to students in a high-tech educational system. A teacher must integrate technology into the methodology, pedagogical practice, and deeper understanding of how to communicate knowledge from an adult to the student. The study and application of TPACK should not simply emphasize technology, but integrate teaching and learning theory, as well as pedagogical practice, in the design and delivery of programs made available over the internet.

IV. Research Hypotheses

The following hypotheses were formulated in designing this study:

H1a: System quality positively affects continuous use of the OL system.

H1b: System quality has a significant positive effect on perceived satisfaction.

H2a: Service quality has a significant positive effect on the continuous use of the OL system.

H2b: Service quality has a significant positive effect on perceived satisfaction.

H3a. Learner Quality positively influences the perceived satisfaction.

H3b. Learner Quality positively influences the continuous use.

H4a: TPACK positively affects perceived satisfaction.

H4b: TPACK positively affects the continuous use of the OL system.

H4c: TPACK positively affects net benefits.

H5a: Expectation confirmation has a significant positive effect on perceived satisfaction.

H5b: Expectation confirmation has a positive effect on the continuous use of the OL system.

H6a: User-perceived ease of use has a significant positive effect on perceived satisfaction.

H6b: User-perceived ease of use positively affects continuous use.

H7: User-perceived satisfaction has a positive effect on continuous use of the OL system.

H8: User-perceived satisfaction has a significant positive effect on net benefits.

H9: Continuous use has positive effects on net benefits.

V. Methodology

This was a quantitative research study that utilized Structural Equation Model based on Partial Least Squares (PLS-SEM) software in analyzing data. Hair [28] pointed out that the data analysis section included a measurement model and a structural model. The reliability and validity of the variables used in this study were measured within a measurement model. Specifically, Cronbach's alpha and Composite Reliability (CR) values were used in measuring reliability. Validity tests the discriminative validity and convergent validity of the variables adopted in this study. Specifically, three detection methods, Fornell-Larcker, Heterotrait-Monotrait (HTMT), and Cross loading, were used for discriminating validity. Convergent validity is mainly measured by the AVE value. In the structural model, the bootstrap method was first applied to test the hypotheses made in this study.

A. Instrument

The relevant studies on OL attitudes, the factors of OL quality, EC, PEU, and TPACK in the last ten years were compiled by reviewing and sorting the literature. The existing research scales were collected to complete the preliminary scale construction. Expert interviews were employed to update and enhance the scale. To verify that the Chinese scales accurately represented the referenced English scales and to increase their accuracy, this study employed a two-way translation process. Twenty school learners were chosen at random to read the questionnaire, complete it, and point out any inconsistencies or misconceptions. The 5-point Likert scale was then changed and enhanced based on their feedback to create the scale for this study.

B. Data Collection and Analysis

The study involved random samples coming from five branches of a provincial Open University in southwest China. The large-scale questionnaire survey was conducted between October 2021 and December 2021, mainly in the form of online questionnaires and on-site paper questionnaires. In the end, 675 responses were deemed valid. The demographic distribution of the research sample is as follows (Table I).

TABLE I: SOCIO-DEMOGRAPHIC PROFILE OF RESPONDENTS

		Frequency	Percent	Valid Percent	Cumulative Percent
Gender	1. Male	200	29.6	29.6	29.6
	2. Female	475	70.4	70.4	100
Age	1. < 21	14	2.1	2.1	2.1
	2. 21–30	252	37.3	37.3	39.4
	3. 31-40	293	43.4	43.4	82.8
	4. 41-50	106	15.7	15.7	98.5
	5. > 51	10	1.5	1.5	100
Education	1. Junior college	382	56.6	56.6	56.6
	2. Undergraduate	293	43.4	43.4	100
Major	1. Economic Management	314	46.5	46.5	46.5
	2. Engineering	34	5	5	51.6
	3. Arts	25	3.7	3.7	55.3
	4. Law	31	4.6	4.6	59.9
	5. Education	66	9.8	9.8	69.6
	6. Medicine	124	18.4	18.4	88
	7. Other	81	12	12	100
Which semester are you studying now	1. Semester 1	35	5.2	5.2	5.2
	2. Semester 2	251	37.2	37.2	42.4
	3. Semester 3	161	23.9	23.9	66.2
	4. Semester 4	140	20.7	20.7	87
	5. Semester 5	53	7.9	7.9	94.8
	6. Semester 6	35	5.2	5.2	100
Occupation	1. Administrative personnel in government organisations and public institutions	164	24.3	24.3	24.3
	2. Private business owners	59	8.7	8.7	33
	3. Professional and technical personnel	146	21.6	21.6	54.7
	4. Senior and middle management personnel of large and medium-sized enterprises	39	5.8	5.8	60.4
	5. Commercial and service workers	119	17.6	17.6	78.1
	6. Migrant workers in cities	39	5.8	5.8	83.9
	7. Industrial workers	19	2.8	2.8	86.7
	8. Agricultural laborers (agriculture, forestry, animal husbandry and fishery)	8	1.2	1.2	87.9
	9. Unemployed	82	12.1	12.1	100
Income (RMB)	1. > 250,001	104	15.4	15.4	15.4
	2. 200,001-250,000	50	7.4	7.4	22.8
	3. 150,001- 200,000	31	4.6	4.6	27.4
	4. 100,001-150,000	65	9.6	9.6	37
	5. 5,0001-100,000	215	31.9	31.9	68.9
	6. <50,000	210	31.1	31.1	100
	Total	675	100	100	

Structural Equation Modeling (SEM) is a statistical methodology that helps investigate and analyze complex multivariate data by examining the covariance matrices of variables. One of the strengths of SEM is that it can account for possible measurement errors in both the independent and dependent variables. SEM methodology takes into consideration the possibility of a difference between the true value of a variable and its measured value, which can occur in both independent and dependent variables. SEM introduces measurement error into the path diagram and considers the relationships between observed variables, which allows for a more accurate investigation of the relationships between variables that are not directly measurable. By exploiting the link between observable variables, SEM can provide more accurate results for variables that cannot be directly measured [29].

As one of the approaches of latent variable analysis, PLS-SEM based on partial least squares is applied to test the interaction of independent variables and dependent variables. When there is a high interconnectivity between the components, PLS-SEM is an effective option [30]. The data analysis method adopted for this research was PLS-SEM 3.0 [28, 31]. The goal was to analyze the conceptual framework for success in adult OL.

C. Assessment of the Measurement Model

The factor loadings of SEQ, SQ, LQ, EC, PEU, US, and USE as first orders and second-order factors of the net Benefits (NB), TPACK, the Cronbach's a rho_A, and CR values were all over 0.7, which showed that the above factors had good reliability. Their Variance Inflation Factor (VIF) values were less than 5, demonstrating that there was no serious multicollinearity.

The scale used in this study demonstrated good construct validity, as evidenced by several factors. Firstly, the loadings for each item were higher than 0.5 within their respective constructs, indicating a strong association between the items and their underlying constructs. Additionally, only one factor greater than 0.5 occurred for each item, further confirming the discriminant validity of the scale.

To further establish the validity of the scale, the standardized loadings for each variable and an Average Extracted Variance (AVE) were calculated. The factor loadings for all items measured in this study were above 0.730 and statistically significant, surpassing the recommended threshold of 0.5. This indicates that the items effectively captured the latent constructs they were intended to measure.

Moreover, the AVE for each latent variable was higher than 0.5, demonstrating good convergent validity. This suggests that a substantial amount of variance in the observed variables is explained by their respective latent constructs, supporting the scale's ability to accurately measure the intended concepts.

By considering these factors—including the item loadings, discriminant validity, and convergent validity—a strong construct validity of the scale was established. These findings provide confidence in the reliability and accuracy of the scale for assessing the intended constructs. For more detailed results, please refer to Table II, which presents the specific factor loadings and AVE values for each latent variable.

In alignment with the recommendation provided by the square root of the Average Extracted Variance (AVE) and the correlation coefficients between latent variables were examined. By comparing these values, the degree of discriminant validity between the latent variables was assessed.

The findings indicated that the square value of the AVE for each latent variable was greater than the correlation coefficients between that variable and other latent variables. This implies that there was a good discriminant validity among the latent variables, as demonstrated in Table III. For example, the AVE for the Expectation Confirmation (EC) variable was 0.854, which was greater than the correlations found between EC and other potential variables (0.086, 0.238). These results indicate a significant discriminant validity for EC.

Furthermore, the HTMT method and cross-loading analysis to examine the discriminant validity of the variables were employed. The results, as presented in Tables IV and V, support the high discriminant validity among the variables.

TABLE II: RELIABILITY AND CONVERGENT VALIDITY

Construct	item	loading	VIF	Cronbach's alpha	rho_A	CR AVE
EC	EC1	0.875	2.27	0.893	1.122	0.91
	EC2	0.831	3.37			
	EC3	0.831	3.77			
	EC4	0.872	4.39			
LQ	LQ1	0.905	4.02	0.941	0.944	0.95
	LQ2	0.918	2.40			
	LQ3	0.936	1.44			
	LQ4	0.926	2.38			
PEU	PEU	0.826	2.27	0.894	0.897	0.92
	PEU	0.808	2.91			
	PEU	0.880	2.68			
	PEU	0.834	2.46			
	PEU	0.841	2.20			
SEQ	SEQ	0.929	3.97	0.932	0.935	0.95
	SEQ	0.906	3.33			
	SEQ	0.910	3.50			
	SEQ	0.900	3.14			
SQ	SQ1	0.909	3.08	0.923	0.928	0.94
	SQ2	0.894	3.02			
	SQ3	0.898	3.15			
	SQ4	0.903	3.25			
US	US1	0.908	3.36	0.942	0.942	0.95
	US2	0.930	4.24			
	US3	0.925	4.08			
	US4	0.928	4.20			
USE	USE	0.922	4.35	0.954	0.955	0.96
	USE	0.900	3.52			
	USE	0.898	3.46			
	USE	0.926	3.16			
	USE	0.951	4.01			
NB	AD	0.879	2.15	0.875	0.875	0.92
	CD	0.910	2.68			
	PD	0.893	1.44			
TPACK	TK	0.868	4.88	0.875	0.877	0.91
	TCK	0.831	3.73			
	PCK	0.863	1.60			
	TPAC	0.850	1.94			

* Note: Numbers 1–5 is to represent the question items

TABLE III: DISCRIMINANT VALIDITY FORNELL-LARCKER CRITERION

	EC	LQ	NB	PEU	SEQ	SQ	TPACK	US	USE
EC	0.854								
LQ	0.086	0.9							
NB	0.158	0.1	0.8						
PEU	0.152	0.0	0.5	0.838					
SEQ	0.12	0.4	0.1	0.08	0.9				
SQ	0.1	0.6	0.2	0.12	0.6	0.90			
TPACK	0.11	0.5	0.3	0.136	0.4	0.52	0.855		
US	0.238	0.2	0.6	0.387	0.3	0.38	0.33	0.923	
USE	0.228	0.3	0.5	0.429	0.2	0.35	0.367	0.58	0.89

TABLE IV: DISCRIMINANT VALIDITY USING THE HTMT METHOD

	EC	SQ	LQ	NB	PEU	SEQ	TPACK	US	USE
EC									
SQ	0.055								
LQ	0.044	0.541							
NB	0.093	0.177	0.1						
PEU	0.079	0.091	0.038	0.58					
SEQ	0.092	0.528	0.443	0.177	0.088				
TPACK	0.087	0.569	0.465	0.361	0.155	0.492			
US	0.17	0.3	0.221	0.662	0.419	0.372	0.358		
USE	0.161	0.368	0.127	0.653	0.501	0.283	0.369	0.647	

In consideration of previous research, relevant studies that explored similar constructs and validated scales were reviewed. These studies consistently reported similar findings regarding the discriminant validity of the constructs under investigation. This alignment with existing literature strengthens the robustness and generalizability of the research outcomes.

By comparing results with previous studies, this study

further strengthened the understanding and validity of the observed discriminant validity in the research. The comparative analysis not only supports the internal validity of this study but also contributes to the broader body of knowledge in the field.

TABLE V: CROSS LOADING

	EC	LQ	NB	PEU	SEQ	SQ	TPACK	US	USE
AD	0.119	0.147	0.880	0.433	0.135	0.203	0.323	0.537	0.493
CD	0.161	0.158	0.909	0.479	0.148	0.220	0.299	0.550	0.489
PD	0.145	0.128	0.893	0.468	0.146	0.196	0.269	0.526	0.528
TK	0.067	0.441	0.294	0.144	0.412	0.464	0.871	0.304	0.329
TCK	0.128	0.385	0.298	0.103	0.312	0.408	0.835	0.255	0.326
PCK	0.103	0.475	0.285	0.125	0.386	0.452	0.864	0.294	0.318
TPACK	0.100	0.445	0.256	0.090	0.392	0.464	0.847	0.273	0.277
EC1	0.880	0.071	0.067	0.038	0.095	0.077	0.081	0.139	0.151
EC2	0.836	0.035	0.039	0.046	0.065	0.047	0.034	0.108	0.128
EC3	0.834	0.028	0.039	0.025	0.055	0.051	0.039	0.124	0.115
EC4	0.866	0.109	0.248	0.253	0.142	0.121	0.160	0.307	0.278
LQ1	0.068	0.905	0.132	0.059	0.440	0.560	0.437	0.249	0.307
LQ2	0.057	0.918	0.140	0.079	0.470	0.582	0.468	0.245	0.317
LQ3	0.102	0.936	0.163	0.094	0.444	0.590	0.483	0.275	0.363
LQ4	0.086	0.925	0.157	0.080	0.471	0.605	0.491	0.272	0.333
PEU1	0.108	0.063	0.437	0.826	0.045	0.055	0.092	0.337	0.375
PEU2	0.114	0.048	0.396	0.807	0.013	0.037	0.092	0.294	0.345
PEU3	0.148	0.092	0.457	0.881	0.084	0.136	0.145	0.353	0.384
PEU4	0.141	0.065	0.407	0.834	0.083	0.111	0.114	0.286	0.318
PEU5	0.125	0.086	0.453	0.842	0.107	0.160	0.125	0.342	0.367
SEQ1	0.144	0.485	0.166	0.092	0.928	0.648	0.422	0.339	0.272
SEQ2	0.084	0.448	0.150	0.059	0.906	0.615	0.406	0.322	0.240
SEQ3	0.083	0.434	0.133	0.062	0.910	0.605	0.385	0.299	0.236
SEQ4	0.122	0.434	0.131	0.076	0.901	0.626	0.388	0.312	0.258
SQ1	0.113	0.621	0.241	0.158	0.639	0.909	0.491	0.382	0.369
SQ2	0.096	0.577	0.179	0.094	0.602	0.894	0.480	0.338	0.288
SQ3	0.081	0.543	0.173	0.097	0.603	0.899	0.455	0.326	0.312
SQ4	0.069	0.539	0.232	0.077	0.622	0.904	0.458	0.353	0.309
US1	0.202	0.248	0.525	0.354	0.414	0.410	0.287	0.909	0.557
US2	0.240	0.261	0.546	0.370	0.289	0.334	0.306	0.930	0.527
US3	0.219	0.271	0.574	0.336	0.301	0.344	0.318	0.925	0.525
US4	0.217	0.265	0.575	0.367	0.285	0.349	0.306	0.928	0.534
USE1	0.187	0.345	0.525	0.408	0.249	0.338	0.336	0.526	0.912
USE2	0.228	0.319	0.509	0.375	0.244	0.331	0.361	0.527	0.875
USE3	0.196	0.336	0.468	0.374	0.269	0.302	0.314	0.488	0.873
USE4	0.198	0.293	0.488	0.369	0.213	0.289	0.278	0.516	0.882
USE5	0.207	0.309	0.518	0.385	0.259	0.328	0.344	0.530	0.921

*Note: Numbers 1–5 is to represent the question items

D. Assessment of the Structural Model

The Bootstrapping method is used for parameter estimation. Bootstrap generated a total of 5000 analogous samples for the bootstrap study and calculated t-values for the route coefficients as recommended by academics [32]. As shown in Table VI, thus H1a, H2a, and H3a are not supported and another 13 hypotheses are supported.

TABLE VI: PATH COEFFICIENTS

Hypothesis	Path	Coefficient	Std	T values	P Values	Result
H1a	**SQ → USE**	0.047	0.043	1.092	0.275	×
H1b	**SQ → US**	0.191	0.049	3.866	***	√
H2a	**SEQ → USE**	−0.047	0.036	1.297	0.195	×
H2b	**SEQ→ US**	0.134	0.039	3.402	0.001	√
H3a	**LQ → US**	0.001	0.043	0.016	0.987	×
H3b	**LQ → USE**	0.153	0.033	4.669	***	√
H4a	**TPACK → US**	0.104	0.04	2.626	0.009	√
H4b	**TPACK → USE**	0.083	0.034	2.46	0.014	√
H4c	**TPACK → NB**	0.08	0.038	2.12	0.034	√
H5a	**EC → US**	0.166	0.031	5.385	***	√
H5b	**EC → USE**	0.093	0.034	2.725	0.006	√
H6a	**PEU → US**	0.246	0.044	5.598	***	√
H6b	**PEU → USE**	0.208	0.049	4.235	***	√
H7	**US → USE**	0.387	0.049	7.826	***	√
H8	**US → NB**	0.354	0.063	5.571	***	√
H9	**USE → NB**	0.365	0.059	6.193	***	√
H1a	**SQ → USE**	0.047	0.043	1.092	0.275	×

Note: *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

VI. DISCUSSION

Based on the result, the H1b hypothesis is supported. OL system quality positively influenced the learners' perceived satisfaction. This conclusion is consistent with the findings of some researchers [5, 13, 14, 33–35]. Learning system quality is reflected by the usefulness, ease of use, and stability that learners feel when using the learning system. Therefore, whether the structure of the OL system is reasonable, easy to use, and flexible, all play a role in a student's perceived satisfaction.

However, the H1a hypothesis is not supported. The quality of OL systems has no significant effect on the continued use of learning systems. That means, whether learners are willing to continue to use the OL system has nothing to do with the quality of the system. Learners continue to use the learning system, not because the system is good or bad. The findings of this are similar to [5, 14, 36–40].

The H2b hypothesis is supported. Service quality has a positive effect on perceived satisfaction. This result shows that service quality plays a key role on the impact of perceived satisfaction. The higher the service quality, the higher the perceived satisfaction of students [8, 10, 33, 41–45]. Online learning support service is a distance learning support service in the context of online learning. Facing the increasingly fierce competition in the education market, online learning support service has attracted much attention, and it is also an

important means to building an educational brand to enhance competitiveness.

H2a is not supported. The effect of service quality on continuous use was not significant. The research shows that the quality of service is not the key factor affecting whether students continue to use the online learning system. The findings are consistent with some previous studies [39, 46–53]. This is because online learning services are mainly auxiliary help for students in the learning process, which is mainly reflected in the timeliness, convenience, and effectiveness of the service provision. In essence, the sustainability of learning is mainly affected by the student's internal factors, such as self-efficacy, intrinsic motivation, and so on. However, service quality will affect a student's willingness to continue using the online learning system through perceived satisfaction. It has been confirmed in this study.

The H3a hypothesis is not valid. The effect of learner quality on perceived satisfaction is not significant. The results of this study are contrary to the findings of some researchers who have shown a positive relationship between learner quality and perceived satisfaction [13, 44, 54]. However, some studies show that the influence of a learner's anxiety about computer technology on perceived satisfaction is not valid [5]. This reason could be because a learner's perceived view of quality is mainly reflected in the ability to use online equipment to carry out learning, proficiency in using equipment functions, and self-efficacy in utilizing the online learning platform.

Different from full-time students, adult learners need to face the pressures of work, family, and daily living to the online learning experience. But they have relatively rich work, social and life experiences that help to overcome the online learning barriers that first-time students can't rely upon. Today's learners know more about social networking, information processing, and technology use and are not unfamiliar with computers. In the third decade of the twenty-first century using an electronic device for work and study has become a normal fact of modern living. Even if adult learners are not familiar with online learning, there is familiarity with technology and technology tools. Moreover, students with high self-efficacy have a more positive attitude toward learning and a compelling willingness to pursue education. They are more disposed to try using new software to acquire new knowledge.

H3b is supported. The quality of learners has a positive effect on the continuous use of the system. The results are consistent with the conclusions of some researchers [13, 44, 54]. In OL, proficiency in the use of the system—and the ability to use technology within the system to complete learning tasks—will provide enthusiasm for the continuous use of the OL system.

H4a, H4b, and H4c hypotheses are supported. The results show that a teacher's ability to use TPACK knowledge directly affects students' satisfaction with the learning system and their willingness to continue using the learning system. Moreover, a teacher's TPACK ability plays a significant role in a student's desire to learn. This study uses quantitative analysis to measure the relationship between a teacher's TPACK ability and a student's learning satisfaction, willingness to continue learning, and learning benefits. There is little in the literature that describes such quantitative research. It should be noted, as well, that this study is also consistent with the qualitative research done in this area. For example, Zhang [55] showed that the application of TPACK knowledge in practice resulted in better instructional design, higher perceived satisfaction of students, and better learning benefits for students. Drugova [56] confirmed that in a university, TPACK knowledge improved a student's foreign language skills through innovative teaching practices. As well, a teacher's TPACK ability that was relatively strong resulted in higher student satisfaction with the teaching performance.

This study also determined that some university teachers resisted the integration of TPACK knowledge into their own teaching due to institutional and personal/professional reasons. Using the TPACK knowledge framework in teaching practice can promote effective teaching in a digital classroom environment [57]. TPACK is a teaching knowledge framework based on information technology. The use of TPACK knowledge can help design the pedagogical delivery of learning according to the needs of students. The ability to adjust to the learning progress of all students, and then meeting the personalized learning needs of each student, is the reason behind this study [58].

Some empirical studies have shown that a teacher's TPACK ability has a positive impact on continuous use [59]. Specifically, teachers who possess higher levels of TPACK are better equipped to integrate technology into their teaching practices, resulting in increased student engagement, improved learning outcomes, and a higher likelihood of students continuing to use technology for learning. These teachers can leverage technology effectively to design interactive and engaging instructional activities, provide personalized learning experiences, and foster collaborative learning environments. Students perceived technology as valuable and beneficial (which results in using technology in their learning journey).

Furthermore, studies have confirmed a significant relationship between a student's regular use of electronic devices for learning and a teacher's TPACK ability results in a student's willingness to continue learning [60]. When teachers possess a strong TPACK foundation, they are more capable of guiding students in using electronic devices for educational purposes. Students benefit from the pedagogical expertise of these teachers, who can effectively integrate technology tools and resources into classroom activities, provide appropriate guidance and support, and create engaging learning environments. Consequently, a student's continuous use of electronic devices becomes more purposeful, leading to enhanced learning experiences, increased motivation, and improved academic performance.

H5a and H5b hypotheses are valid. This study demonstrates that expectation confirmation has a significant influence on a student's perceived satisfaction and continuous use, which aligns with the research findings of previous scholars [61, 62]. Expectation confirmation refers to the process in which a student's prior expectations about technology use are met or exceeded, leading to positive perceptions and attitudes toward technology. When a student's initial expectations are confirmed through the

effective integration of technology in teaching and learning, there is a perceived higher satisfaction with the learning experience. The student is more likely to continue using technology as a valuable tool for his/her educational pursuits. EC also has a significant influence on a student's continuous use of technology. Researcher results show that EC plays a key role in a student's continuous use [63–66]. The higher the degree of a learner's expectation confirmation, the more learners use the learning system to continue learning which creates a virtuous cycle for continued use (or return to the online experience well after the course or program is over).

H6a and H6b hypotheses are supported. PEU has a positive effect on learning satisfaction. It shows that PEU has a positive impact on a learner's continuous use, indicating that a learner's perception of resources and services provided by an OL platform is convenient and easy to use. This will directly affect a learner's continuous use intention. This is consistent with the findings of many researchers [13, 67–70].

The H7 hypothesis is valid. The research proves that the US has a significant positive effect on continuous OL usage, which is consistent with the conclusions of some researchers [12, 13, 61, 70, 71]. The more satisfied learners are with the OL system, the more they will continue to use the OL system, which indicates that a student's perceived satisfaction plays a key role in a student's continuous learning.

The H8 hypothesis is valid. Previous studies show that a student's learning benefit is improved when the perceived satisfaction is higher. On the contrary, when the learning satisfaction is low, the learning benefit for students also shows a downward trend. Many studies of OL agree with this study finding [5, 13, 14, 39].

The H9 hypothesis is also supported. The benefits of continuous use of OL systems are demonstrated. If the OL system can meet the needs of students, those students will continue to use the online system and this state of learning will be effective and successful. The results corresponded to the literature [5, 13, 14, 39].

VII. Conclusion and Implications

This study demonstrated that a teacher's TPACK ability has a positive influence on a learner's continuous use and perceived satisfaction of an online course. This study also indicates a positive pedagogical influence of TPACK on a student's ability to learn in an online learning course of study. That is to say, the stronger the teacher's TPACK ability, the more one's pedagogical practice promotes learners to continue to use the online learning system, and the more it can enable learners to generate high perceived satisfaction. Analysis of the results indicated that TPACK's impact was more clearly perceived by the adult learners in this study. This is a significant contribution of this study.

This study identified several key elements that contributed to the success of an adult online learning system. These elements were derived from the analysis of empirical data and are supported by relevant literature. These elements include system quality; service quality; learner quality; expectation confirmation; system usability; and teacher's TPACK ability. Based on these findings, it is recommended that online learning systems integrate these elements within their teaching, service, management, and evaluation frameworks. Online teachers should continually enhance their pedagogical practice by staying updated with current pedagogical approaches and actively improving their technical literacy. They should also prioritize continuous professional development to keep pace with the rapid changes in technology and strengthen their TPACK knowledge structure. By constantly improving the functional application of TPACK in practice, teachers can enhance learning outcomes and promote successful online learning experiences for adult learners.

It is crucial to acknowledge the limitations of this study. The generalizability of the results should be approached with caution, as the findings are based on data collected from a specific population of non-full-time adult students in a particular region of Southwest China. Further study needs to expand the scope of this investigation and verify the effectiveness and reliability of the model. The model of adult online learning success in Southwest China is the first integrated model combining TPACK theory with the IS model, TAM model, and EM model. In addition, this study was carried out from the perspective of students. Future studies should explore teacher and administrator perspectives to determine the success factors of adult online learning from a multi-faceted approach.

A contribution of this study is to propose and outline a multidimensional and comprehensive model for adult online learning success. This model is based on the research literature of previous researchers and combines four theories: ISS, TAM, ECM-ISC, and TPACK under a single more comprehensive model. This model takes into account a broader set of factors influencing adult satisfaction with online delivery of courses and programs. This study went further in analyzing more elements of perceived quality in online programs from the adult learner perspective.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Li Yuebo conducted and carried out the study; Siti Hajar Halili supervised the study and contributed to the writing of the manuscript; Rafiza Abdul Razak supervised the study and proofread the manuscript.

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