

A Study on the Factors Influencing Tpack Using Behavior of University English Instructors in Western China: Based on the Model of Tam-Tpb

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Abstract

The integration of technology into higher education has become essential for enhancing teaching effectiveness, particularly in regions like Western China, where educational reform is actively promoted. The Technological Pedagogical Content Knowledge (TPACK) framework offers a model for incorporating technology into teaching. However, the factors influencing university English instructors' adoption of TPACK in this region remain under explored. This study aims to investigate the factors that affect TPACK usage behaviours among university English instructors in Western China, focusing on how perceived usefulness, subjective norms, and technological knowledge impact their intentions and behaviours in adopting TPACK. A mixed-methods approach was employed, combining the Technology Acceptance Model (TAM) and the Theory of Planned Behavior (TPB). Quantitative data were collected from 422 instructors across 30 universities in 12 provinces through questionnaires, and qualitative insights were derived from interviews with 10 instructors. Structural equation modelling was used to analyse the quantitative data, while thematic analysis was applied to the qualitative data. The findings revealed that university instructors generally possess moderate TPACK abilities, with older and more experienced instructors demonstrating higher technological knowledge (TECH-K). Perceived usefulness and subjective norms significantly influenced TPACK usage intentions, whereas perceived ease of use did not have a direct effect. Behavioural intention mediated the relationship between perceived usefulness, subjective norms, and actual TPACK usage. Additionally, qualitative findings emphasised the importance of institutional support, peer attitudes, and instructors' self-efficacy in promoting TPACK adoption. The study underscores the need for systematic training, policy support, and improved infrastructure to enhance TPACK adoption among English instructors. Future research should broaden the sample, refine the questionnaire, and explore the long-term professional development of instructors. This study provides insights into the development of TPACK in China and offers strategies for improving technology integration in English language teaching.

Keywords: TPACK Using Behavior; TAM-TPB Model; University English Instructors; Western China

Introduction

At the university level, instructors are not only the implementers of educational activities, but also the leaders and promoters of educational reform (Datnow, 2020). With the continuous application of information technology in higher education activities, traditional educational and teaching methods are undergoing revolutionary changes (Cabaleiro-Cerviño, 2020). For two decades, how to integrate information technology into course teaching to improve educational and teaching effectiveness has become the focus of many educational

researchers (Abdullah, 2016; Pal, 2023). Particularly, in 2005, Koehler and Mishra created a new theoretical structure, TPACK framework which based on Shulman's Pedagogical Content Knowledge (PCK) which refers to the specialization and in-depth content knowledge of a certain type of curriculum or subject with a disciplinary teaching methodology knowledge and integrated information technology knowledge (TK), subject content knowledge (CK), and pedagogical knowledge (PK) into the framework that can be used to promote the process of a dynamic integration process of appropriate choices and adjustments based on different contextual factors while teaching (Lamminpää, 2021). Once the concept of TPACK was proposed, its concepts and mechanism has provided a reasonable solution for the integration and application of information technology in educational contexts (Teo, 2009), and points out the direction for the development and improvement of instructors' technological and professional literacy (Baracaldo, 2019). Research has shown that curriculum design based on TPACK can effectively improve students' classroom participation and achieve good teaching outcomes (Chaaban & Sawalhi, 2023; Rahimi & Pourshahbaz, 2018).

In 2022, the Higher Education Department of the Ministry of Education of China clearly stated in the issued annual work points that it is necessary to comprehensively promote the digitization of higher education teaching and use digitization to help improve the talent cultivation capability of colleges and universities. Therefore, improving the information technology teaching ability of college and university instructors is a requirement and an inevitable choice of the times (Wang et al., 2023). To respond to this policy, this study puts forward the importance of focusing on English language instructors. Since it is all of their salience and priority to focus on improving their information technology teaching abilities and behaviours, it is crucial that all English instructors are effective in using technology in teaching the "College English Course," which has been listed as compulsory for all students in every major to develop, cultivate, and enhance their cultural literacy and employability.

Despite the recognition of TPACK's significance, many university English instructors face challenges in its practical implementation. Common issues include a lack of institutional support, insufficient training in technology integration, and varying levels of technological knowledge among instructors. This study aims to address these research problems by identifying the specific factors influencing TPACK behaviours of university English instructors in Western China. Understanding these factors is critical, as it provides insights into the obstacles instructors encounter and highlights the necessary support mechanisms for successful technology integration in their teaching practices.

Given the pressing need for effective technology integration in language education, this paper is presented to offer a comprehensive analysis of the challenges and facilitators of TPACK adoption. By exploring these dynamics, this research seeks to inform educational policies and practices that can enhance the technological capabilities of instructors, ultimately leading to improved teaching outcomes in English language education.

In order to systematically explore TPACK, this study applied the Technology Acceptance Model (TAM) and Theory of Planned Behavior (TPB) as the foundation to gain a deeper understanding of the factors influencing the TPACK behaviours of university English instructors in Western China. By using the results of empirical analysis from previous research, this study aimed to find an effective model to promote the application of information technology in the teaching of university English instructors, thereby providing assistance for better teaching English with technology in the universities in Western China.

Research Objectives

- 1) To explore the factor components that influence the TPACK using behaviors of university English instructors in the universities in Western China.
- 2) To determine the causal relationship of factors that influence the TPACK using behaviors of university English instructors in the universities in Western China.

Literature Reviews

With the rapid integration of technology into the field of education, the role of technological pedagogical and content knowledge (TPACK) has become increasingly significant (Koehler and Mishra, 2005) as a framework that encompasses subject content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK), with their interactions (Mishra & Koehler, 2006). This framework is aimed for the instructors to be effective in incorporating technology into teaching practice as to enhance effective learning outcomes by encompassing the foundational theories, concepts, and methods in a particular subject area, crucial for conveying knowledge accurately (Jeschke, 2021).

In this study, theoretical concepts of TPACK and TAM were applied. First, for TPACK, while PK involves strategies, evaluation methods, and management techniques used in the teaching process, requiring instructors to understand and apply educational theories such as constructivism and cognitive learning theory (Guerriero, 2014), TK pertains to the instructors' knowledge of various technologies, including traditional and emerging tools, and their application in teaching (Nicolaou, 2019; Lewis, 2003). Three core components of TPACK are: 1) Pedagogical content knowledge (PCK), the integration of PK and CK, for facilitating student learning; 2) Technological Pedagogical Knowledge (TPK), focusing on using technology to support educational strategies; and 3) Technological Content Knowledge (TCK), the intersection of technology and subject matter; and context, which encompasses the broader social, cultural, and psychological factors that influence teaching and learning (Mishra & Koehler, 2006; Koehler & Mishra, 2009). Thus, TPACK's primary role is to reform educational models, shifting instructors' and students' positions within the educational structure (Ghavifekr, 2014). Jadhav (2022) argues that integrating technology into the curriculum help improve learning, foster a conducive learning environment, and transform existing learning methods. From a teaching perspective, TPACK also enables instructors to address complex concepts more effectively, enrich teaching materials, and enhance their teaching skills (Ghavifekr & Rosdy, 2014). For students, it cultivates autonomy, innovation, and practical abilities, positioning them as active learners rather than passive recipients of knowledge (De Vita & Tan, 2021).

Next, the Technology Acceptance Model (TAM) with the Theory of the Planned Behavior (TPB) offer insights into individuals' adoption of technology and behaviors. As TAM focuses on perceived usefulness and ease of use as determinants of technology adoption (Davis, 1989), TPB, on the other hand, emphasizes the influence of attitudes, subjective norms, and perceived behavioral control on intention and behavior (Ajzen, 1985). These models have been applied in various fields, including education, where they help explain instructors' willingness to adopt technological teaching practices (Motaghian, 2013; Mouloudj, 2021). As TAM and TPB have been combined to predict instructors' behavioral intentions towards technology adoption in education, its integrated model, TAM-TPB, enhances predictive power by considering both cognitive and affective factors (Imtiaz & Maarop, 2014). In the context of TPACK, this model can elucidate instructors' willingness to integrate technology into their

teaching, thereby facilitating their professional development and improving teaching effectiveness.

In conclusion, by adopting the TPACK and the TAM-PB model, this study developed the conceptual framework and hypotheses as to explore the insights into instructors' adoption of technological teaching practices with the significance of perceived usefulness, ease of use, attitudes, and social norms, in expectation of comprehensive understanding of technology integration in education and guide future research and practice.

Research Methodology

The researcher outlines the methodology of the study, focusing on three key components: population and sample, research instruments, and data analysis. The population consists of approximately 40,000 English instructors across 302 colleges and universities in 12 regions of Western China, with a sample size of 422 respondents selected proportionally. The research utilized a comprehensive questionnaire divided into four sections: basic information, TPACK ability measurement, TAM, and TPB questionnaires. Validity was confirmed using the Index of item-objective congruence (IOC) test, with a high Cronbach's Alpha coefficient of 0.96. Data analysis included descriptive statistics and advanced methods like Confirmatory Factor Analysis (CFA) and Structural Equation Modeling (SEM) to assess reliability, validity, and causal relationships.

Population and Sample

The population of the study contained around 40,000 English instructors from a total of 302 colleges and universities and in 12 regions of Western China. A sample size of 422 respondents is conducted based on the proportion of English instructors from the sampled universities.

Research Instrument

The questionnaire was divided into four parts. The first part was the basic information of the samples, the second part was the instructors' TPACK ability level measurement questionnaire, the third part was the TAM questionnaire, and the fourth part was the TPB questionnaire. The IOC (Index of item-objective congruence) test was conducted to confirm the validity of the instruments that all the items are qualified for the content validity at 1. After the questionnaire was back translated, a pretest was performed with 30 non-samples of university English instructors. The Cronbach's Alpha coefficients of all core variables was 0.96.

Data Analysis

In statistical analysis of data, the study will use descriptive analysis to analyze the demographic variable characteristics of the test samples reliability and validity analysis to test the reliability and consistency of the data measured by the scales in the questionnaires, descriptive analysis (mean \pm standard deviation) to measure the TPACK proficiency level of the test samples, and the same method to test the behavioral intention of English instructors in Western China towards integrating information technology and teaching. Finally, guided by the TAM-TPB integration theory, the study will use Structural Equation Modeling (SEM) to explore the factor components that influence the TPACK using behaviors of English instructors, and based on this, confirm the model as to enhance the TPACK ability of University English instructors in Western China.

Research Conceptual Framework

This study utilizes the TAM-TPB integrated model to explore the factors affecting the TPACK use behavior of university English instructors in Western China. The research model is shown in Figure 1.

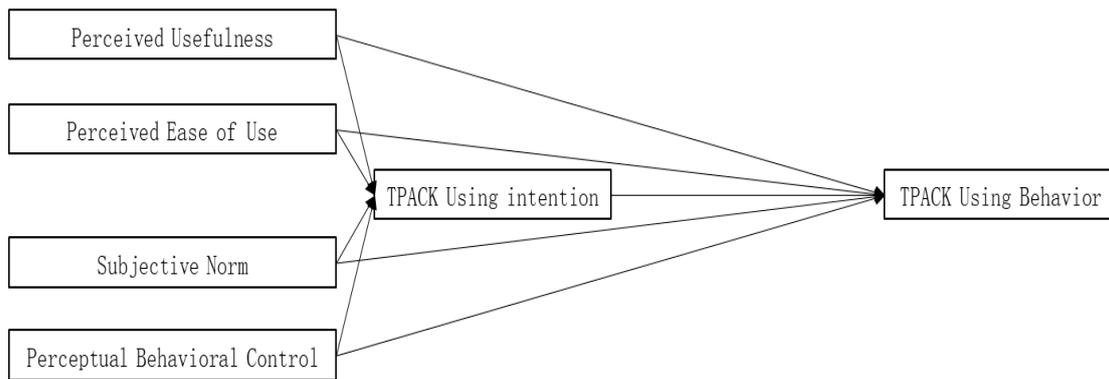


Figure 1 Research Conceptual Framework

Perceived Usefulness, Perceived Ease of Use and Instructors' Intention to Use TPACK

Perceived usefulness refers to the degree to which instructors feel that IT teaching can improve their teaching level. Perceived ease of use refers to how easy it is for instructors to use information technology to teach daily courses. TPACK usage intention refers to the measurable degree of instructors' willingness to use information technology for daily curriculum teaching. The research shows that instructors' perceived usefulness of information technology in improving their teaching level can not only affect instructors' initial adoption of information technology, but also affect their satisfaction and intention to continue using it. In addition, in today's world of user experience, if instructors feel that a certain information technology is easy to use, then their willingness to continue to use is likely to increase. At the same time, empirical research shows that instructors' perceived ease of use and perceived usefulness have a positive impact on their IT usage intention in the context of network and mobile learning. Based on this, the study puts forward the following hypothesis:

H1: Perceived usefulness has a positive impact on instructors' TPACK using intention.

H2: Perceived ease of use has a positive impact on instructors' TPACK using intention.

Subjective Norms, Perceived Behavioral Control and Instructors' TPACK Using Intention

Subjective norms refer to the extent to which the words or actions of others influence instructors' use of information technology to teach. Orapin (2009) found that subjective norms can affect individuals' purchase intention for a certain product and thus affect their use behavior. In daily teaching activities, the stronger the degree of subjective norms of instructors, the more easily their behavior in teaching activities is affected by the surrounding environment, so as to produce behavioral intention consistent with the expectations of others. Shen Meng (2019) pointed out that different from subjective norms, under certain conditions, perceptual

behavioral control can directly affect the factors influencing instructors' TPACK ability under the TAM-TPB integrated model in FIG. 5. Ajzen believes that perceptual behavioral control affects people's production of certain behavioral intentions, and Stancu et al. (2016) and Liao Fen et al. (2020) have also confirmed this view in their studies. In this study, perceived behavioral control refers to instructors' judgment on a series of promoting or hindering factors such as their ability and condition to use information technology during teaching. When instructors have enough ability and resources and can better control their own behavior, their enthusiasm to use information technology in daily teaching will be greatly improved. Based on this, the following hypothesis is proposed:

H3: Subjective norms have a positive impact on instructors' intention to use TPACK.

H4: Perceived behavioral control has a positive impact on instructors' TPACK using intention.

2. In the current academic research, the test of the mediating effect of a variable has aroused extensive attention of scholars. The so-called intermediary effect is the actual path to study the mutual influence of different variables, which helps to strengthen people's understanding of the actual influence mechanism of something and enhance the credibility of research conclusions. Lu Ying et al. (2021) confirmed in their study that product usage intention plays a positive mediating role in the influence of other variables on usage behavior. Information technology teaching is a conscious and planned behavior. The more active its perceptual behavior control and subjective norms are in the process of information technology teaching, the stronger its perception of usefulness, sensuality and ease of use is, the stronger its subjective intention to use information technology teaching is, the easier it is to stimulate its use behavior. Based on this, this paper proposes the following hypotheses: The influence of instructors' TPACK usage intention on their usage behavior;

H5: Instructors' TPACK using intention has a mediating effect between perceived usefulness and TPACK using behavior.

H6: Instructors' TPACK using intention has a mediating effect between perceived ease of use and TPACK using behavior.

H7: Instructors' TPACK using intention has a mediating effect between subjective norms and TPACK using behavior.

H8: Instructors' TPACK using intention has mediating effect between perceived behavior control and TPACK using behavior

Research Results

The demographic analysis of the participants in this study reveals a significant gender disparity, with females representing 64.93% of the sample. Age distribution shows a predominance of individuals aged 31-40, accounting for 38.15% of respondents, while educational attainment is notably high, with 52.13% holding master's degrees. Furthermore, the confirmatory factor analysis (CFA) indicates a robust model fit, supported by high values of reliability and validity for the core variables of perceived usefulness, perceived ease of use, subjective norms, behavioral control, usage intention, and usage behavior. The structural equation modeling (SEM) results confirm the hypothesised relationships, indicating that perceived usefulness, subjective norms, and perceived behavioural control significantly

influence instructors' intentions to utilise Technological, Pedagogical, and Content Knowledge (TPACK). These findings provide a reliable foundation for understanding the factors affecting technology adoption in educational contexts.

Demographic Information

Among the samples collected by the research institute, males accounted for 35.07% and females accounted for 64.93%. In terms of age distribution, the group aged 20-30 accounts for 10.66%, the group aged 31-40 accounts for 38.15%, those aged 41-50 account for 30.09%, and those aged over 51 account for 21.09%. In terms of working years, those who have worked for 1-5 years account for 16.59%, those who have worked for 6-10 years account for 40.05%, those who have worked for 11-20 years account for 29.62%, and those who have worked for more than 21 years account for 13.74%. In terms of their educational background, those with bachelor's degrees accounted for 33.65%, those with master's degrees accounted for 52.13%, and those with doctoral degrees accounted for 14.22%. In terms of their professional titles, those with teaching assistant titles accounted for 7.11%, those with lecturer titles accounted for 36.73%, those with associate professor titles account for 43.60%, and those with professor titles accounted for 12.56%.

Confirmatory Factor Analysis (CFA)

The results of this confirmatory factor analysis showed that the fit index of the model performs well. Specifically, the value of X^2/DF was 1.517, much lower than the reference value of 3. The value of RMSEA was 0.035, and the measured value of SRMR was 0.031, both of which were less than the reference value of 0.08. In addition, the values of GFI, AGFI, NFI, TLI, and CFI were 0.928, 0.911, 0.944, 0.977, and 0.980, respectively, all of which were greater than or equal to the reference value of 0.9.

Table 1 Confirmatory Factor Analysis Model Fit

Indicator	X ² /DF	RMSEA	SRMR	GFI	AGFI	NFI	TLI	CFI
Reference value	≤3	<0.08	<0.08	≥0.9	≥0.9	≥0.9	≥0.9	≥0.9
Measured value	1.517	0.035	0.031	0.928	0.911	0.944	0.977	0.980

The analysis of the convergent validity results of the measurement model showed that the Cronbach's alpha coefficient of each item was above 0.8, the factor loadings of each item were above 0.7, and they were all significant. From the perspective of Average Variance Extracted (AVE), the AVE values of the six latent variables USE, EOU, SN, BC, BI, and UB were all greater than the reference value of 0.5, indicating that these six latent variables had good convergence validity. Finally, from the perspective of combined reliability (CR), the combined reliability of the six latent variables was greater than the reference value of 0.7, indicating that the measurement models for these six latent variables have high stability and reliability.

Table 2 Convergence validity test

Observed Variable	Cronbach's α	N Of Items	Factor Loading	AVE	CR
USE	0.925	4	0.853-0.889	0.755	0.925
EOU	0.916	4	0.820-0.888	0.731	0.916
SN	0.897	4	0.810-0.835	0.684	0.897
BC	0.840	4	0.712-0.824	0.572	0.842
BI	0.889	5	0.769-0.815	0.617	0.889
UB	0.908	5	0.715-0.857	0.666	0.908

The results of discriminant validity analysis indicated that the correlation coefficients between the six core variables of USE, EOU, SN, BC, BI, and UB were all less than their respective Average Variance Extracted (AVE) values. This result not only validates the theoretical validity of the model, but also confirms the statistical independence of the data.

Table 3 Discriminant validity test

Core Variables	USE	EOU	SN	BC	BI	UB
USE	0.869					
EOU	0.078	0.855				
SN	0.392	0.236	0.827			
BC	0.444	0.214	0.500	0.756		
BI	0.444	0.193	0.492	0.505	0.785	
UB	0.417	0.303	0.536	0.464	0.477	0.816

In summary, this confirmatory factor analysis had laid a solid foundation for subsequent data analysis, ensuring the credibility and explanatory power of the study. Based on these reliable results, the relationships and impacts between core variables were further explore and analyzed.

Structural Equation Model (SEM)

After using AMOS26 software to perform data analysis on the structural equation model constructed in the research, the results showed that all key fit indices met the established criteria. This indicated that the model constructed in this research had a good fit relationship with the data, and the model could effectively explain and represent the structural relationships in the actual data. Therefore, the structural equation model constructed in this research was a reasonable and effective data analysis tool, providing a reliable foundation for subsequent research and practical applications. As shown in Table 4.

Table 4 Model Fit

Indicator	X ² /DF	RMSEA	SRMR	GFI	AGFI	NFI	TLI	CFI
Reference value	≤3	<0.08	<0.08	≥0.9	≥0.9	≥0.9	≥0.9	≥0.9
Measured value	1.517	0.035	0.031	0.928	0.911	0.944	0.977	0.980

Hypothesis Testing Results

1.) Hypothesis Testing Results for H1-H4

After testing the hypothesized paths in the structural equation model using AMOS software, the hypothesis verification results are as follows.

H1: Perceived usefulness has a positive impact on instructors' TPACK usage intention.

The standardized coefficient (Std) for this path was 0.22, and the statistical significance level (P) was less than 0.001, indicating that the path was highly significant statistically. The confidence interval (Lower to Upper) excluded 0, further confirming this. Therefore, we can accept the original hypothesis that perceived usefulness had a positive impact on instructors' TPACK usage intention.

H2: Perceived ease of use has a positive impact on instructors' TPACK usage intention.

The standardized coefficient for this path was 0.052, with a P-value of 0.238, which was greater than the significance level of 0.05, indicating that this path was not statistically significant. Since the confidence interval included 0, the original hypothesis was not supported.

H3: Subjective norms have a positive impact on instructors' intention to use TPACK.

This path showed strong statistical significance, with a standardized coefficient of 0.276 and a P-value less than 0.001. The confidence interval also excluded 0, confirming that SN had a positive and significant impact on BI, and the original hypothesis was supported.

H4: Perceived behavioral control has a positive impact on instructors' TPACK using intention.

Similar to the BI←SN path, the BI←BC path also exhibits high statistical significance, with a standardized coefficient of 0.296 and a P-value less than 0.001. The confidence interval excludes 0, indicating that BC has a positive and significant impact on BI, and the original hypothesis is similarly supported.

In summary, by analyzing the hypothesis testing results output from AMOS software, we have confirmed that USE, SN, and BC all have significant positive impacts on BI, while the impact of EOU on BI is not significant. As shown in Table 5.

Table 5 H1-H4 Hypothesis Testing Results

Hypothesis	Std	S.E.	C.R.	P	Lower	Upper	Results
H1:BI←USE	0.22	0.063	3.492	0.001	0.096	0.339	Accepted
H2:BI←EOU	0.052	0.045	1.156	0.238	-0.036	0.145	Rejected
H3:BI←SN	0.276	0.066	4.182	0.001	0.151	0.404	Accepted
H4:BI←BC	0.296	0.073	4.055	0.001	0.153	0.447	Accepted

2) Hypothesis Testing Results for H5-H8

After testing the hypothesized paths (H5-H8) in the structural equation model using AMOS software, the hypothesis verification results are as follows.

H5: Instructors' TPACK usage intention has a mediating effect between perceived usefulness and TPACK usage behavior.

Total effects: The total effect of USE on UB was significant (Estimate = 0.189, S.E. = 0.062, C.R. = 3.048, P = 0.001), indicating that BI played a significant mediating role between USE and UB.

Direct effects: The direct effect of USE on UB is significant (Estimate = 0.153, S.E. = 0.066, C.R. = 2.318, P = 0.013), indicating that USE had a direct positive impact on UB.

Indirect effects: The indirect effect of BI between USE and UB was significant (Estimate = 0.035, S.E. = 0.019, C.R. = 1.842, P = 0.009), suggesting that BI played a significant mediating role in the process of USE influencing UB, and its indirect effect accounted for 18.52% of the total effect.

H6: Instructors' TPACK usage intention has a mediating effect between perceived ease of use and TPACK usage behavior.

Total effects: The total effect of EOU on UB was significant (Estimate = 0.181, S.E. = 0.044, C.R. = 4.114, P = 0.001), indicating that BI played a significant mediating role between EOU and UB.

Direct effects: The direct effect of EOU on UB was significant (Estimate = 0.173, S.E. = 0.043, C.R. = 4.023, P = 0.001), indicating that EOU had a direct positive impact on UB.

Indirect effects: The indirect effect of BI between EOU and UB was not significant (Estimate = 0.008, S.E. = 0.009, C.R. = 0.889, P = 0.152). Although there was an indirect effect, its statistical significance was low, accounting for only 4.42% of the total effect.

H7: Instructors' TPACK usage intention has a mediating effect between subjective norms and TPACK usage behavior.

Total effects: The total effect of SN on UB was significant (Estimate = 0.367, S.E. = 0.058, C.R. = 6.328, P = 0.001), indicating that BI played a significant mediating role between SN and UB.

Direct effects: The direct effect of SN on UB was significant (Estimate = 0.322, S.E. = 0.059, C.R. = 5.458, P = 0.001), indicating that SN had a direct positive impact on UB.

Indirect effects: The indirect effect of BI between SN and UB was significant (Estimate = 0.044, S.E. = 0.022, C.R. = 2.000, P = 0.01), suggesting that BI played a significant mediating role in the process of SN influencing UB, and its indirect effect accounted for 11.99% of the total effect.

H8: Instructors' TPACK use intention has a mediating effect between perceived behavior control and TPACK use behavior.

Total effects: The total effect of BC on UB was significant (Estimate = 0.189, S.E. = 0.066, C.R. = 2.864, P = 0.005), indicating that BI played a significant mediating role between BC and UB.

Direct effects: The direct effect of BC on UB was significant (Estimate = 0.141, S.E. = 0.065, C.R. = 2.169, P = 0.029), indicating that BC had a direct positive impact on UB, but the significance was relatively low.

Indirect effects: The indirect effect of BI between BC and UB was significant (Estimate = 0.048, S.E. = 0.022, C.R. = 2.182, P = 0.01), suggesting that BI played a significant mediating role in the process of BC influencing UB, and its indirect effect accounted for 25.40% of the total effect.

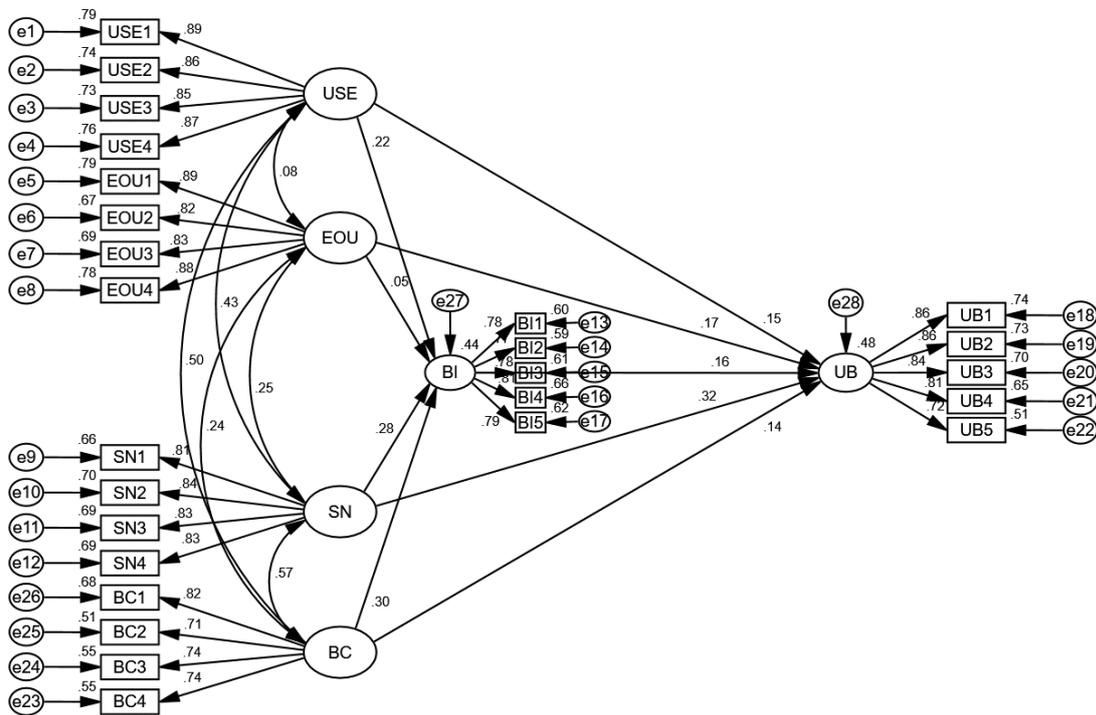
In summary, the study conducted a thorough data analysis of the constructed structural equation model using AMOS 26 software, verifying multiple key hypotheses. Specifically, Perceived Usefulness (USE), Subjective Norms (SN), and Perceived Behavioral Control (BC) all had significant positive effects on the Usage Intention (BI) of the Technological, Pedagogical, and Content Knowledge (TPACK) model among instructors, with standardized coefficients of 0.22, 0.276, and 0.296, respectively, and statistical significance levels below 0.001. This result indicated that these factors played crucial roles in stimulating instructors' willingness to adopt new technologies. However, the impact of Perceived Ease of Use (EOU) on usage intention was not significant, with a standardized coefficient of 0.052 and a P-value of 0.238, suggesting that ease of use was not a decisive factor influencing instructors' adoption of TPACK in the context of this study. As shown in Table 6.

Table 6 H5-H8 Hypothesis Testing Results

	Hypothesis		Std	S.E.	C.R	Lower	Upper	P	Proporti on of indirect effect	results
H 5	UB←BI←U SE	Total effects	0.189	0.062	3.048	0.077	0.320	0.001	18.52%	Accept ed
		direct effects	0.153	0.066	2.318	0.033	0.289	0.013		
		Indirect effects	0.035	0.019	1.842	0.008	0.085	0.009		
H 6	UB←BI←E OU	Total effects	0.181	0.044	4.114	0.096	0.267	0.001	4.42%	Accept ed
		direct effects	0.173	0.043	4.023	0.085	0.259	0.001		
		Indirect effects	0.008	0.009	0.889	-	0.031	0.152		
H 7	UB←BI←S N	Total effects	0.367	0.058	6.328	0.251	0.481	0.001	11.99%	Accept ed
		direct effects	0.322	0.059	5.458	0.204	0.436	0.001		
		Indirect effects	0.044	0.022	2.000	0.01	0.096	0.01		
H 8	UB←BI←B C	Total effects	0.189	0.066	2.864	0.059	0.313	0.005	25.40%	Accept ed
		direct effects	0.141	0.065	2.169	0.016	0.272	0.029		
		Indirect effects	0.048	0.022	2.182	0.011	0.099	0.01		

Further analysis revealed that instructors' usage intention played a significant mediating role between multiple independent variables and Usage Behavior (UB). Specifically, the mediating effect of usage intention between USE and UB accounted for 18.52% of the total effect, between SN and UB accounted for 11.99%, and between BC and UB accounted for a substantial 25.40%. These findings not only confirm the central role of usage intention in facilitating the process of technology acceptance but also uncover the complex pathways through which different factors influence behavior via intention. As shown in Figure 2

Figure 2 Hypothesis of structural model verification result diagram



Conclusion

The study explored the impact of multiple variables on TPACK usage intention (BI) and usage behavior (UB). The research results showed that:

Perceived usefulness (USE): H1 was validated, that is, perceived usefulness had a significant positive impact on instructors' intention to use TPACK. This suggested that when instructors believe that using TPACK can bring significant teaching improvements, they are more likely to have the intention to use TPACK (Wangdi, et al., 2023).

Perceived ease of use (EOU): H2 was not supported, the impact of perceived ease of use on TPACK usage intention was not significant.

Subjective Norms (SN): H3 was validated, subjective norms had a significant positive impact on instructors' intention. This reflected the enhancing effect of positive attitudes and support from colleagues, school leaders, and students on instructors' intention to use TPACK, especially, with student-centered learning strategies were especially perceived as effective and influenced by stronger collaboration at the school level (Tammets, et al., 2024).

Perceived Behavioral Control (BC): H4 was validated, perceived behavioral control also had a significant positive impact on TPACK usage intention. This suggests that when instructors believe they have the ability to overcome obstacles in using TPACK, they are more likely to generate usage intention (Omur, C., & Ramazan, C., 2019).

Mediating effect: In hypotheses H5 to H8, we further validated the mediating effect of TPACK usage intention between multiple independent variables and the results indicated that usage intention plays a significant mediating role in most cases, especially in the influence of perceived usefulness (USE) and subjective norm (SN) on usage behavior. This emphasizes the crucial role of using intention in promoting behavioral change in that in that now is an era of online learning and day by day the infrastructure barriers of time and place are being substituted by digital world where physical access to education must be empowered with ICT for better performance and integration with modern era (Shah, et al., 2021).

Discussion

This study conducted a comprehensive and in-depth exploration of the TPACK (Technological Pedagogical Content Knowledge) ability of English instructors in universities in western China through a combination of quantitative analysis and qualitative interviews. Ultimately, out of eight hypotheses, seven were confirmed, only the second hypothesis was not.

H1: Perceived usefulness has a positive impact on instructors' TPACK using intention, was confirmed.

H2: Perceived Ease of Use has positive impact on instructors' TPACK using intention, was not confirmed.

H3: Subjective norms have a positive impact on instructors' intention to use TPACK, was confirmed.

H4: Perceived behavioral control has a positive impact on instructors' TPACK using intention, was confirmed.

H5: Instructors' TPACK usage intention has a mediating effect between perceived usefulness and TPACK using behavior, was confirmed.

H6: Instructors' TPACK usage intention has a mediating effect between perceived ease of use and TPACK using behavior, was confirmed.

H7: Instructors' TPACK usage intention has a mediating effect between subjective norms and TPACK using behavior, was confirmed.

H8: Instructors' TPACK using intention has mediating effect between perceived behavior control and TPACK using behavior, was confirmed.

This finding aligns with the research outcomes of multiple scholars, further substantiating the significance of perceived usefulness in technology acceptance and application. Mishra & Koehler (2006) pointed out in their study that the TPACK (Technological Pedagogical Content Knowledge) framework aims to identify and describe the types of knowledge teachers need when integrating technology into teaching. They argued that when teachers recognize the potential of technology integration to enhance teaching effectiveness, they are more motivated to grasp and apply TPACK. This viewpoint directly supports the results of the hypothesis testing, namely, that perceived usefulness is a crucial driver for teachers' use of TPACK. Scherer et al. (2019), through a meta-analysis of the TPACK acceptance model, found that perceived usefulness is an important predictor of teachers'

adoption of digital technologies in teaching. Their research indicates that when teachers believe a certain technology is useful for improving teaching quality, they are more inclined to use it in the classroom. This finding is highly consistent with the hypothesis testing results of this paper, further reinforcing the positive impact of perceived usefulness on TPACK usage intention. Ertmer et al. (2012) noted in their study that teachers' perceived usefulness of technology integration significantly influences their practice of technology integration. They believed that when teachers see technology integration as a solution to teaching problems or an improvement in teaching practice, they are more likely to actively adopt these technologies. This aligns with the positive impact of perceived usefulness on TPACK usage intention observed in the hypothesis testing, emphasizing the central role of teachers' perceived usefulness of technology in their technology acceptance process. Although the study by Teo et al. (2019) directly focused on the acceptance of Web 2.0 technologies, their conclusions are also applicable to the TPACK framework. They found that perceived usefulness is one of the main factors determining teachers' acceptance and use of new technologies, which echoes the hypothesis testing results of this paper and once again underscores the crucial role of perceived usefulness in driving teachers to adopt new technologies, including TPACK. In summary, perceived usefulness has a significant positive impact on teachers' intention to use TPACK, and this conclusion is supported by multiple scholars. From Mishra & Koehler's (2006) description of the TPACK framework to Scherer et al.'s (2019) meta-analysis results, and further to the specific empirical studies by Ertmer et al. (2012) and Teo et al. (2019), all indicate that perceived usefulness is an integral part of the technology acceptance model, playing a vital role in promoting teachers' adoption and application of new technologies.

Ajzen (1991) explicitly pointed out the significant influence of Subjective Norms (SN) on behavioral intention in his Theory of Planned Behavior (TPB). Subjective Norms refer to an individual's perception of the expectations of others or groups that have influence over their behavioral decisions. This normative pressure is also applicable in the adoption and use of educational technology. When teachers feel positive support and expectations from colleagues, school leaders, and students, they are more likely to adopt new technologies, such as the teaching practices advocated by the TPACK framework. Furthermore, multiple scholars have emphasized the importance of a supportive culture for technology adoption. For instance, Teo, Sang, Mei, & Hoi (2019) found in their study that support from organizations or communities has a significant impact on teachers' willingness to use technology. This support is not only reflected in the provision of resources but also includes emotional encouragement and positive evaluations of new technologies.

Therefore, when teachers feel supported by school leaders and colleagues in practicing TPACK, their willingness to use it significantly increases (Teo, Sang, Mei, & Hoi, 2019). Venkatesh, Morris, Davis, & Davis (2003) also mentioned the importance of social influence (i.e., Subjective Norms) on technology acceptance in their Unified Theory of Acceptance and Use of Technology (UTAUT). They pointed out that individuals are often influenced by the expectations and behavioral patterns of those around them (such as colleagues and students) when using new technologies. In the field of education, this influence is particularly significant because teachers, as knowledge transmitters, have a profound impact on students' behaviors and attitudes. Therefore, when teachers perceive that their colleagues and students expect them to adopt new technologies, they are more motivated to learn and implement the TPACK framework (Venkatesh et al., 2003). Multiple empirical studies also support the influence of Subjective Norms on teachers' use of TPACK. For example, Hatlevik, Throndsen, Loi, &

Gudmundsdottir (2018) found in their study of Icelandic students that teachers' self-efficacy in information technology and their computer and information literacy were influenced by peer and student support, which indirectly enhanced their willingness to adopt new technologies. Similarly, these supportive factors also played a positive role in the adoption process of TPACK (Hatlevik et al., 2018).

Ajzen's (1991) TPB model provides a theoretical foundation for understanding the intention to use TPACK. TPACK involves the integration of technological, pedagogical, and content knowledge, and its implementation process may be influenced by various internal and external factors. Perceived Behavioral Control (BC), as an individual's assessment of their ability to execute TPACK, directly affects their intention to use it. When teachers believe they have the adequate ability to overcome various obstacles encountered in the process of integrating TPACK, they are more likely to form an intention to use TPACK. Venkatesh et al. (2003) also emphasized the influence of ease of use on behavioral intention in the Unified Theory of Acceptance and Use of Technology (UTAUT), which echoes the concept of BC in TPB.

In the integration process of TPACK, if technological tools are easy to use, teachers are more likely to believe that they can successfully integrate and form an intention to use. Cheng et al. (2019) pointed out in their comparison of TPB and TAM that although both models focus on users' perceptions and behavioral intentions, TPB provides a more in-depth explanation of complex behavioral intentions by introducing the BC construct. In the context of TPACK usage, teachers not only need to perceive the usefulness of TPACK but also believe that they can overcome obstacles related to technology, pedagogy, or content during the implementation process. This belief, known as PBC, significantly influences the intention to use TPACK. Habibi et al. (2020) found in their study on the integration of ICT by pre-service teachers in teaching practice in Indonesian universities that BC has a significant impact on the actual use of TPACK. This finding supports the important role of BC in the intention to use TPACK, indicating that when teachers believe they have the ability to successfully integrate TPACK, they are more likely to put it into practice.

In summary, Perceived Behavioral Control, as a core construct in the Theory of Planned Behavior, has a significant positive impact on the intention to use TPACK. When teachers believe they can overcome various obstacles encountered in the process of integrating TPACK, they are more likely to form an intention to use TPACK. This viewpoint has been verified and supported by the research of multiple scholars.

Zheng et al. (2020) pointed out in their research that Perceived Usefulness (PU) in the technology acceptance model is one of the important factors for predicting technology acceptance intention. Similarly, Jang et al. (2021) also mentioned in their research on AR and VR technologies that perceived usefulness (referred to as performance expectancy in their study) directly influences usage intention, which further affects actual usage behavior. Subjective Norm (SN), as a social influence factor, indirectly affects usage behavior through usage intention. Venkatesh et al. (2003) explicitly stated in the UTAUT model that Subjective Norm (SN) is one of the important factors influencing behavioral intention. Similarly, in the study by Rahimi and Tafazoli (2022), the significant influence of subjective norm on usage intention, which further affects university teachers' actual usage attitude towards ICT, was also verified.

Perceived Ease of Use (EOU) also plays a crucial role in promoting technology acceptance, but its impact on usage behavior is partially mediated through usage intention. Yang et al. (2021), in their study on K-12 teachers' technology acceptance of e-Schoolbag, found that perceived ease of use not only directly affects perceived usefulness but also indirectly promotes usage behavior by influencing usage intention. Perceived Behavioral Control (BC) is a key variable in the TPB model, representing an individual's perception of the ease or difficulty of performing a certain behavior. According to the research by Foulger et al. (2021), behavioral control has a significant impact on the actual behavior of integrating technology into teaching by influencing usage intention. This finding echoes the discovery by Venkatesh et al. (2003) in the UTAUT model, where facilitating conditions, as a similar concept to behavioral control, also showed an indirect influence on usage behavior by affecting intention.

Control (BC) is a key variable in the TPB model, representing an individual's perception of the ease or difficulty of performing a certain behavior. According to the research by Foulger et al. (2021), behavioral control has a significant impact on the actual behavior of integrating technology into teaching by influencing usage intention. This finding echoes the discovery by Venkatesh et al. (2003) in the UTAUT model, where facilitating conditions, as a similar concept to behavioral control, also showed an indirect influence on usage behavior by affecting intention.

In summary, usage intention plays a significant mediating role in the influence of multiple independent variables (such as perceived usefulness, subjective norm, perceived ease of use, and behavioral control) on usage behavior. This finding is not only consistent with classic theories such as TPB and UTAUT but also supported by empirical research conducted by multiple scholars (Li et al., 2016; Jang et al., 2021; Venkatesh et al., 2003; Yang et al., 2019; Foulger et al., 2021). Therefore, when promoting the application of technology in teaching, emphasizing the enhancement of teachers' or users' usage intention is key to promoting behavioral change and achieving effective technology integration.

In this study, Hypothesis H2 was not confirmed.

Herzberg's two factor theory (Herzberg et al., 1959) states that improvements in health factors such as work environment, company policies, supervision and management, interpersonal relationships, wages, and benefits can alleviate employee dissatisfaction, but cannot directly increase employee satisfaction or work enthusiasm. In this study, perceived ease of use (EOU) can be considered as a healthcare factor. It is related to the ease of operation of technical tools or platforms, and is a basic requirement that users feel during the use process. According to the research results, although the direct impact of perceived usability on TPACK usage intention is not significant, it does not mean that usability is not important. On the contrary, usability, as a health factor, has a limited further motivating effect on users after reaching a certain level. For English instructors in universities in western China, they generally have a certain technical foundation, so the ease of use of technical tools may no longer be a key factor in deciding whether to use TPACK. They may be more concerned with deeper issues such as whether technological tools can bring actual improvements in teaching effectiveness and whether they meet teaching needs.

Mind Map of TPACK Usage Factors

The overall findings of this study can be synthesized into a mind map that illustrates the key constructs and their interrelationships regarding TPACK usage among university English instructors in Western China. The central theme revolves around the intention to use TPACK, influenced by several factors: Perceived Usefulness:

1. Strongly affects the intention to use TPACK, indicating that instructors who believe TPACK will enhance their teaching effectiveness are more likely to adopt it.

2. Subjective Norms: The expectations and support from peers and institutional leaders significantly encourage instructors to use TPACK.

3. Perceived Behavioral Control: Instructors' beliefs in their ability to implement TPACK effectively influence their intention to integrate it into their teaching.

4. Perceived Ease of Use: While not directly affecting intention, ease of use remains a fundamental aspect, particularly once instructors possess a certain level of technological proficiency.

This mind map serves as a visual representation of how these constructs interact, providing a comprehensive overview of the factors that shape the TPACK usage intentions and behaviors of English instructors, ultimately contributing to effective technology integration in educational practices.

Recommendations

Based on the above research conclusions, this study proposes specific strategic suggestions from multiple aspects such as systematic training, optimization of teaching resources, policy support, communication and cooperation, in order to effectively promote the development of TPACK ability of English instructors in western China.

1. Strengthen Systematic Training and Continuous Support

In order to enhance instructors' TPACK abilities, comprehensive and in-depth training courses must be provided. These courses should cover the principles, application methods, and specific teaching cases of new technologies to ensure that instructors can comprehensively understand and proficiently master them. At the same time, establish a dedicated technical support team and online learning community to provide instructors with instant technical support and learning exchange platforms, forming a comprehensive and multi-level instructor development support system.

2. Optimize Teaching Resources and Technological Environment

Increase investment in teaching resources, introduce advanced teaching software and hardware equipment, and provide instructors with a strong material foundation. At the same time, establish a sound technical support system to ensure that instructors can receive timely and professional assistance and guidance when using new technologies. This can not only relieve instructors' worries about technical operations, but also improve their teaching efficiency and effectiveness.

3. Implement Policy Incentives and Support

Develop incentive policies, such as setting up special funds, providing incentives and other economic support measures, to encourage instructors to actively apply new technologies in teaching practice. At the same time, university leaders should clearly express their recognition and support for new technologies, formulate relevant policies, provide necessary resources and financial guarantees, and create a favorable environment for instructors to teach technology.

4. Promote Communication and Cooperation

Organize collective lesson preparation, teaching observation and other activities, and build a platform for instructors to communicate and learn. Through inter school cooperation and communication, advanced teaching concepts and methods are introduced to provide instructors with a broader perspective and diversified learning resources. These exchanges and collaborations not only facilitate mutual learning and progress among instructors, but also stimulate their innovative thinking and practical abilities.

5. Inspire Instructors' Intrinsic Motivation and Self-Efficacy

By setting clear learning goals and reward mechanisms, instructors' interest and motivation in learning can be stimulated. At the same time, helping instructors develop personalized career development plans to enhance their sense of professional identity and achievement. These measures can significantly enhance instructors' intrinsic motivation and confidence, driving them to continuously improve their TPACK abilities to meet the development needs of educational informatization.

6. Establish a Scientifically Reasonable Evaluation System

Build a diversified evaluation system to comprehensively and objectively evaluate the application effectiveness of instructors in technology teaching. The system should cover multiple dimensions such as the basic abilities of instructors in technology application, teaching innovation, and student participation. Through timely and specific feedback mechanisms, help instructors clarify their strengths and weaknesses in teaching and provide improvement suggestions and resource support. This will help instructors continuously accumulate experience, optimize teaching methods, and enhance their TPACK abilities.

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