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Continuance Intention to Use Bilibili for Online Learning:
An Integrated Structural Equation Model

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ABSTRACT

Bilibili, a popular video-sharing and danmaku-themed platform, has played a crucial role in online learning. However, limited research has been conducted to examine the factors that influence its users' continuance intention. Thus, this study proposes an integrated model of technology acceptance model, expectation-confirmation model, and task-technology fit based on the data collected from 265 Chinese participants. The model also includes content richness and a newly introduced variable, danmaku interface, to fill the research gap. The results show that 1) content richness has no positive influence on satisfaction and perceived usefulness, 2) danmaku interface significantly and positively influences satisfaction at the significant 0.05 level but has no positive effect on perceived usefulness, 3) task-technology fit positively and significantly predicts perceived ease of use and perceived usefulness at the significant 0.05 level, and 4) the other hypotheses within TAM and ECM are well accepted. The features and educational functions of Bilibili could be further explored in the future.

KEYWORDS

Bilibili, Content Richness, Continuance Intention, Danmaku, Expectation-Confirmation Model, Online Learning, Task-Technology Fit, Technology Acceptance Model

INTRODUCTION

As proposed by Curtain (2002), online learning can be defined as the use of the internet to facilitate teacher-student interactions, which encompasses both asynchronous and synchronous activities, such as using web-based course materials, email, and conferencing tools. The terms "web-based education" and "e-learning" are often used interchangeably with online learning. By implementing online learning, the teaching-learning process can become more flexible, student-centered, and innovative (Dhawan, 2020). Technology and education have led to the development of several websites and mobile applications, including YouTube (Dubovi & Tabak, 2020; Liu & Luo, 2022),

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WhatsApp (Mpungose, 2020), Google Classroom (Sobaih et al., 2022), Superstar Learning System (Yu, 2022), and Tencent Meeting (Quadir & Zhou, 2021), which have been widely applied to online learning. Moreover, online learning platforms can enhance students' learning outcomes (Yu et al., 2022), improve their learning proficiency, and reduce cognitive loads (Yu et al., 2019).

Founded in 2004, Bilibili (www.bilibili.com) is an influential and popular video-sharing platform in China. In the third quarter of 2022, Bilibili reported 90.3 million average daily active users (Bilibili, 2022). It allows users to create their original content and upload it and it illustrates a clear classification of the content, thus improving user guidance (see Figure 1). Videos of all kinds, such as animations, TV shows, online courses, etc., are available for users. It is also worth noting that Bilibili divides instructional videos into three categories: class, knowledge, and open courses. As shown in Figure 2, users can either subscribe to paid courses or follow free courses uploaded by others. Another prominent feature of Bilibili is the use of danmaku (see Figure 3), which is a type of video comment that appears as streams superimposed on video screens, moving horizontally from right to left (R. Wang, 2022). This allows users to receive instant feedback from their co-viewers while watching the video.

Previous studies (Lin et al., 2018; Shen & Liang, 2022; Wu et al., 2022) have confirmed the educational implications of Bilibili, whereas there is scarce research on the contributing factors to its use and acceptance in an educational setting. Meanwhile, Liu et al., (2021) proposed an extended Unified Theory of Acceptance and Use of Technology model to study users' experience of using

Figure 1. Video categories on Bilibili

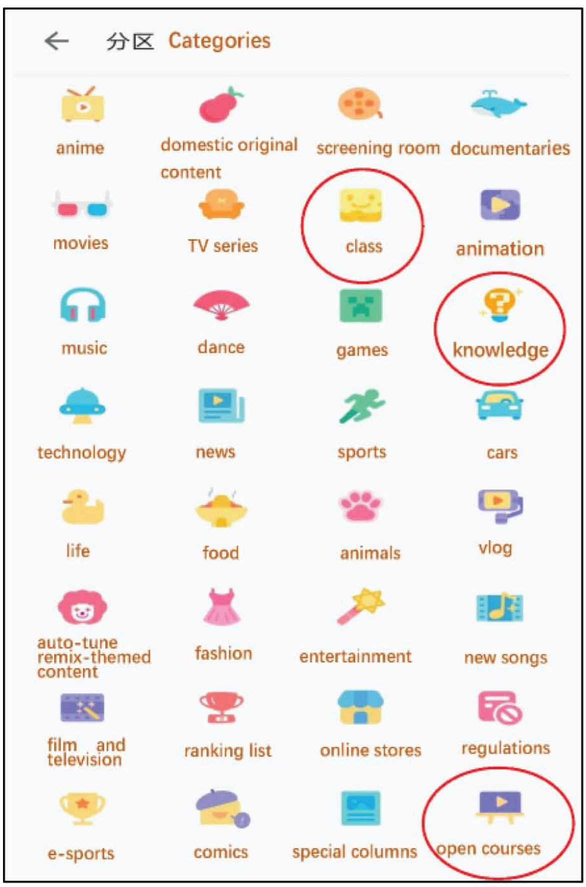


Figure 2. Examples of paid and free courses

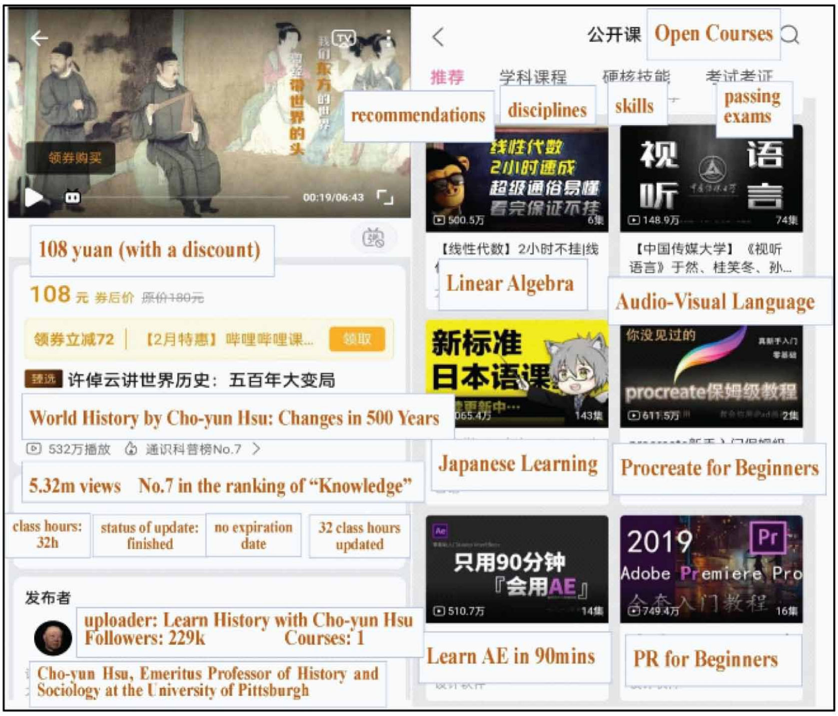
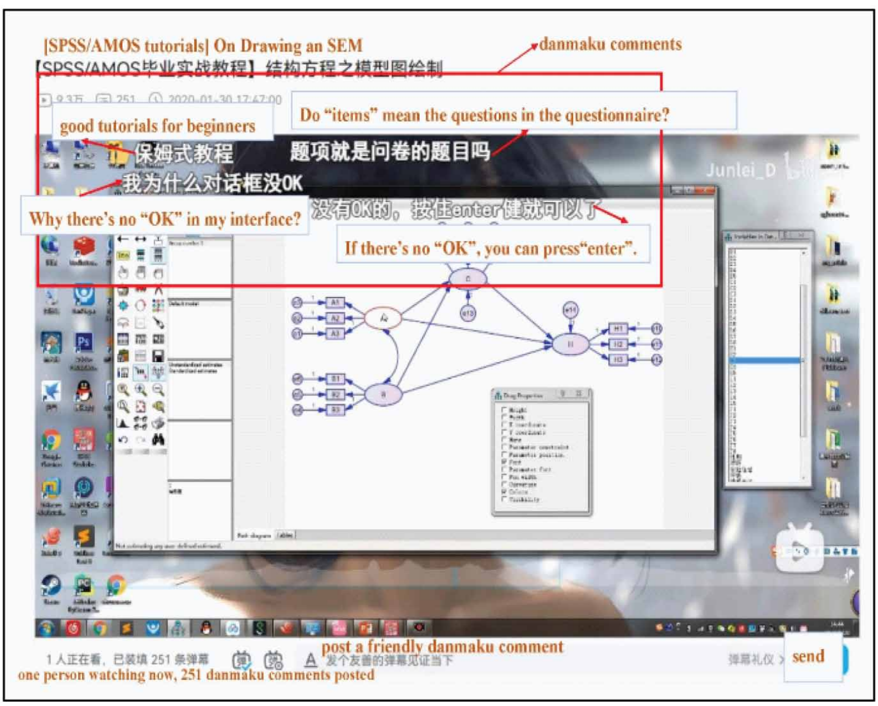


Figure 3. An instructional video with danmaku comments



Bilibili. Hu et al. (2016) investigated users' participation by applying self-construal and community interactivity in a structural equation model. However, few studies have proposed a model to investigate the adoption of Bilibili in online learning. Therefore, this study aims to identify the predictors of the continuance intention to use Bilibili for online learning and formulate two research questions: 1) Can danmaku interface and content richness contribute to learning on Bilibili? 2) Can this study establish an integrated model of technology acceptance model (TAM), expectation-confirmation model (ECM), and task-technology fit (TTF)?

LITERATURE REVIEW

Technology Acceptance Model (TAM)

Davis (1986) introduced the technology acceptance model as an adaptation of the Theory of Reasoned Action to explore users' acceptance of information systems (Davis et al., 1989). Perceived usefulness and perceived ease of use are the two major determinants in this model and positively influence attitude toward using. These two major constructs are also associated with external variables (Davis et al., 1989), which have become a crucial research area for subsequent studies. As a result, numerous new external variables have been incorporated with the extensions of TAM. For example, job relevance, output quality, and subjective norm in TAM2 (Venkatesh & Davis, 2000); performance expectancy and facilitation conditions in Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003); hedonic motivation in UTAUT 2 (Venkatesh et al., 2012); computer anxiety and computer playfulness in TAM3 (Venkatesh & Bala, 2008).

Despite that TAM had been proven to be a powerful model in many technologies and contexts, previous studies also suggested that it could be well integrated with other theories and models (Granic, 2022). Khan et al. (2018) integrated TAM with task-technology fit model, self-determination theory (SDT), and social motivation to investigate Pakistani students' acceptance of Massive Open Online Courses (MOOCs). Al-Rahmi et al. (2019) extended TAM with Innovation Diffusion Theory (IDT) to study students' intention to use e-learning systems. In addition, expectation-confirmation model (ECM) was combined with TAM by previous research to study users' continuance intention to use an online logistics platform (Zheng et al., 2022) and e-health services (Kumar & Natarajan, 2020). It was also demonstrated that Theory of Planned Behavior (TPB) could be successfully integrated with TAM (AlHamad, 2020; Nguyen et al., 2022).

TAM and Online Learning

TAM has been widely implemented in educational research regarding e-learning (Abuhassna et al., 2023; Valverde-Berrocoso et al., 2020). Mizher et al. (2022) studied EFL students' attitudes towards online learning and demonstrated that perceived ease of use positively predicted attitude and perceived usefulness, while the latter positively predicted attitude as well. In the context of e-learning, it was also verified that perceived usefulness and perceived ease of use were positively and significantly related to attitude (Cheung & Vogel, 2013; Wang et al., 2022). Similarly, attitude was predicted by perceived ease of use and perceived usefulness in using YouTube as an educational tool. (Maziriri et al., 2020) Furthermore, attitude had a positive correlation with continuance intention in terms of distance education (Liu & Pu, 2020) and using blogs for learning (Ifinedo, 2017). However, few studies have applied TAM to analyze users' acceptance of Bilibili.

According to the definitions proposed by Davis et al. (1989), in the context of this research, perceived usefulness can be defined as the perception that using Bilibili will enhance users' learning performance. Perceived ease of use refers to how easy it is to use Bilibili for educational purposes. Attitude toward using Bilibili can be seen as users' degree of evaluative affect toward this platform (Davis, 1986) and continuous intention can be defined as users' intention to continue applying Bilibili to online learning (Bhattacherjee, 2001). Thus, the following hypotheses are formulated and the alpha level is set at 0.05 as suggested by Fisher (1992):

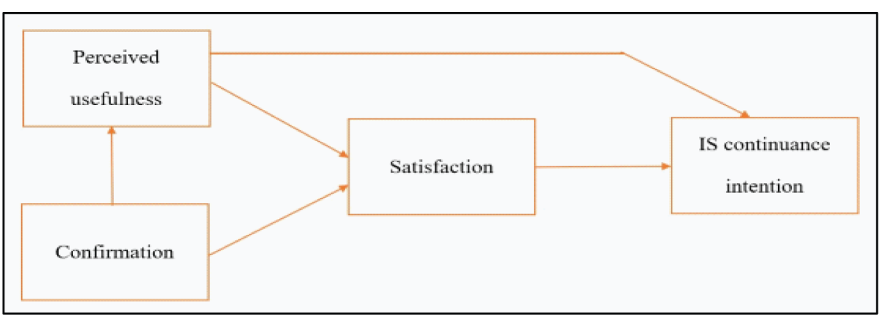
H1: Perceived usefulness significantly and positively predicts attitude of using Bilibili at the alpha level of 0.05.
H2: Perceived ease of use significantly and positively predicts perceived usefulness of Bilibili at the alpha level of 0.05.
H3: Perceived ease of use significantly and positively predicts attitude of using Bilibili at the alpha level of 0.05.
H4: Attitude significantly and positively predicts continuance intention to use Bilibili at the alpha level of 0.05.

Expectation-Confirmation Model (ECM)

Bhattacherjee (2001) developed the expectation-confirmation model (ECM) (see Figure 4) using the expectation-confirmation theory (Oliver, 1980) to examine users' continuance intention to use information systems (IS). Despite its initial application in online banking, ECM has been applied to a variety of research fields in recent years. Alraimi et al. (2015) and Jin and Shang (2022) examined the continuance intention of MOOCs and verified that confirmation was positively associated with perceived usefulness and satisfaction, and these two variables positively predicted continuance intention. Similar results were found in the study conducted by Li, Wang, and Wei (2022) except for the positive correlation between confirmation and satisfaction. Besides, perceived usefulness positively predicted satisfaction concerning students' use of Facebook (Mouakket, 2016) and the acceptance of smart wearable devices (Park, 2020). Furthermore, by integrating ECM with TAM, Niu and Wu (2022) and Park (2020) proved that confirmation had a positive correlation with perceived ease of use and perceived usefulness. Based on the operational definitions of Bhattacherjee (2001), in the context of using Bilibili, satisfaction can be defined as the extent to which users feel content with their previous use of Bilibili. Confirmation refers to the degree to which users perceive the performance of Bilibili as being consistent with their expectations. Thus, this study proposed the following hypotheses:

H5: Perceived usefulness significantly and positively predicts continuance intention to use Bilibili at the alpha level of 0.05.
H6: Confirmation significantly and positively predicts satisfaction with Bilibili at the alpha level of 0.05.
H7: Confirmation significantly and positively predicts perceived usefulness of Bilibili at the alpha level of 0.05.

Figure 4. A post-acceptance model of IS continuance (Bhattacherjee, 2001)



H8: Confirmation significantly and positively predicts perceived ease of use of Bilibili at the alpha level of 0.05.

H9: Perceived usefulness significantly and positively predicts satisfaction with Bilibili at the alpha level of 0.05.

H10: Satisfaction significantly and positively predicts continuance intention to use Bilibili at the alpha level of 0.05.

Task-Technology Fit (TTF)

Task-technology fit (TTF), as an important construct in technology-to-performance chain (TPC) model, refers to the extent to which technology facilitates the completion of tasks by individuals. It is a measurement of how well task requirements, individual abilities, and technology functionality correspond (Goodhue & Thompson, 1995). It also provides practical guidance to help implement a technology or task most effectively (Yu & Yu, 2010). Various integrated models of TTF were formed by combining ECM (Larsen et al., 2009), SDT (Khan et al., 2018), and TPB (Yu & Yu, 2010). Meanwhile, researchers placed great emphasis on its combination with TAM. According to Vanduhe et al. (2020), TTF was positively related to perceived ease of use but had no positive correlation with perceived usefulness in students' use of gamification for training. However, in examining the continuance intention to use MOOCs, both perceived usefulness and perceived ease of use were positively predicted by TTF (Kim & Song, 2022; Wu & Chen, 2017). According to the definition proposed by Goodhue and Thompson (1995), in the present research, TTF refers to the extent to which users adopt Bilibili to facilitate their learning tasks. Following that, the author proposed these two hypotheses:

H11: Task-technology fit significantly and positively predicts perceived usefulness of Bilibili at the 0.05 level.

H12: Task-technology fit significantly and positively predicts perceived ease of use of Bilibili at the 0.05 level.

Content Richness

In the context of Bilibili, content richness can be defined as the Bilibili's availability of a broad range of resources to enhance a user's learning experience (Lee & Lehto, 2013). It can be evaluated from three aspects: relevance, sufficiency, and timeliness (Jung et al., 2009), which implies that the resources should be useful, complete, and current for users (De Wulf et al., 2006). Previous studies have applied content richness to examine the use of message delivery applications in mobile learning (Boyinbode et al., 2017; Lan & Sie, 2010) and the continuance intention to use online learning platforms (Z. Wang, 2022). Sun and Cheng (2007) validated that rich instructional content was positively related to learning satisfaction. Other studies focused on the relationships between content richness and TAM constructs. Al-Maroof et al. (2021) and Lee and Lehto (2013) both confirmed a positive relationship between content richness and perceived usefulness. Moreover, content richness was positively correlated with satisfaction and perceived usefulness in an extended TAM (Liu & Luo, 2022). Thus, the author proposed these two hypotheses:

H13: Content richness significantly and positively predicts satisfaction with Bilibili at the alpha level of 0.05.

H14: Content richness significantly and positively predicts perceived usefulness of Bilibili at the alpha level of 0.05.

Danmaku Interface

Danmaku was initially launched on a Japanese video platform called Nicovedio in 2006 and soon gained popularity in China. Now it is widely used by various video-sharing websites such as Bilibili, TikTok, and Youku. Danmaku caters to users' need for seeking information and adds to the entertaining function of video websites, providing hedonistic values to users. Users also feel a sense of community as danmaku creates a pseudo-synchronic viewing pattern (Johnson, 2013) regardless of spatial and temporal constraints (Lin et al., 2018; R. Wang, 2022). Despite its early popularity in videos related to animations and games (Chen et al., 2015), danmaku comments have been adopted in an assortment of videos including television series, documentaries, and instructional videos.

Due to the features of danmaku, prior studies also confirmed its educational function in video platforms. Danmaku could enhance interaction among students and offer practical information in online lectures (Li, Zhu, et al., 2022). Besides, Yao et al. (2017) reported that students benefited from danmaku during online learning since it provided additional information and promoted students' engagement in learning. Likewise, Zhang et al. (2019) revealed that danmaku comments relevant to video content in MOOCs could enhance students' satisfaction and achievement in learning. However, few studies have considered it as a predictive factor in the use of Bilibili for online learning. In the context of using Bilibili for online learning, the construct "danmaku interface" refers to the video comments that move horizontally from right to left on the video screens of Bilibili (R. Wang, 2022). Therefore, these two hypotheses are formed:

H15: Danmaku interface significantly and positively predicts satisfaction with Bilibili at the alpha level of 0.05.
H16: Danmaku interface significantly and positively predicts perceived usefulness of Bilibili at the alpha level of 0.05.

RESEARCH METHODS

Participants

The participants were randomly selected from Chinese universities based on the criteria that they had previously used Bilibili for online learning and agreed to join the research. The questionnaire was initially developed via an online survey platform called Questionnaire Star (www.wjx.cn) and then shared on WeChat and QQ (Chinese social media platforms). Participants were informed in advance that their data would be used only for this study and that they would receive a reward after completing the survey. Finally, 265 Chinese participants from more than 10 universities agreed to participate in the research. As shown in Table 1, undergraduates accounted for the largest proportion (86.8%), and most participants were between the ages of 20 and 22 (71.3%). In addition, the sample included students from all majors, with the majority of students coming from Arts and Humanities, Social Sciences, and Science and Engineering.

Research Instrument

An online survey was conducted via Questionnaire Star to examine the proposed hypotheses. The questionnaire of this study (see Appendix) consisted of three parts. The first section included the participants' consent to join the study and their demographic information. In the second part, the participants were asked to rate 37 item questions based on 5-point Likert scale. As shown in Table 2, the proposed model comprised 9 constructs, and the items were designed and revised from previous literature. The last section was an open question regarding users' opinions and suggestions for online learning on Bilibili.

Research Procedure

Questionnaire Design

The design of the questionnaire consisted of three steps. On the basis of prior research, 37 questions related to the hypotheses were developed using 5-point Likert scale (1-strongly

Table 1. Demographic information of the participants

Item	Type	Frequency	Percentage
Gender	Male	80	30.2
	Female	185	69.8
Major	Arts & Humanities	107	40.4
	Social Sciences	64	24.2
	Science & Engineering	85	32.1
	Agriculture	2	0.8
	Medicine	7	2.6
Age	below 20 years old	38	14.3
	20-22 years old	189	71.3
	23-25 years old	33	12.5
	26-28 years old	2	0.8
	over 28 years old	3	1.1
Degree of education	Below undergraduate	10	3.8
	Undergraduate	230	86.8
	Postgraduate	21	7.9
	Doctor	4	1.5

Table 2. Constructs and instruments

Constructs	Instruments
Content richness	four questions adapted from Lee & Lehto (2013)
Danmaku interface	five questions self-designed based on R. Wang (2022) and Yang et al. (2019)
Task-technology fit	four questions adapted from Niu & Wu (2022) and Wu & Chen (2017)
Confirmation	four questions adapted from Baker-Eveleth & Stone (2015) and Niu & Wu (2022)
Satisfaction	four questions adapted from Liu & Luo (2022) and Yang & Lee (2021)
Perceived usefulness	four questions revised from Alfadda & Mahdi (2021) and Salloum et al. (2019)
Perceived ease of use	four questions revised from Ibrahim et al. (2017)
Attitude	four questions adapted from Alfadda & Mahdi (2021)
Continuance intention to use	four questions revised from Ibrahim et al. (2017) and Yu (2020)

disagree, 2-disagree, 3-neutral, 4-agree, 5-strongly agree). Afterward, the author invited an expert in education and technology to revise the questionnaire and make some suggestions. In the following step, the questionnaire was uploaded to Questionnaire Star, an online survey platform that facilitates the distribution of questionnaires. This can be accomplished by providing a quick response (QR) code or a link to the questionnaire, which can then be shared on social media platforms.

Questionnaire Distribution and Data Collection

The distribution of the questionnaire was conducted in two phases. First, the QR code was distributed to several university students' chat groups on WeChat and QQ, as well as posted on the author's WeChat Moments and QQ Zone. After that, some participants and friends of the author volunteered to repost the questionnaire on their social media accounts. It was distributed from January 18, 2023 to January 22, 2023, for a period of five days. The data was collected and downloaded from the platform in Excel format and imported into SmartPLS 3 for further analysis. The entire research procedure is illustrated in Figure 5.

RESULTS

This research applied SmartPLS 3 to analyze the results. Following the two-step approach proposed by Anderson and Gerbing (1988), quantitative analysis was performed using partial least squares structural equation modeling (PLS-SEM). The measurement model was first evaluated in terms of reliability, validity, average variance extracted (AVE), and composite reliability (CR). Then the author examined the structural model's variance inflation factor (VIF) values, model fit, R^2 of the endogenous variables, f^2, and path coefficients.

Measurement Model Assessment

Factor loadings, values of AVE and CR (rho_a), and Cronbach's α were assessed in the reliability and convergent validity test. According to the results of SmartPLS 3 (see Table 3), the values of Cronbach's α of the nine constructs all exceed the ideal value of 0.7 (Nunnally & Bernstein, 1994), which indicates a satisfactory reliability. Additionally, the factor loadings range from 0.722 to 0.930, CR values range from 0.885 to 0.955, and AVE from 0.660 to 0.842. Hair et al. (2010) suggested that the recommended values of factor loading, AVE, and CR should be 0.5, 0.5, and 0.7 respectively. Therefore, all indices have exceeded the threshold, indicating convergent validity.

The discriminant validity of the proposed model was first examined under the criterion of Fornell and Larcker (1981). This measurement refers to the degree to which a construct differs from the others (Hair et al., 2010). As shown in Table 4, each construct's square root of AVE (in bold) is greater than its inter-correlation coefficients with other constructs, therefore establishing discriminant validity.

Discriminant validity can also be assessed by the heterotrait–monotrait ratio of correlations (HTMT), which possesses better efficacy as proposed by Henseler et al. (2015). Since HTMT values higher than 0.9 indicate the lack of discriminant validity (Hair, Risher, et al., 2019), the correlations in this study, which vary between 0.341 and 0.877, have been tested to meet the criterion, thus confirming a good discriminant validity (see Table 5).

Figure 5. The research procedure

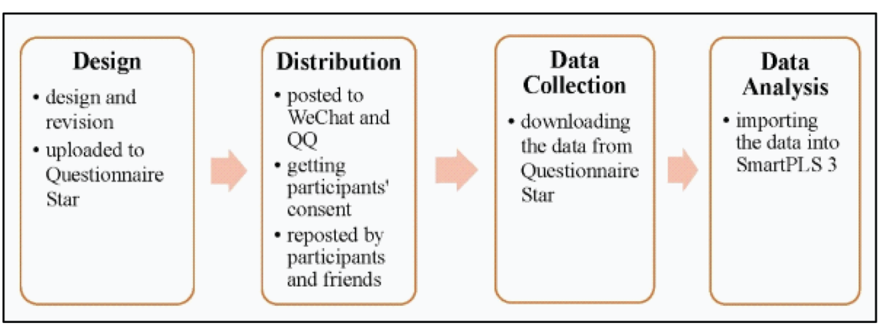


Table 3. Factor loadings, reliability, and convergent validity

Item	Factor Loading	Cronbach's α	CR (rho_a)	AVE
AT1	0.906	0.937	0.955	0.842
AT2	0.930			
AT3	0.913			
AT4	0.921			
CI1	0.876	0.827	0.885	0.660
CI2	0.722			
CI3	0.883			
CI4	0.756			
CON1	0.895	0.912	0.938	0.791
CON2	0.883			
CON3	0.871			
CON4	0.908			
CR1	0.869	0.889	0.923	0.750
CR2	0.847			
CR3	0.862			
CR4	0.886			
DI1	0.802	0.914	0.936	0.745
DI2	0.858			
DI3	0.883			
DI4	0.858			
DI5	0.912			
PEU1	0.878	0.857	0.904	0.703
PEU2	0.724			
PEU3	0.894			
PEU4	0.847			
PU1	0.895	0.901	0.931	0.771
PU2	0.854			
PU3	0.873			
PU4	0.888			
SAT1	0.910	0.927	0.948	0.820
SAT2	0.870			
SAT3	0.911			
SAT4	0.930			
TTF1	0.867	0.874	0.914	0.726
TTF2	0.816			
TTF3	0.875			
TTF4	0.849			

Table 4. Data of discriminant validity (Fornell–Larcker)

Constructs	AT	CON	CR	CI	DI	PEU	PU	SAT	TTF
AT	**0.917**								
CON	0.711	**0.889**							
CR	0.637	0.694	**0.866**						
CI	0.787	0.731	0.638	**0.812**					
DI	0.405	0.449	0.312	0.415	**0.863**				
PEU	0.710	0.570	0.532	0.679	0.303	**0.838**			
PU	0.767	0.731	0.655	0.747	0.352	0.629	**0.878**		
SAT	0.815	0.769	0.625	0.740	0.417	0.702	0.784	**0.905**	
TTF	0.687	0.751	0.724	0.746	0.387	0.565	0.747	0.705	**0.852**

Table 5. Heterotrait–Monotrait ratio of correlations (HTMT)

Constructs	AT	CON	CR	CI	DI	PEU	PU	SAT	TTF
AT									
CON	0.767								
CR	0.696	0.769							
CI	0.877	0.834	0.733						
DI	0.437	0.489	0.345	0.481					
PEU	0.789	0.639	0.607	0.784	0.341				
PU	0.831	0.805	0.729	0.857	0.384	0.707			
SAT	0.870	0.834	0.684	0.832	0.450	0.789	0.852		
TTF	0.749	0.836	0.816	0.869	0.426	0.643	0.837	0.771	

Structural Model Assessment

In analyzing the structural model, the author first evaluated the problem of collinearity and goodness of model fit, then examined the values of R^2 and f^2, and finally conducted path analysis. As for collinearity issues, previous studies (Hair, Risher, et al., 2019; Zhou et al., 2022) suggested that the variance inflation indicator (VIF) should be lower than 3, while other studies (Hair et al., 2011; Huang, 2021; Niu & Wu, 2022) recommended a cut-off value of 5. Thus, the VIF values of the present study, ranging from 1.255 to 3.644 (see Table 6), remain acceptable. However, some of the

Table 6. Variance inflation factor (VIF), R^2 value, and R^2 adjusted value

Constructs	AT	CON	CR	DI	PEU	PU	SAT	TTF	R^2	R^2 Adjusted
AT					1.656	1.656			0.674	0.671
CI	3.407					2.973	3.644		0.676	0.672
PEU		2.291						2.291	0.369	0.364
PU		2.861	2.409	1.267	1.619			2.911	0.664	0.657
SAT		2.82	2.118	1.255		2.367			0.703	0.698

VIF values in this research are higher than the ideal criterion of 3 (Hair, Risher, et al. 2019), which is a limitation of this research. In terms of model fit, standardized root mean residual (SRMR) and normed fit index (NFI) were calculated in SmartPLS 3. The recommended value of SRMR is less than 0.08 (Hu & Bentler, 1998), and NFI should be greater than 0.8 (Forza & Filippini, 1998). In this study, SRMR=0.074, and NFI=0.816, supporting a suitable model fit.

R^2 values reveal the amount of variance explained in the dependent variables by the independent variables (Wu & Chen, 2017). As illustrated in Table 6, 36.9% of the variance in perceived ease of use can be explained by confirmation and task-technology fit. Likewise, 66.4% of the variance in perceived usefulness is explained by confirmation, task-technology fit and perceived ease of use. 67.4% of the variance in attitude is explained by perceived ease of use and perceived usefulness. 67.6% of the variance in continuance intention is explained by satisfaction and perceived usefulness. 70.3% of the variance in satisfaction is explained by content richness, danmaku interface, and perceived usefulness.

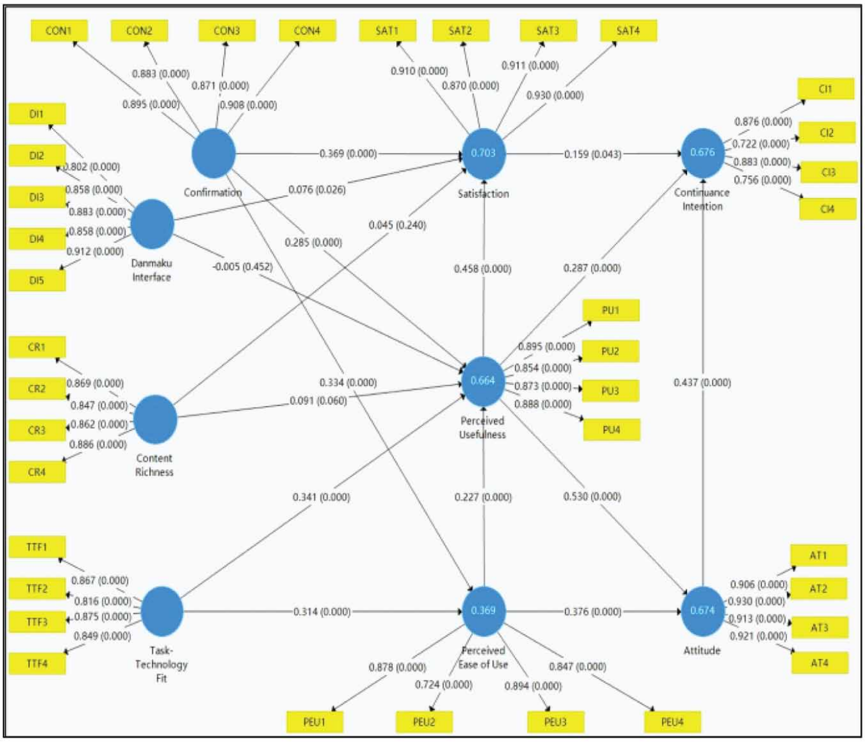
Cohen (1988) proposed the criteria of f^2 to calculate effective size: 0.02 (small), 0.15 (medium), 0.35 (large). The results of f^2 indicate that confirmation has a medium effect on satisfaction (f^2=0.162), and a small effect on perceived ease of use (f^2=0.077) and perceived usefulness (f^2=0.084). Perceived usefulness has a large effect on attitude (f^2=0.52), a medium effect on satisfaction (f^2=0.298), and small effect on continuance intention (f^2=0.085). Perceived ease of use has medium effect on attitude (f^2=0.262) and a small effect on perceived usefulness (f^2=0.095). Attitude has a medium effect on continuance intention (f^2=0.173).

The results of path analysis are presented in Table 7 and Figure 6. The results reveal that H1 (β=0.53, p<0.001), H2 (β=0.227, p<0.001), H3 (β=0.376, p<0.001), H4 (β=0.437, p<0.001), H5 (β=0.287, p<0.001), H6 (β=0.369, p<0.001), H7 (β=0.285, p<0.001), H8 (β=0.334, p<0.001), H9 (β=0.458, p<0.001), H11 (β=0.341, p<0.001), and H12 (β=0.314, p<0.001) are validated at the significant level of p<0.001. Also, H10 (β=0.159, p<0.05), and H15 (β=0.076, p<0.05) are accepted at the significant level of p<0.05. However, H13 (β=0.045, p=0.24), H14 (β=0.091, p=0.06), and

Table 7. Path analysis

Hypothesis	Path	Std. β	SE	T Statistics	P Values	Support
H1	PU -> AT	0.53	0.058	9.126	0.000	Yes
H2	PEU -> PU	0.227	0.046	4.893	0.000	Yes
H3	PEU -> AT	0.376	0.056	6.748	0.000	Yes
H4	AT -> CI	0.437	0.075	5.852	0.000	Yes
H5	PU -> CI	0.287	0.074	3.879	0.000	Yes
H6	CON -> SAT	0.369	0.064	5.756	0.000	Yes
H7	CON -> PU	0.285	0.065	4.408	0.000	Yes
H8	CON -> PEU	0.334	0.084	3.981	0.000	Yes
H9	PU -> SAT	0.458	0.073	6.291	0.000	Yes
H10	SAT -> CI	0.159	0.093	1.714	0.043	Yes
H11	TTF -> PU	0.341	0.074	4.614	0.000	Yes
H12	TTF -> PEU	0.314	0.087	3.607	0.000	Yes
H13	CR -> SAT	0.045	0.064	0.707	0.240	No
H14	CR -> PU	0.091	0.059	1.558	0.060	No
H15	DI -> SAT	0.076	0.039	1.946	0.028	Yes
H16	DI -> PU	-0.005	0.038	0.121	0.452	No

Figure 6. The proposed research model



H16 (β=-0.005, p=0.452) are rejected as their p values are greater than 0.05. Hence, thirteen of the sixteen hypotheses are supported while H13, H14, and H16 are not.

DISCUSSION

Bilibili, as a comprehensive danmaku-themed video platform, is a useful learning tool for students. Since little research has been conducted to investigate the factors influencing the continuance intention to apply it to online learning, the present study integrated TAM, ECM, and TTF, incorporating danmaku interface as a new construct and content richness. Several results contrary to previous findings were found in this study regarding the role of content richness and danmaku in online learning. Thus, this study may lead to a further discussion about the use of Bilibili for online learning as well as suggestions for the website's designers.

Content Richness

Inconsistent with previous findings, in this study, content richness is not positively associated with satisfaction or perceived usefulness. Although Bilibili provides sufficient and the most recent videos, learners may experience difficulties selecting the videos that are most appropriate for them. As some participants reported, some topics involve multiple videos from different uploaders, and the video that has the most views may not be of the highest quality. Furthermore, since Bilibili possesses a combination of education and entertainment, irrelevant videos may appear in the recommendation column during the learning process, thus distracting learners. It is suggested that the platform set a "learning mode" for learners through which they can filter other types of videos while learning to achieve better concentration. The designers can also establish a ranking mechanism for the instructional content, which allows users to rate the videos so that they can make more informed choices.

Danmaku Interface

This study found that danmaku interface was positively related to satisfaction but not to perceived usefulness. Mou et al. (2022) argued that danmaku comments enhance interaction between learners by providing timely feedback, but decrease learning outcomes. A sense of belonging may develop within a learning community during the learning process. Some participants also reported that some intriguing danmaku comments captured their interest and engaged them in the learning process. However, useful information in danmaku remains limited due to low-quality comments such as complaints and questions that deviate from the topic, which negatively affect the learning environment. It is therefore necessary for the designers to refine the regulation of danmaku commenting and perfect the filtering mechanism of the comments to create a more satisfactory learning environment.

Task-Technology Fit

In accordance with prior research (Abugabah et al., 2015; Cheng, 2020), task-technology fit positively and significantly predicted perceived ease of use and perceived usefulness in online learning via Bilibili. The results indicate that students are more likely to use Bilibili if its technological characteristics are appropriate for their tasks. The platform enables users to save their preferred videos to the playlist and track their viewing history, which makes it convenient for them to review the tutorials. Besides, learners have easy access to the courses related to their majors, which complement their learning at school. Thus, the platform should continue to optimize this advantage to offer better user experiences.

Constructs in TAM

The hypotheses within the traditional constructs in TAM were all accepted. The present study revealed that Bilibili was a useful tool for online learning. It is easy to operate and contributes to students' academic performance in various disciplines such as mathematics, communication, and language learning. Students adopt a positive attitude towards this website and their intention to use it increases. Since the young generation accounts for a large proportion of its users, Bilibili should continue to perform its educational function and improve the overall system to attract more potential users. Meanwhile, students can also make good use of this platform not only to facilitate their professional training but to broaden their scope of knowledge.

Constructs in ECM

The results of this study supported the hypotheses in ECM. Users will be satisfied with their learning experiences on Bilibili and consider it helpful if it meets their expectations, which further promotes the intention to use it. The main reason why students turn to online courses on Bilibili is to fulfill their academic requirements, and this website can be an effective learning resource. Besides, in the integration of TAM and ECM, perceived ease of use was also found to be influenced by confirmation, which confirmed the study of Cheng (2020). This indicates that if users' expectations of learning via Bilibili are confirmed, their perceived ease of use increases as well.

CONCLUSION

Major Findings

Based on a synthesis of TAM, ECM, and TTF, this study examined the factors that affect continuance intention to use Bilibili for online learning. As a new construct, danmaku interface was successfully incorporated to form a fit model. Thirteen hypotheses were accepted while three were rejected. The study also found that content richness had no positive correlation with perceived usefulness and satisfaction, while danmaku interface positively predicted satisfaction but failed to predict perceived usefulness. This integrated model has provided empirical evidence and a theoretical framework for future research into online learning platforms.

Limitations

Two limitations can be addressed in this research. First, due to a limited range of sampling, there were fewer postgraduates, doctors, and students from vocational colleges, which may reduce the generalizability of the study. Another limitation is that the female participants outnumbered the male, and this quantitative disparity may also influence the findings.

Future Research Direction

The instructional content of Bilibili varies depending on the type of knowledge and the discipline covered in the videos. Students may have different reactions and perceptions towards declarative knowledge and procedural knowledge (Li, Zhu, et al., 2022), and their expectations of learning via Bilibili may differ depending on their majors. Therefore, future research could clarify and specify different kinds of videos, analyze how they moderate the use of Bilibili, and involve more students studying different subjects. Concurrently, danmaku interface as a prominent feature of Bilibili as well as a new variable, should be further investigated. Researchers could continue to explore its impact on learning system quality and students' interaction and engagement, which affect learners' satisfaction (Pangarso & Setyorini, 2023). Furthermore, due to the educational value of Bilibili, in the future, researchers can consider its implementation in educational activities at school to promote students' engagement (Davies et al., 2023).

Apart from Bilibili, some other online platforms also provide educational content to users. TikTok benefits students' learning through interactive features (Rahimullah et al., 2022) and offers pedagogical values to teachers (Vizcaíno-Verdú & Abidin, 2023). Other social media platforms such as Edmodo (Kesuma et al., 2023), Instagram (Gómez-Ortiz et al., 2023), Little Red Book ("Xiaohongshu" in Chinese), and Tandem can work as educational tools as well. Research could continue to examine more online learning platforms and their characteristics in improving interactions among users and their academic performance, and to apply structural equation models to develop more theoretical frameworks in the field of online learning.

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COMPETING INTERESTS

All authors of this article declare there are no competing interest.

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APPENDIX

This questionnaire aims to explore students' use of Bilibili for online learning. All the information you fill in will remain confidential and be only used in this research. Thanks for your participation!

1. Do you agree to join this study?
   Yes
   No
2. What is your gender?
   Male
   Female
3. What is your major?
   Arts & Humanities
   Social Sciences
   Science & Engineering
   Agriculture
   Medicine
4. How old are you?
   below 20 years old
   20-22 years old
   23-25 years old
   26-28 years old
   over 28 years old
5. What is your degree of education?
   Below undergraduate
   Undergraduate
   Postgraduate
   Doctor

Content Richness

CR1: Bilibili contains very useful instructional videos that I need.
CR2: Bilibili provides up-to-date instructional videos that I need.
CR3: Bilibili provides sufficient instructional videos that I need.
CR4: I find a satisfactory number of instructional videos on Bilibili.

Danmaku Interface

DI1: I can obtain useful information via the danmaku of the instructional videos.
DI2: The danmaku promotes a sense of interactivity while watching instructional videos.
DI3: The danmaku promotes my engagement in learning.
DI4: The danmaku makes learning more interesting.
DI5: Overall, I think the danmaku facilitates my online learning.

Task-Technology Fit

TTF1: Bilibili is fit for the requirements of my learning.
TTF2: Bilibili is suitable for helping me complete online courses.
TTF3: Bilibili is suitable for helping me complete my academic tasks.
TTF4: Using Bilibili is necessary for my academic tasks.

Confirmation

CON1: My learning experience on Bilibili is better than I expected.
CON2: The service level provided by Bilibili is better than I expected.
CON3: The academic usefulness of Bilibili is better than I expected.
CON4: Overall, my expectations of learning on Bilibili are confirmed.

Satisfaction

SAT1: I am satisfied with the performance of Bilibili.
SAT2: I am pleased with the experience of using Bilibili.
SAT3: My choice to use Bilibili for learning was a wise one.
SAT4: My overall learning experience on Bilibili is very satisfying.

Perceived Usefulness

PU1: Bilibili helps to enhance my learning performance.
PU2: Bilibili helps to enhance my learning effectiveness.
PU3: Instructional videos on Bilibili are a good supplement to the courses at school.
PU4: I find Bilibili to be useful in my learning.

Perceived Ease of Use

PEU1: I find it easy to use Bilibili.
PEU2: Interacting with the Bilibili does not require a lot of my mental effort.
PEU3: It is easy to become skillful at using Bilibili.
PEU4: It is easy for me to find learning materials on Bilibili.

Attitude

AT1: Learning on Bilibili is fun.
AT2: Using Bilibili for learning is a good idea.
AT3: Using Bilibili is an attractive way to learn.
AT4: Overall, I like using the instructional videos on Bilibili.

Continuance Intention

CI1: In the future, I intend to continue using the instructional videos on Bilibili.
CI2: I intend to continue using Bilibili to learn rather than an alternative video platform.
CI3: I will recommend instructional videos on Bilibili to others.
CI4: I intend to use Bilibili frequently for my academic tasks.

What do you think are the advantages and disadvantages of learning on Bilibili? Do you have any suggestions?

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