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ORIGINAL PAPER

The influence of students' ability on the continuous intention of blended learning

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Abstract

Blended learning has grown in importance in colleges since the COVID-19 pandemic because it is a creative and effective extension of traditional education. The aim of this paper is to characterize how students' ability affects their desire for continuous learning in a blended learning environment. In order to do this, a proposed and tested integral model of students' flow in blended learning environments is constructed. This is achieved by a survey resulting in a sample of 344 valid questionnaires. The theoretical model was tested and validated using the standard methodological procedure based on exploratory and confirmatory analyses. According to the results, the students' web skills and social skills significantly impact the flow experience in a positive way, and metacognitive regulating ability has a significant negative impact on flow experience, which in return significantly impact the continuous learning intention. In conclusion, some suggestions for teachers and the online teaching systems are put forward to improve students' continuous learning intention.

Keywords Blended learning · Continuous intention · Ability · Flow experience

Introduction

The education industry is undergoing an informatization as a result of the advancement of information and communication technologies (Köse 2010). Information-Computer Technologies environments lead to the instructional innovations and make students equipped with technological devices and software's which provide a ubiquitous learning environment, initiating a new e-learning period (Horton 2000). As a computer-mediated teaching technique, blended learning is growing quickly. As per the 2017 New Media Consortium Horizon Report, blended learning designs were among the short term forces driving technology adoption in higher education in the next few years (Adams Becker et al. 2017).

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The covid-19 pandemic has increased the urgency of the need for blended learning. In over 109 countries across the world, social distancing is being enforced because of the Covid-19 pandemic. The implementation of social distancing has paved way for the temporal closure of schools both regionally and locally in all these countries. In order to avoid total curriculum disruption while the Covid-19 pandemic lasted, some government had introduced blended learning to ensure that learners hold access to learning materials while staying at home (Mahaye 2020). Self-paced eLearning and virtual classrooms are already commonplace in education and training programs. Post Covid-19, even when learning returns to the physical classroom, the trend toward blended learning will continue (Singh 2021).

Blended learning is a continuum of educational delivery which combined with face-to-face learning and online learning (Bates 2005). However, it is not just a simple technology mix, but it produces a highly participatory and personalized learning experience for students (Smith 2014). As per the research, the blended learning leads to an improvement in students' academic achievement and sense of community, improving the interaction between students and students, students and content, and students and external resources (Ceylan and Kesici 2017; Yen and Lee 2011). Teachers assist students in mastering knowledge according to their needs through the blended learning method (Ellis et al. 2006). Thus, blended learning realizes the transformation from teacher-centered to student-cantered (Goodyear and Dudley 2015).

However, blended learning raises the bar for student's ability while simultaneously improving the learning effect. Students' proficiency in learning system (Davis and Wong 2007; Liu and Jiang 2004; Vaughan 2007), metacognitive ability (Kim and Lim 2019; Rasheed et al. 2020), social communication ability (Kintu et al. 2017; Richardson and Swan 2003) as well as other abilities would influence the blended learning effect. There are important issues that need to be resolved, such as what types of students are better suited for blended learning and how to give students the best learning experience.

A person who is fully immersed in a feeling of energized focus, full involvement, and enjoyment when performing some activities is said to be in a state of flow. Essentially, flow is characterized by the complete absorption in what one does, and occurs when one's skills are neither overmatched nor underutilized to face a particular issue (Csikszentmihalyi 1990). We believe flow theory is appropriate for the research context because it is predicted on the idea that the achievement of optimal experience depends on the development of the necessary skills to overcome course-related challenges and the capacity to master the blended learning (Howland and Moore 2002), we think that the.

Moreover, although online learning platform provides learners with a high degree of autonomy, learners' continuous learning intention is still low because of the less than optimal online experience (Kang et al. 2014). Therefore, it is crucial to create an environment that is appropriate for learning. Lin and Wang (2012) explored that good blended learning experience could make learners develop the intention of continuous learning. The theory of flow experience, which studies how to get the optimal experience in activities, is introduced into the research,

to discover the factors, which can bring the best learning experience to blended learners and affect their intention to continue learning.

Literature review

Relationship between ability and flow experience

In blended learning, students must initially engage in independent online learning, where teachers play a less guiding role. Blended learning has higher requirements for students' ability, so this learning mode may not be suitable for all students. The ability of students must be matched with the blended learning process for there to be a positive engagement with the students.

Currently, some scholars have put forth some challenges that blended learning brings to students as well as the abilities which must be possessed by students. Hong et al. (2012) argued that people are gladder to attempt and persist in behaviors that they feel capable of performing. In the learning environment, mastering the skills associated with the course challenge, positively affects students' flow experience (Davis and Wong 2007).

Furthermore, competence has been considered a significant factor that enhances the flow of intrinsic motivation because learners are provided with a sense of control they may take in learning (Deci and Ryan 1987). Liu and Jiang (2004) refined the skills which are crucial when it comes to blended learning. While suggesting that learners' familiarity with the carriers (which includes hardware and software environment) used in e-learning, such as whether they are familiar with the basic operation of the network, various teaching software as well as corresponding computer knowledge, has an impact on the development of learning activities. Lack of control over the teachers and the learning environment would make students less motivated to work hard and pay attention to the content. Through a questionnaire survey, Fang (2015) validated this claim and discovered that, in the MOOC learning environment, the better learners' web skills are, the more they feel that the learning process is simple and easy to control, and it also enhances the sense of entertainment they obtain from learning.

According to the findings of this study, students who can skillfully use the online learning system, do not have to spend energy on studying the system's use. Rather, they can focus on the learning content. Thus, the following hypotheses have been put forward in this study:

H_1 Students' web skills significantly affect the pleasure in the process of using blended learning.

H_2 Students' web skills significantly affect the sense of concentration in the process of using blended learning.

H_3 Students' web skills significantly affect their controllability in the process of using blended learning.

Blended learning needs students to manage their time to finish online courses without teachers' supervision, indicating that it requires precise analysis and constructive modification of learners' learning processes and learning strategies (Aycock et al. 2002). Owing to the flexibility and autonomy of blended learning (Rasheed et al. 2020), self-regulatory skills of time management resulted in a better performance and efficiency in blended learning environments (Selim 2007). Thus, scholars emphasize the significance of metacognitive ability in the blended learning.

Learners' control ability of self-cognitive process is referred to as metacognitive competence. According to Flavell (1979), metacognition is the ability to identify a person's thinking process, set goals and evaluate performance, which includes planning in advance, monitoring in the middle and evaluating results. The process of coordinating cognition known as "metacognitive regulation" includes top-down cognitive control, bottom-up cognitive monitoring (such as error checking, information monitoring recovered from memory), and both (such as error correction, planning and resource allocation). Self-appraisal and self-management are thought to be the two primary aspects of metacognition, according to Paris and Winograd (1990). Self-appraisal is the process through which an individual evaluates their own knowledge state, skill, and motivation levels as well as their emotional state to these factors. Self-management helps individuals coordinate the psychological process of problem solving.

The impact of metacognitive abilities on the feeling of flow has been empirically investigated by many researchers. The influence of metacognitive ability on the feeling of flow has been empirically investigated by many researchers. Admiraal et al. (2011), stated that the higher the self-regulatory level of students, the more flow they showed in the learning process, which was consistent with Csikszentmihalyi's flow theory (1990). Csikszentmihalyi suggests that the challenges of the learning and the skills needed to meet those challenges seemed to be important for the generation of flow, students demonstrated more flow in the learning process the higher their self-regulation levels. Kim and Lim (2019) are of the opinion that metacognitive ability is particularly required in the online learning environment where learners must control their learning path and speed. Wang and Wang (2020) explained the causes why metacognitive ability is a necessity. Their investigation demonstrates that online learners' metacognitive ability promotes students' spontaneous learning fluency, therefore, increasing their sense of pleasure, enjoyment as well as controllability in learning.

This paper splits metacognitive ability into metacognitive regulating ability before and during learning and metacognitive evaluating ability after learning according to the research of Paris and Winograd (1990) and puts forward the following hypotheses:

H_4 Students' metacognitive regulating ability significantly affects the pleasure in the process of using blended learning.

H_5 Students' metacognitive regulating ability significantly affects the sense of concentration in the process of using blended learning.

H_6 Students' metacognitive regulating ability significantly affects their controllability in the process of using blended instruction.

H_7 Students' metacognitive evaluating ability significantly affects the pleasure in the process of using blended learning.

H_8 Students' metacognitive evaluating ability significantly affects the sense of concentration in the process of using blended learning.

H_9 Students' metacognitive evaluating ability significantly affects their controllability of using blended instruction.

In blended learning, students not only learn online, but also participate in offline teachers' question answering courses to communicate with students and teachers. Willging and Johnson (2009) pointed out that learners may not continue blended learning if they are not capable of making friends thereby being disconnected and developing feelings of isolation during their blended learning experiences. Students with social skills have high perceptions of learning and high satisfaction with their instructor as argued by Richardson and Swan (2003). Thus, we assume that students with social skills would feel less lonely and would be more satisfied with their instructors, so they will have a higher sense of pleasure in blended learning.

According to Kintu et al. (2017), students' high-level interaction with peers can aid them in developing their own ideas and improve the effect of blended learning. Students with higher social level are better at expressing the difficulties they encounter in the learning process, which allows them to overcome the difficulties and thus, better concentrating on the learning. Therefore, the following hypotheses are put forward:

H_{10} Students' social skills significantly affect the pleasure of using blended learning.

H_{11} Students' social skills significantly affect the sense of concentration in the process of using blended learning.

H_{12} Students' social skills significantly affect their controllability in the process of using blended instruction.

Relationship between flow experience and continuous learning intention

The term "flow" describes an individual who is fully engaged in some type of entertainment or activity, if the difficulty of the challenge is relatively balanced with his skills, flow will occur. Csikszentmihalyi (1990) introduced the elements of flow experience, which involves clear activity goal, balance between challenge as well

as skill, immediate feedback, high sense of control, distorted sense of time, high concentration, integration of activity and consciousness, purpose and loss of self-consciousness. Koufaris (2002) identified the cognitive and affective factors that are used in flow research, namely intrinsic pleasure, perceived control, and concentration. Based on the definition of flow experience as well as the elements of flow experience proposed, the flow experience has also been split into pleasure, concentration and controllability. Continuous learning intention means the willingness of learners to continue taking part in the course learning or complete the learning task after they participate in the blended learning course.

According to Davis and Wong's (2007) hypothesis, flow experiences have a stronger influence on continuous learning intention than perceived usefulness. In the process of blended learning, students who find the learning process engaging and can exert some influence over it have better learning emotional experience, so they have higher willingness to continue learning. Yang et al. (2013) discovered that MOOC learners' concentration decreases the possibility of dropping out of school, thus improving their learning persistence. The argument was verified by Lan et al. (2019) and stated that learners' concentration on online learning directly affects their continuous learning intention.

H_{13} The sense of pleasure in the process of blended learning significantly affects the continuous learning intention.

H_{14} The sense of concentration in the process of blended learning significantly affects the continuous learning intention.

H_{15} The controllability in the process of blended learning significantly affects the intention of continuous learning intention.

Based on the above assumptions, the model is as follows (Fig. 1).

Methods

Participants and procedure

We select undergraduate students to serve as the study's subjects to test our research theories. Through a questionnaire survey of their ability to prepare for the use of blended learning and their subjective feeling, we assessed how students' ability to prepare for the use of blended learning affects students' flow experience in the learning process, and further research was done on how students' abilities affected their intention to study continuously.

In this study, random sampling method has been utilized for investigating the undergraduates. The questionnaire was collected online and offline. The questionnaire was released online using Wechat and QQ. For offline investigation, a paper questionnaire from Wuhan University of Science and Technology was randomly

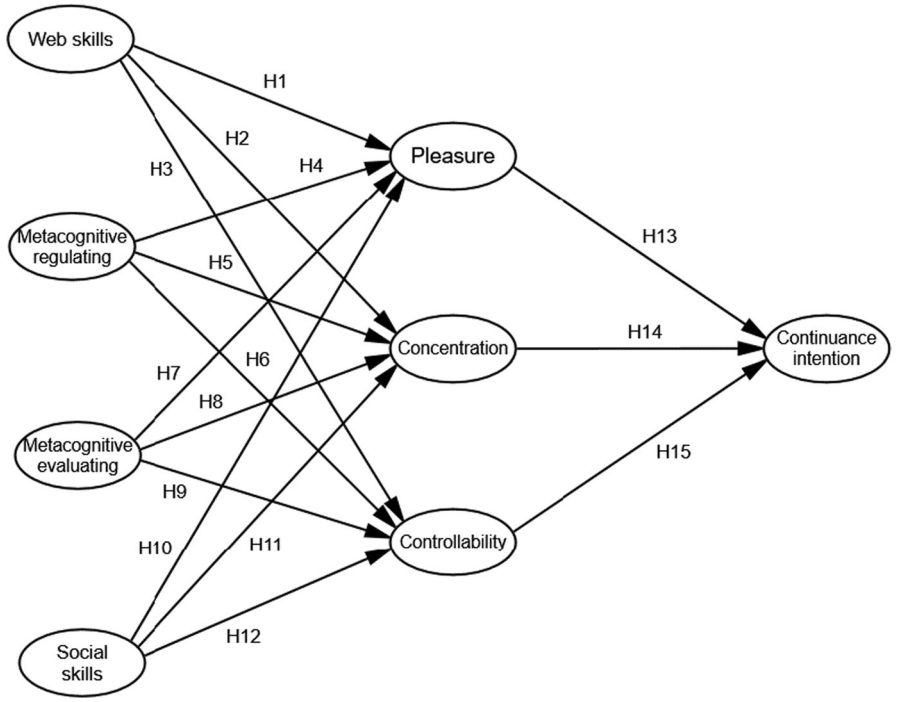

Fig. 1 Research model

released during rush hour at the entrance teaching building. Students who filled in the paper questionnaire were given gifts such as candy as material return. After deleting the invalid questionnaires, 344 valid questionnaires had been gathered. The personal characteristics of the samples in the questionnaire involve gender, grade, and major. Table 1 displays the descriptive statistical findings. As per the descriptive statistics of the sample, in terms of gender, boys and girls accounted for 33.4% and

Table 1 Descriptive statistical analysis of sample basic information

Attribute	Item	Total frequency	Frequency	Percentage
Gender	Male	344	115	33.4
	Female		229	66.6
Grade	Lower grades (freshmen to sophomores)	344	166	48.3
	Higher grades (junior to senior)		178	51.7
Major	Non STEM	344	227	66.0
	STEM		117	34.0

66.6%, respectively. Students in lower grades (freshmen to sophomores) accounted for 48.3%, while those in higher grades (junior to senior) accounted for 51.7%. In terms of major, students in STEM accounted for 34.0%, and students in non-STEM major accounted for 64.0%. Students' ability, flow experience and continuous learning intention had nothing to do with gender, grade and major, according to the findings of an Independent sample t-test results that showed no significant differences among the variables in terms of gender, age and major ($P > 0.05$).

Measures

The items of the questionnaire had been designed in the form of Likert 5 scale, 1–5 from low to high, representing the degree of intention from "very disagree" to "very agree". Table 2 displays the questionnaire's specific scale design.

Data analysis

SPSS version 23.0 had been used for analyzing the demographic variables and investigate reliability and validity among the research variables. Then, Amos version 24.0 was used for carrying out a structural equation modeling to test the research hypotheses.

Results

Descriptive statistical analysis

To test whether the distribution of the sample data conforms to the normal distribution, the central variables in the model, including mean, standard deviation, peak, and skewness, are multivariate normally analyzed in this study. Joanes and Gill (1998) argued that when the absolute value of skewness coefficient is less than 3, and the absolute value of kurtosis coefficient is less than 8, the data of variables conform to normal distribution. The data in Table 3 shows that the questionnaire data complies with the normal distribution. Under the ability classification, the web skills, metacognitive regulating, metacognitive evaluation and social skills are all above 3.00, as well as the highest score of web skills is 3.66, which displays that college students basically have the Internet technology, which is required by online teaching and can use online learning software more skillfully.

The average of pleasure, concentration and controllability under the classification of flow experience all exceeds 3.00, and the average scores of pleasure and controllability are quite similar, which is 3.44. Apparently, in the process of using blended learning, it could bring flow experience to students. The average student's intention to continue studying through blended learning is 3.50, which shows that the majority of students are open to doing so.

Table 2 Questionnaire items

Variable	Code	Item	Source
Web skills	WS1	I'm good at learning with online learning software	Novak and Hoffman (1997)
	WS2	I know how to find the information I require when I study online	
Metacognitive regulating	MR1	When I study, I think about what I really need to learn	Kang (2005)
	MR2	Once I start a task, I always ask myself if I've learned as much as I should	
	MR3	After the test, I would consider how to do better in the next test	
	MR4	I would change my learning method according to different conditions or subject requirements	
Metacognitive evaluating	ME1	After I study, I will consider whether I have really learned what I need to learn	
	ME2	I will conceive some questions to help focus on learning next time	
	ME3	When I have understood the contents under a topic, my learning effect is the best	
	ME4	After I finish a task, I ask myself if I have an easier way to do things	
Social skills	SS1	I often share my learning experience with my classmates	Self-made
	SS2	I often take the initiative to consult the teacher when I encounter problems in my study	
	SS3	I am very willing to participate in the discussion with my classmates	
Pleasure	PL1	I think the blended learning process is highly interesting	Pearce et al. (2005)
	PL2	I enjoy using blended learning	
	PL3	The blended learning process excited my curiosity	
Concentration	CT1	Whenever I use blended learning, I feel highly focused	Wang (2019)
	CT2	In the blended learning, I feel completely integrated into what the teacher said	
	CT3	It makes me feel like time flies when I study with blended instruction	
	CT4	My mood would fluctuate with what the teacher says	
Controllability	CA1	When I face challenges in my study, I think my ability can let me meet the challenges	Tenenbaum et al. (1999)
	CA2	I know exactly what I want to do in the process of accepting blended learning	
	CA3	I feel completely in control of my behavior when I study	
	CA4	I know what I wish to achieve in the process of accepting blended learning	
	CA5	I know how well I'm doing with blended instruction	

Table 2 (continued)

Variable	Code	Item	Source
Continuous intention	CI1	I think blended learning is suitable for learners	Lin and Wang (2012)
	CI2	I would propose that others adopt a blended learning model	
	CI3	Generally speaking, I am willing to continue to use the blended learning mode	

Table 3 Descriptive statistical analysis of variables

Variable	Code	Item mean	Variable mean	Standard deviation	Skewness		Kurtosis	
					Figure	Standard error	Figure	Standard error
Web skills	WS1	3.64	3.66	0.92	−0.38	0.13	0.33	0.26
	WS2	3.68		0.92	−0.28	0.13	−0.24	0.26
Metacognitive regulating	MR1	3.62	3.55	0.87	−0.20	0.13	−0.23	0.26
	MR2	3.53		0.84	−0.19	0.13	0.00	0.26
	MR3	3.69		0.91	−0.28	0.13	−0.27	0.26
	MR4	3.58		0.81	−0.18	0.13	−0.09	0.26
	MR5	3.34		0.97	−0.13	0.13	−0.23	0.26
Metacognitive evaluating	ME1	3.65	3.62	0.84	−0.24	0.13	−0.04	0.26
	ME2	3.50		0.90	−0.09	0.13	−0.44	0.26
	ME3	3.74		0.90	−0.38	0.13	0.05	0.26
	ME4	3.57		0.86	−0.14	0.13	−0.11	0.26
Social skills	SS1	3.20	3.31	0.94	0.02	0.13	−0.30	0.26
	SS2	3.17		1.00	−0.20	0.13	−0.20	0.26
	SS3	3.56		0.90	−0.15	0.13	−0.18	0.26
Pleasure	PL1	3.52	3.44	0.92	−0.27	0.13	0.10	0.26
	PL2	3.40		0.90	−0.13	0.13	0.05	0.26
	PL3	3.41		0.94	−0.11	0.13	−0.07	0.26
Concentration	CT1	3.19	3.32	0.93	0.11	0.13	−0.14	0.26
	CT2	3.22		0.87	0.05	0.13	0.08	0.26
	CT3	3.48		0.98	−0.22	0.13	−0.30	0.26
	CT4	3.37		0.98	−0.30	0.13	−0.09	0.26

Table 3 (continued)

Variable	Code	Item mean	Variable mean	Standard deviation	Skewness		Kurtosis	
					Figure	Standard error	Figure	Standard error
Controllability	CA1	3.38	3.44	0.87	−0.21	0.13	0.04	0.26
	CA2	3.47		0.86	−0.21	0.13	−0.03	0.26
	CA3	3.29		0.88	−0.12	0.13	−0.13	0.26
	CA4	3.55		0.85	−0.16	0.13	−0.18	0.26
	CA5	3.51		0.90	−0.02	0.13	−0.10	0.26
Continuous intention	CI1	3.52	3.50	0.92	−0.37	0.13	0.20	0.26
	CI2	3.44		0.93	−0.31	0.13	0.10	0.26
	CI3	3.53		0.92	−0.43	0.13	0.31	0.26

Pearson correlation analysis

Pearson correlation analysis was used to analyze the variables, to further explore the relationship between the variables. The analysis results have been given in Table 4. There are significant positive correlations among the variables of web skills, metacognitive regulating ability, metacognitive evaluation ability, social skills, sense of pleasure, concentration, controllability as well as continuous intention ($P<0.01$). Simultaneously, according to this conclusion, we could further test the structural equation model.

Reliability and validity

Confirmatory factor analysis (CFA) had been utilized for testing the reliability and validity of the variables. KMO sampling suitability test measures were close to 1, Bartlett spherical test results were significant ($P=0.00<0.05$), which indicates that the sample size is appropriate for factor analysis. Cronbach's α coefficient and combined reliability CR value had been selected as the indicators for measuring the reliability of the measurement model. It could be seen for the table given below that the internal consistency reliability index Cronbachs α value and combined reliability are distributed between 0.78–0.89 and 0.87–0.93, respectively, which are greater than the standard of 0.7. This is an indication that the reliability of each scale of the measurement model is high. The mean variance extraction value and the standardized factor load coefficient were chosen as the test indices of aggregate validity in this study. The standardized factor load coefficient of all index items is greater than 0.4, so the index reliability is high. Moreover, the average variance extraction value (AVE) of each variable ranged from 0.61 to 0.87, which was greater than the evaluation standard of 0.5, indicating that all variables had aggregate validity (Table 5).

Linear regression analysis

SPSS had been used to conduct multiple regression analysis for examining the influence of students' ability on their continuous learning intention. The first model treats students' ability as an independent variable and treats the pleasure, concentration, and controllability of the flow experience as dependent factors. The second model treats the three dimensions of flow experience as independent variables and the students' continuous intention to engage in blended learning as dependent variables. The results of linear regression analysis are shown in Table 6.

From model 1, we could view that web skills, metacognitive regulating ability, metacognitive evaluating ability and social skills all significantly affect the pleasure and controllability in the flow experience. From the standard regression coefficient β, we could see that social skills hold the greatest influence on the pleasure of using blended learning, and metacognitive regulating ability has the greatest impact on the sense of control. Moreover, the web skills, metacognitive regulating ability and social skills significantly influence on concentration, but the metacognitive

Table 4 Pearson correlation analysis of variables

	Web skills	Metacognitive regulating	Metacognitive evaluating	Social skills	Pleasure	Concentration	Controllability	Continuous intention
Web skills	1.00	0.56**	0.49**	0.38**	0.45**	0.43**	0.52**	0.46**
Metacognitive regulating		1.00	0.80**	0.69**	0.62**	0.61**	0.72**	0.55**
Metacognitive evaluating			1.00	0.65**	0.60**	0.57**	0.68**	0.53**
Social skills				1.00	0.59**	0.61**	0.62**	0.43**
Pleasure					1.00	0.75**	0.68**	0.67**
Concentration						1.00	0.73**	0.68**
Controllability							1.00	0.67**
Continuous intention								1.00

**P<0.01

Table 5 Reliability and validity test results

Variable	Code	Factor load	AVE	CR	Cronbachs α
Web skills	WS1	0.93	0.87	0.93	0.84
	WS2	0.93			
Metacognitive regulating	MR1	0.83	0.61	0.89	0.84
	MR2	0.78			
	MR3	0.79			
	MR4	0.78			
	MR5	0.74			
Metacognitive evaluating	ME1	0.84	0.66	0.89	0.83
	ME2	0.79			
	ME3	0.83			
	ME4	0.80			
Social skills	SS1	0.85	0.70	0.87	0.78
	SS2	0.85			
	SS3	0.80			
Pleasure	PL1	0.90	0.81	0.93	0.88
	PL2	0.89			
	PL3	0.90			
Concentration	CT1	0.84	0.63	0.87	0.80
	CT2	0.88			
	CT3	0.76			
	CT4	0.69			
Controllability	CA1	0.81	0.67	0.91	0.87
	CA2	0.85			
	CA3	0.79			
	CA4	0.83			
	CA5	0.80			
Continuous intention	CI1	0.91	0.82	0.93	0.89
	CI2	0.89			
	CI3	0.91			

evaluating ability has no significant impact on concentration, which means H8 is not valid. We can show from model 2 that students' flow experiences significantly affect their intentions for continuous learning in blended learning. Multicollinearity was tested using the variance inflation factor (VIF) method (Table 6). The VIF values for all variables are below 5, thus, there is no presence of Multicollinearity.

Structural equation model analysis

To deeply examine the effect of students' ability on their continuous learning intention and path coefficient, the hypothesis model had adjusted according to the results of SPSS multiple regression analysis. After deleting the non-significant

Table 6 Results of multiple regression analysis

Model	Dependent variable	Independent variable	B	β	t value	p value	VIF	Adjusted R^2
Model 1	Pleasure	Web skills	0.21	0.15**	3.05	0.003	1.46	0.459
		Metacognitive regulating	0.15	0.20**	2.69	0.008	3.06	
		Metacognitive evaluating	0.16	0.18**	2.63	0.009	2.98	
		Social skills	0.29	0.28***	4.92	0.000	2.02	
	Concentration	Web skills	0.21	0.12*	2.50	0.013	1.47	0.447
		Metacognitive regulating	0.17	0.20**	2.60	0.010	3.02	
		Metacognitive evaluating	0.14	0.14	1.95	0.052	2.98	
		Social skills	0.42	0.34***	5.88	0.000	2.02	
	Controllability	Web skills	0.33	0.16***	3.81	0.000	1.46	0.581
		Metacognitive regulating	0.34	0.33***	4.95	0.000	3.03	
		Metacognitive evaluating	0.27	0.21***	3.55	0.000	2.98	
		Social skills	0.28	0.19***	3.82	0.000	2.00	
Model 2	Continuous intention	Pleasure	0.28	0.28***	4.91	0.000	2.49	0.554
		Concentration	0.21	0.25***	4.15	0.000	2.85	
		Controllability	0.21	0.30***	5.45	0.000	2.31	

*P<0.05, **P<0.01, ***P<0.001

path metacognitive evaluating ability → concentration, the improved hypothesis mode's path analysis and fitting degree were assessed using Amos 24.0 software. Considering the impact of demographic variables which includes gender, grade and major, this study takes demographic variables as covariates into the structural equation model for control, and finally constructs the model as demonstrated in the figure. Gender, grade and major have no significant influence on the willingness to continue learning, which indicates that this study has better controlled the demographic characteristics, which is conducive to the promotion of the conclusion.

Table 7 displays the results of the parameter testing. In the model, the three paths of metacognitive regulating ability → pleasure ($B=0.27$, $P=0.337$), metacognitive evaluating ability → controllability ($B=0.21$, $P=0.346$) as well as concentration → continuous learning intention ($B=0.01$, $P=0.924$) failed to meet the significance standard of parameter test, so H7, H9 and H14 are not tenable (Fig. 2). It is possible that metacognitive evaluating ability is the ability of retrospective reflection after the learning task, which is primarily reflected after the completion of learning activities, while flow experience is the emotional state during the learning period using blended learning, so the ability of post evaluation has little effect on it (Table 8). The other alternatives satisfy the fitting degree standard ($P<0.05$)

Table 7 Nonstandard regression analysis

	Estimate	S.E.	C.R.	*P*
PL ← WS	0.69	0.22	3.13	0.002
CT ← WS	0.88	0.30	2.90	0.004
CA ← WS	0.46	0.13	3.44	***
PL ← MR	− 2.59	0.86	− 3.01	0.000
CT ← MR	− 3.56	1.13	− 3.15	0.002
CA ← MR	− 1.26	0.53	− 2.37	0.018
PL ← ME	0.27	0.28	0.96	0.337
CA ← ME	0.21	0.23	0.90	0.346
PL ← SS	2.95	0.73	4.07	***
CT ← SS	4.14	1.04	3.97	***
CA ← SS	1.73	0.43	3.98	***
CI ← PL	0.45	0.13	3.48	***
CI ← CT	0.01	0.16	0.10	0.924
CI ← CA	0.50	0.11	4.38	***

***P<0.001

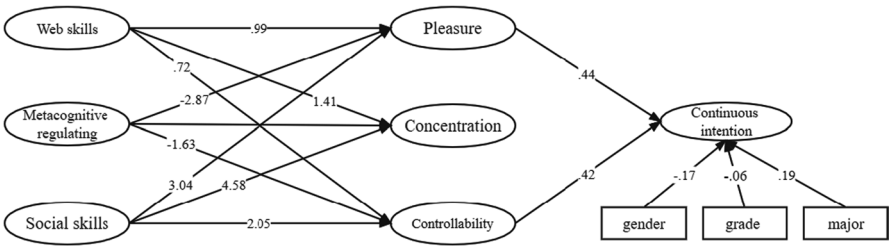

Fig. 2 The influencing factors model and path coefficient of blended learning continuous learning intention

Table 8 Model fit index

Reference index	χ^2/df	RMSEA	SRMR	TLI	CFI
Eligibility criteria	< 3.000	< 0.080	< 0.080	> 0.900	> 0.900
Before revision	2.580	0.068	0.048	0.900	0.912
After revision	2.563	0.068	0.045	0.901	0.913

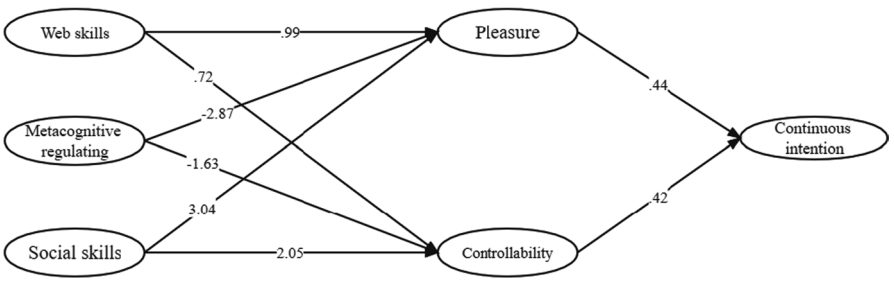

Fig. 3 The modified model after deleting the insignificant path

after the aforementioned three paths are eliminated. The model passes the test (see Fig. 3), and the overall model explains 65% of the variance of continuous learning intention.

According to the modified structural equation model (as shown in Fig. 3), the negative impact of metacognitive regulating ability on the use of flow experience in the process of blended learning might be because of the balance between the skills and challenges, which flow experience produces. The survey group's metacognitive regulating ability, sensation of pleasure, and sense of controllability mean values can be compared to determine the metacognitive regulating ability of the group. The survey group's metacognitive regulating ability is higher, which might make the challenge of blended learning to students relatively low. The challenge of blended learning primarily lies in the online self-study part. Thus, for the subjects of this experiment, it might be more suitable to utilize pure online teaching to make the challenge match the ability, so as to improve the flow experience.

The mediation effects

We used the bootstrapping method to assess if the indirect effects were meaningful to investigate the mediation effects. The bootstrapping test results indicate that web skills, metacognitive regulating ability as well as social skills had significant indirect relationship with continuous intention through pleasure and controllability (see Table 9).

Discussion

Based on the descriptive statistics, correlation analysis as well as structural equation model test of the results, the following conclusions are drawn:

At first, the students' computer proficiency significantly positively influences the continuance learning intention, which complies with previous research results (Liu and Jiang 2004). The results demonstrate that the influence path of web skills on the continuous learning intention is "web skills → pleasure → continuous intention" and "web skills → controllability → continuous intention". Moreover, students' social

Table 9 Indirect effect of ability on continuous intention

Summary of the hypothesized path	Value	*P*	Bias-corrected 95% confidence interval	
			Lower limit	Upper limit
WS → PL → CI	0.385	0.000	0.116	0.191
WS → CA → CI	0.451	0.000	0.327	0.575
MR → PL → CI	− 0.245	0.000	− 0.304	− 0.187
MR → CA → CI	− 0.304	0.000	− 0.378	− 0.233
SS → PL → CI	0.400	0.000	0.306	0.489
SS → CA → CI	0.426	0.000	0.335	0.521

skill also significantly positively influences students' flow experience. For students with strong social communication ability, they could actively take part in Teachers' answering questions and communicate with students. This has something in common with Csikszentmihalyi (1990), that is, positive learning atmosphere, harmonious teacher-student relationship as well as online communication can promote the flow experience by improving learners' positive emotional experience.

Contrary to previous research conclusions, this study discovered that students' metacognitive regulating skill significantly reverses the students' flow experience. For example, Wang and Wang (2020) believes that metacognitive skills enhances students' enjoyment and participation in online learning, as well as further improve learners' continuous intention. According to the occurrence conditions of flow experience (Csikszentmihalyi 1990), it might be that when students have strong metacognitive regulating ability, offline question answering in blended learning is a waste of time and reduces learning efficiency for students, which would reduce the challenges faced by students and thus, influencing the pleasure brought by the sense of acquirement in overcoming challenges and the sense of controllability in self-control learning.

Third, prior studies (Davis and Wong 2007; Wang et al. 2017) has demonstrated that students' flow experience in online learning has a beneficial impact on their intention to continue learning. However, flow experience also encompasses pleasure, concentration and other aspects (Csikszentmihalyi 1990). Previous studies have not studied different aspects of flow experience. The three components of flow experience are pleasure, controllability, and concentration in this study. The results display that the pleasure and controllability of students in blended learning have a significant positive effect on their willingness to continue learning, which complies with previous research results. For instance, Padilla-MeléNdez et al. (2013) suggested that the pleasure of online learning can promote students' willingness to continue learning. Lee (2010), for example, believes that online learners' involvement in learning is positively correlated with their continuance learning intention. Nevertheless, the study discovered that the influence of the sense of concentration on the continuous learning intention is insignificant, which might be because of the fact that the current college students could pay attention to the curriculum in the traditional face-to-face learning as well as blended learning, and the index of sense of concentration cannot reflect the particularity of blended learning mode, thus, the impact on the subjective index of the continuous learning intention using blended learning is comparatively weak.

Our research also have has implications that could be helpful for students, teachers and online learning platform.

Students should master the operation of the teaching system in advance

Teachers should look into the students' web skills, metacognitive ability and social skills before implementing blended learning. Teachers should give guidance in advance for students who need it to confirm that students are proficient in using the online learning system. Moreover, for students having strong metacognitive

ability and self-learning ability, online teaching might be more suitable for improving learning efficiency and promote students' continuous learning behavior than blended learning.

Curriculum design should be interesting and interactive

Teachers must focus on the richness and entertainment of the course, while designing the blended teaching course. Teachers can use humorous language and set up appropriate teaching activities of game to stimulate learners' interest, in the teaching process.

Additionally, we can improve the communication between educators and students, or increase the teaching activities of students' group discussion to exercise students' social communication ability, develop a positive and relaxed learning atmosphere, and enhance students' sense of pleasure.

Teaching system should be simple handling and real-time interactive

The design of online teaching system must be easily operate able, so as to reduce the requirements of students' computer ability, which assists in promoting blended learning. In the online teaching part, the feedback mechanism such as scoring and comments needs to be appropriately added to enable students to self-regulate and control the learning process.

According to Van Popta et al. (2017), a student employs several cognitive processes and may experience various learning gains when delivering online peer feedback. It could also provide real-time interaction area in the course, so that students can get peer feedback at a certain time in the learning process. More immediate feedback for students and more practical classroom experiences can also help learners' more in charge and encourage ongoing learning behavior. Moreover, online learning system could design some real-time interactive games and provide material rewards to enhance the interest of learning and enhance the students' sense of pleasure while using the system.

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Declarations

Conflict of interest The authors declare that they have no conflict of interest.

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