An Investigation into the Factors Affecting the Knowledge Sharing Behavior of College Students in Flipped Classrooms

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Abstract

The study combined the technical characteristics and the variables featured in the flipped classroom teaching model to discover the mechanism of the role of students' knowledge sharing intentions and behavior generation, which is practically significant for enhancing teaching effectiveness. This study integrated flipped classroom characteristic variables with the technology acceptance model (TAM) and S-O-R framework to construct a model of factors influencing college students' knowledge sharing behavior. Focusing on flipped classroom students in Chinese universities, SPSS22.0 was utilized to analyze the validity of the questionnaire, while AMOS23.0 was employed to verify the model and hypothesis. The findings revealed that teacher support, interactivity, information, and system quality had significant positive effects on both perceived ease of use and perceived usefulness and affected intention to share knowledge through the mediating role of perceived ease of use and perceived usefulness. Perceived ease of use, perceived usefulness, and goal orientation (mastery and performance approach goal) significantly and positively affect willingness to share knowledge; goal orientation (performance avoidance goal) harms intention to share knowledge. Knowledge sharing intention significantly and positively influences knowledge sharing behavior.

Keywords: Flipped classroom, knowledge sharing, influencing factors

Introduction

In the field of education, the construction and application of information technology in the educational hardware environment have become a common phenomenon, which has changed the traditional way of learning and acquiring knowledge and promoted the deep integration of information technology and education, and it is an essential direction of the current educational teaching reform (Osman, et al., 2015). The Horizon 2020 Report (Teaching and Learning Edition) states that as the global ecological environment deteriorates, especially in the face of the COVID-19 that is ravaging the world, minimizing its impact has become a strategic priority for universities. Online versus face-to-face education has become a necessary capability for modern educational institutions to survive and thrive in the industry. As a typical model for the deep integration of information technology and learning theory, the flipped classroom has emerged as a popular subject in the field of advanced education in recent years. (Yang, 2016).

The flipped classroom is an innovation of the conventional teaching model. The essence is to return to "learning of students" as the logical entry point of classroom education (Wang, 2016). Namely, the internalization and absorption of knowledge are realized via the construction of a "student-centered" interactive field (Huang & Department, 2016), which is the same essence of deep learning as the flipped classroom that refers to the internalization and absorption of knowledge. Consequently, it is vital to study the factors influencing knowledge sharing behaviors and their paths of action to enhance the learning effectiveness of flipped classrooms (Lin & Huang, 2020).

Research Objectives

The correlation between knowledge sharing intention and knowledge sharing behavior has been almost unanimously recognized by scholars in previous studies and exploring the factors that stimulate the intention to share has also been one of the focuses of prior research. Yet, research has not been extensively developed in the flipped classroom model, and studies of knowledge sharing behavior in this new teaching model remain restricted. The purpose of this research is to explore the factors that influence the knowledge-sharing behavior of college students in the flipped classroom and their internal paths of action in a deeper way with the help of existing research findings and to provide relevant suggestions and recommendations for educational practitioners.

1. Explore the factors that influence the knowledge-sharing behavior of college students in the flipped classroom.

2. Find out their internal paths of action in a deeper way with the help of existing research findings.

3. Provide relevant suggestions and recommendations for educational practitioners.

Literature Review

Knowledge sharing

The term "knowledge sharing" originated from a 1977 study of U.S. multinational corporations by an American scholar (Teece, 1977). Teece believed that cross-border transfer of technology helps firms accumulate valuable knowledge and promote the diffusion of technology, thereby reducing the regional technology divide.

Knowledge sharing is recognized as a fundamental element of the learning process. Scholars have stated that active knowledge sharing is a critical component of effective learning in advanced education (Keong & Subhi, 2015). While such views have been widely accepted, many current studies have focused on exploring the impact of knowledge sharing on corporate and organizational performance due to profit-driven factors, and its impact in the field of education has not been emphasized, especially the issue of knowledge sharing in classroom settings has yet to be explored (Bagais et al., 2020; Majid & Wey, 2011). Jantavongso & Nuansomsri. (2019) noted that by communicating with others, students can better express their ideas and thoughts, while discovering reasons that motivate their knowledge sharing behavior is the key. Over recent years, question-oriented teaching, contextualized teaching, objective-oriented teaching, and interactive and collaborative teaching have been increasingly employed, with these innovative teaching methods enabling the teaching process to be transformed into sharing process. (Majid & Wey, 2011; Osman et al., 2015). In addition, new teaching strategies such as blended learning and flipped classroom not only provide online and face-to-face learning scenarios, but also create an environment for knowledge sharing (Chen & Xu, 2018).

A consensus definition of knowledge sharing has not yet been reached. Among the existing studies, scholars have broadly discussed the information communication perspective, the organizational learning perspective, and the knowledge transformation process perspective. Knowledge sharing as discussed in this study is the process by which an individual student

transmits knowledge, ideas, experiences, and skills to another student or group. The inquiry focuses on the factors and paths of action that influence individual knowledge sharing behavior.

S-O-R model

The SOR (Stimulus–Organism–Response) theory was proposed by environmental psychologists Mehrabian & Russell (1974) to explain the influence of the environment on human psychology and behavior. The model consists of the antecedent variables: external environmental factors of Stimulus (S), the emotionally and cognitively mediated state of Organism (O) that arises when the individual interacts with external stimuli is the mediating variable, and the outcome variable, Response (R), which is the individual's attitudinal or behavioral response, consists of three components. The theory holds that the external environment can stimulate the individual's mental activity, causing changes in the person's emotional and cognitive state, leading to certain behavioral consequences (Mehrabian & Russell, 1974). Donovan & Rossiter (1982) applied the S-O-R to marketing for the first time to interpret consumer buying behavior, etc... Later on, other scholars have widely applied the theory to study how environmental characteristics in various fields affect users' psychological states and user behavior (Zhang et al., 2017). The theory has also been adopted by educational researchers in recent years for the study of behavioral learning. Wu, et al. (2020) modeled the influence of instructor support on intention to continue learning in MOOC courses based on the S-O-R framework and TAM model, and empirically demonstrated that instructor support influenced intention to continue learning through perceived ease of use, mental experience, and perceived usefulness.

Technology acceptance model (TAM)

The Technology Acceptance Model (TAM) is a model proposed by Davis et al. (1989) that builds on the Theory of Reasoned Action (TRA) proposed by Fishbein & Ajzen (1977) and is specifically designed to explain the behavior introduced by computer usage.

In contrast to traditional pedagogy, the Technology Acceptance Model (TAM) is the primary model for flipped teaching to explore learners' perceptions of technology acceptance (Haghighi et al., 2019; Hsieh et al., 2016; Khlaisang et al., 2021).

The flipped classroom is a new teaching model supported by information technology, and scholars have identified perceived usefulness and perceived ease of use as two core variables that influence students' behavioral intentions toward the flipped classroom (Cheng et al., 2019; Shen, 2016). Accordingly, the perceived usefulness and perceived ease of use in the TAM model were selected in this study to measure students' overall perceived evaluation of the flipped classroom

teaching model. The perceived usefulness is the value students place on the flipped classroom to enhance learning, and the perceived ease of use is the perceived difficulty of the flipped classroom learning model.

Conceptual Framework

Taking the S–O–R theory as the research framework and combining the TAM model. The study identified teacher support, interactivity, information quality, and system quality as input variables for the stimulus of the flipped classroom course environment. Perceived usefulness, perceived ease of use, and goal orientation are used as perceived variables of learners' internal mental states, or organism. Knowledge sharing intention and knowledge sharing behavior as student behavioral response outcome variables. The mechanisms of flipped classroom characteristic factors on students' knowledge sharing behavior were then explored. The conceptual framework is shown in Figure 1.
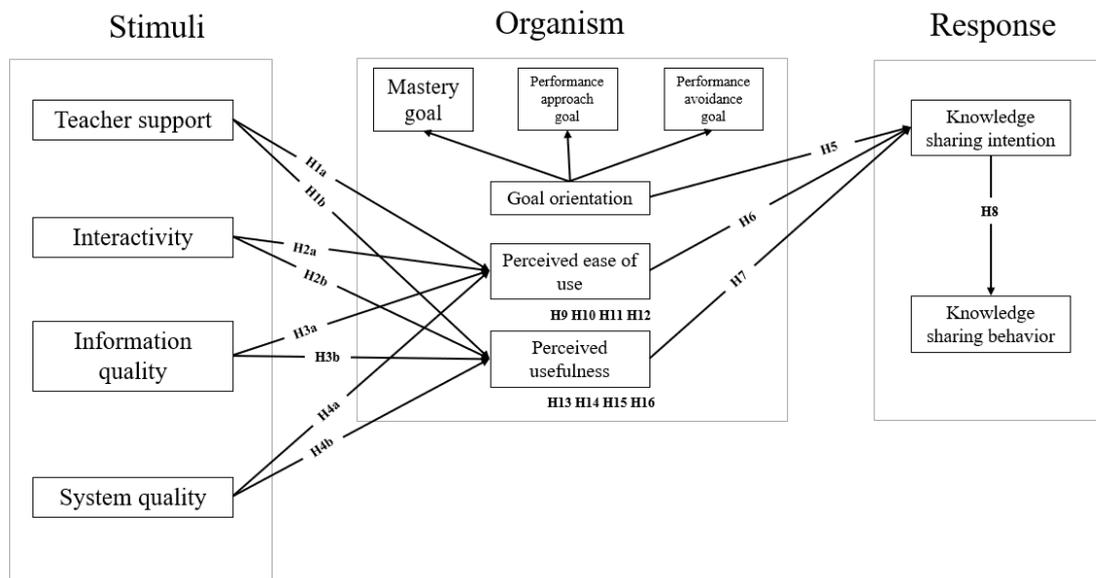

Fig.1: Conceptual framework of the research

Impact of teacher support on perceived ease of use and perceived usefulness

Teacher support is the teacher's contribution to student learning activities and processes, including the learning materials provided by the teacher, the learning activities organized, as well as teacher characteristics (Cha & Kwon, 2018; Gu et al., 2010; Limniou et al., 2018).

Cha & Kwon (2018) found that teacher characteristics and perceived mobility were key determinants of learners' perceived ease of use and perceived usefulness. Wang (2013) designed

an ecological teaching system for mobile and inquiry-based learning, stating that teaching activities had a significant positive effect on perceived usefulness, and perceived ease of use. Rajak et al. (2018) in a study on the acceptance of e-learning services in higher education institutions found that instructor characteristics, and teaching materials corresponded to perceived ease of use; the design of learning content was positively correlated with perceived ease of use.

The hypotheses are proposed:

H1a, Teacher support positively influences perceived ease of use

H1b, Teacher support positively influences perceived usefulness

Impact of interactivity on perceived ease of use and perceived usefulness

The behaviors of interaction determine the intensity and frequency of hybrid learning interaction and are important factors influencing the depth of learning (Zhang, 2018; Kuo et al. (2014) discovered that student-teacher interaction was a significant predictor of satisfaction and that they preferred to interact with the teacher with interactive features such as emojis, conversations, or hand raises. Wu et al. (2010) concluded that the learning atmosphere and students' interactive behaviors were positively correlated with students' acceptance of hybrid learning styles (Du, 2017). The interactivity explored in this paper includes student-teacher and student-student interactions.

Ning & Zhang, (2014) identified the interactive environment as a factor influencing perceived ease of use and the frequency & degree of interaction as factors affecting perceived usefulness in a study on the influence of virtual communities on consumers' intentional behavior. In a study of the relationship between classroom interaction and student engagement in SPOC learning, Guo et al. (2019) noted that classroom interaction significantly and positively influenced perceived usefulness and perceived ease of use and promoted student engagement with the SPOC system.

Thus, the hypothesizes are proposed as:

H2a: Interactivity positively affects perceived ease of use

H2b: Interactivity positively affects perceived usefulness

Impact of information quality and system quality on perceived ease of use and perceived usefulness

Virtually unanimous conclusions have been reached in the extant studies that system quality and information quality are the primary factors driving users' intention and satisfaction with e-learning (Mohammadi, 2015).

The results of Salloum et al. (2019) study on students' acceptance of e-learning in five different universities showed that system quality has a significant impact on the ease-of-use of e-learning systems with a positive impact of information quality on perceived ease of use and perceived usefulness.

Thus, the hypothesizes are proposed as:

H3a, Information quality positively affects perceived ease of use

H3b, Information quality positively affects perceived usefulness

H4a, System quality positively affects perceived ease of use

H4b, System quality positively affects perceived usefulness

The effect of goal orientation on the intention to share knowledge

The concept of goal orientation was first introduced by Carol Dweck. It is a particular standard of behavior that a person tries to achieve at a particular time (Dweck, 1986). Goal orientation has often been applied by researchers in the field of learning to explore the effects of different goal orientations for individuals upon individual outcome variables. Swift et al. (2010) argue that goal orientation provides a framework for individual knowledge sharing by shaping how individuals cognitively assess the costs and benefits associated with sharing knowledge. Each of the goal orientations is related to a preference for sharing a particular type of knowledge and is focuses on a different aspect of the knowledge provider-recipient relationship. Further research by Zhou et al. (2018) revealed that individuals with different performance goal orientations externally exhibited differences in intention to share explicit and implicit knowledge. Mastery goal orientation and performance approach goal had significant positive effects on both explicit and implicit knowledge sharing intentions, while performance avoidance goals had significant negative effects on both explicit and implicit knowledge sharing intentions. Drawing on the research, the paper will explore the role of goal orientation on the intention to share knowledge and verify the differences in the effects of student mastery goals, performance approach goal, and performance avoidance goal on knowledge sharing in a flipped classroom context.

Thus, the hypothesis is proposed as:

H5, Goal orientation positively influences intention to share knowledge

Effect of perceived ease of use and perceived usefulness on intention of sharing knowledge

In comparison with traditional study methods, information technology-based flipped classroom has the advantages of high efficiency and a wide range of knowledge dissemination. It

provides a platform for students to move from being passive recipients of information into major participants in knowledge acquisition.

Wu et al. (2017) has studied students' intention and behavior to share knowledge in a specific instructional setting based on a combination of personal, technological, and organizational characteristics. He observed that perceived usefulness and perceived ease of use exerted a significant positive influence on the intention of knowledge sharing, while more functional perceived usefulness significantly contributed to perceived ease of use. Knowledge sharing intention fully mediates between perceived usefulness and knowledge sharing behavior. Wahyuni et al. (2018) noted in a study of factors influencing students' intention to share knowledge within an online learning environment that learning outcomes, knowledge self-efficacy, and trust possessed positive effects on knowledge sharing among students. Nonetheless, perceived usefulness negatively affects students' intention to share knowledge in e-learning.

Thus, the hypothesizes are proposed as:

H6, Perceived ease of use positively influences intention to share knowledge

H7, Perceived usefulness positively influences intention to share knowledge

Given the relationship between variables 3.1–3.5, the following mediating hypothesizes are proposed:

H9, Perceived ease of use mediates between teacher support and intention to share knowledge

H10, Perceived ease of use mediates between interactivity and intention to share knowledge

H11, Perceived ease of use plays a mediating role between information quality and intention of knowledge sharing

H12, Perceived ease of use plays a mediating role between information quality and intention of knowledge sharing

H13, Perceived usefulness plays a mediating role between system quality and intention of knowledge sharing

H14, Perceived usefulness plays a mediating role between system quality and intention of knowledge sharing

H15, Perceived usefulness plays a mediating role between system quality and intention of knowledge sharing

H16, Perceived usefulness plays a mediating role between system quality and intention of knowledge sharing

Effect of intention to share knowledge on knowledge sharing behavior

In a study of knowledge sharing intentions and behaviors of learners in educational virtual communities, Wu et al. (2017) found that psychological ownership directly influences knowledge sharing behaviors and also affects knowledge sharing behaviors through knowledge sharing intentions. Furthermore, knowledge sharing intention exclusively mediates between perceived usefulness and knowledge sharing behavior. Also, there were significant mediating effects between perceived ease of use and knowledge sharing behavior, in addition to between psychological ownership and sharing behavior.

Thus, the hypothesis is proposed as:

H8, Knowledge sharing intention positively influences knowledge sharing behavior

Research Methodology

Research Subjects

The subjects of this study were college students with flipped classroom experience. Following the recommendation of typical courses with typical flipped classroom practice in universities by catechism platforms such as Wisdom Tree and Xue Tang Online, the QR code of the electronic questionnaire is sent to the lecturers through the questionnaire website. Subsequently, teachers send it to the students of the classes they teach in the class QQ group or WeChat group to complete. 278 valid questionnaires were obtained by eliminating invalid questionnaires with incomplete responses and almost no online learning experience.

Measurement Instruments

The questionnaire scales in the study were all adopted and referred to the mature scales developed and used by preceding scholars, and the Likert 5-point scale was utilized for the measurement of 39 question items on 9 variables involved in the study model. Teacher Support Scale was derived from a study by Limniou et al. (2018). Interactivity scale was adapted from a study by Kuo et al. (2014). The information quality and system quality question items draw on Zhou's (2019) study. Perceived usefulness and perceived ease of use are assessed with Hsieh et al.'s (2016) measurement scale for online learning systems. The intention of knowledge sharing and behavior of knowledge sharing scales draw on the scales developed by Bock & Kim (2002)

and Collins & Smith (2006). To ensure the validity and precision of the questionnaire, 50 university students who received flipped classroom teaching were selected and tested in universities before the large-scale distribution of the questionnaire, and the final questionnaire was formed by combining the pretest results with the removal of questions that were not clearly expressed semantically and prone to ambiguity.

Research Results

Descriptive analysis

In terms of gender, the percentage of male and female students were 56.4% and 43.6% respectively. Looking at the grade level, freshmen accounted for the most with 39.3%, while the remaining sophomore to senior students accounted for 13.2%, 33.8% and 13.7% respectively. Among the categories of majors, 46.7% of students in science and technology and 43.1% of students in literature and history. Art and other major categories account for a relatively small percentage of 9% and 1.2%. In terms of time spent on online learning per day, those who studied for more than 2 hours, 1.5-2 hours, 1-1.5 hours, and less than 1 hour were 19.1%, 35.7%, 40.3%, and 4.9%, respectively. Questionnaires with "none" for online study time were counted as invalid questionnaires.

Reliability

Cronbach's alpha was used to analyze the reliability of the scales. The results are shown in Table 1, and the Cronbach's α values for teacher support, interactivity, information quality, system quality, mastery goal, performance approach goal, performance avoidance goal, perceived ease of use, perceived usefulness, knowledge sharing intention, and knowledge sharing behavior ranged from 0.809 to 0.931. The results indicate that the internal consistency of the variables is high, and the scale has high reliability.

Table 1 Reliability test results

Variables	Items	Cronbach's α
Teacher support	5	0.906
Interactivity	5	0.896
Information Quality	3	0.890
System Quality	3	0.931
Mastery goal	3	0.809
Performance Approach Goal	3	0.876
Performance Avoidance Goal	4	0.815
Perceived Ease of Use	3	0.928
Perceived Usefulness	4	0.838
Knowledge Sharing Intention	3	0.931
Knowledge Sharing Behavior	3	0.832

Validity

The validity of the scale was analyzed using validated factor analysis. The fit of the measurement model was examined, and the overall measurement model fit was good. The results are $\chi^2/df=1.507$, GFI=0.857, IFI=0.958, TLI=0.951, CFI=0.957, SRMR=0.077, RMSEA=0.046. The results demonstrate that the validated factor analysis measurement model fits well.

Convergent validity

The results of the convergent validity test for each variable of the scale are shown in Table 2. The standardized estimate coefficients of each observed variable were above 0.5, the composite reliability (CR) was above 0.7, and the average variance extracted (AVE) was above 0.5, indicating that the potential variables were highly aggregated with the constituent observed variables and the scale possessed good convergent validity. Table 2 demonstrates the convergent validity test.

Table 2 Convergent Validity Test

Latent variables	Observed variables	Estimate	CR	AVE
Teacher Support	TS1	0.857	0.907	0.662
	TS2	0.771		
	TS3	0.802		
	TS4	0.844		
	TS5	0.791		
Interactivity	INT1	0.808	0.898	0.639
	INT2	0.773		
	INT3	0.860		
	INT4	0.749		
	INT5	0.803		
Information Quality	SYQ1	0.780	0.894	0.737
	SYQ2	0.895		
	SYQ3	0.896		
System Quality	INS1	0.864	0.932	0.820
	INS2	0.922		
	INS3	0.929		
Mastery Goals	AGM1	0.797	0.811	0.590
	AGM2	0.698		
	AGM3	0.805		
Performance Approach Goal	AGM4	0.890	0.878	0.705
	AGM5	0.833		
	AGM6	0.794		
Performance Avoidance Goal	AGM7	0.796	0.821	0.537
	AGM8	0.633		
	AGM9	0.679		
	AGM10	0.807		
Perceived Ease of Use	EOU1	0.876	0.930	0.815
	EOU2	0.916		
	EOU3	0.916		
Perceived Usefulness	USE1	0.773	0.839	0.567
	USE2	0.742		
	USE3	0.810		
	USE4	0.681		
Knowledge Sharing Intention	KS1	0.890	0.932	0.821
	KS2	0.942		
	KS3	0.886		
Knowledge Sharing Behavior	KS4	0.824	0.842	0.642
	KS5	0.875		
	KS6	0.694		

Differential validity

The test of differential validity between variables is mainly used to compare the correlate on coefficient with the square root of AVE. As can be found in Table 3, the correlation coefficients of each variable with the other variables are less than the square root of the AVE of the variables. This indicates that the internal correlations of the variables of this research scale are greater than the correlations with other variables, indicating a good differential validity between the scale variables.

Table 3 Differential validity

Variable	1	2	3	4	5	6	7	8	9	10	11
Teacher Support	(0.814)										
Interactivity	0.519	(0.799)									
Information Quality	0.472	0.640	(0.858)								
System Quality	0.378	0.395	0.463	(0.906)							
Mastery goals	0.561	0.499	0.494	0.420	(0.768)						
Performance Approach Goal	0.369	0.293	0.341	0.380	0.520	(0.840)					
Performance Avoidance Goal	−0.467	−0.431	−0.402	−0.354	−0.538	−0.370	(0.733)				
Perceived Ease of Use	0.512	0.551	0.552	0.471	0.456	0.311	−0.387	(0.903)			
Perceived Usefulness	0.559	0.644	0.609	0.512	0.478	0.395	−0.543	0.597	(0.753)		
Knowledge Sharing Intention	0.382	0.405	0.470	0.257	0.521	0.429	−0.470	0.483	0.545	(0.906)	
Knowledge Sharing Behavior	0.472	0.393	0.442	0.384	0.461	0.330	−0.474	0.400	0.440	0.421	(0.918)

Hypothesis test

The study employed structural equation modelling to test the influence relationship between variables and tested target orientation as a second-order variable and a first-order variable respectively.

Model 1 hypothesis test

The target orientation was included in the model as an overall second-order variable, and the overall model fit revealed by testing was good. (χ^2/df=1.593, GFI=0.844, IFI=0.948, TLI=0.942, CFI=0.947, SRMR=0.077, RMSEA=0.046). The path influence relationships between the variables are shown in Table 4.

Table 4 Model 1 path test results

	Path		Unstandardized Estimate	Standardized Estimate	S.E.	C.R.	P
Teacher Support	$\longrightarrow$	Perceived Ease of Use	0.243	0.223	0.068	3.552	***
Interactivity	$\longrightarrow$	Perceived Ease of Use	0.266	0.222	0.088	3.014	0.003
Information Quality	$\longrightarrow$	Perceived Ease of Use	0.244	0.217	0.083	2.925	0.003
System Quality	$\longrightarrow$	Perceived Ease of Use	0.199	0.198	0.058	3.419	***
Teacher Support	$\longrightarrow$	Perceived Usefulness	0.223	0.221	0.064	3.496	***
Interactivity	$\longrightarrow$	Perceived Usefulness	0.347	0.314	0.084	4.141	***
Information Quality	$\longrightarrow$	Perceived Usefulness	0.228	0.218	0.078	2.929	0.003
System Quality	$\longrightarrow$	Perceived Usefulness	0.185	0.199	0.054	3.396	***
Perceived Ease of Use	$\longrightarrow$	Knowledge Sharing Intention	0.160	0.154	0.068	2.335	0.020
Perceived Usefulness	$\longrightarrow$	Knowledge Sharing Intention	0.215	0.192	0.085	2.539	0.011
Goal Orientation	$\longrightarrow$	Knowledge Sharing Intention	0.611	0.429	0.127	4.813	***
Knowledge Sharing Intention	$\longrightarrow$	Knowledge Sharing Behavior	0.396	0.434	0.059	6.706	***

From Table 4, it is observed that teacher support (β=0.223, p<0.01) has a significant effect on perceived ease of use. Teacher support (β=0.221, p<0.01) has a significant effect on perceived usefulness, so H1a and H1b are valid. Interactivity (β=0.222, p<0.01) had a significant effect on perceived ease of use, while interactivity (β=0.314, p<0.01) has a significant effect on perceived usefulness, so H2a and H2b are valid. Information quality (β=0.217, p<0.01) has a significant effect on perceived ease of use, it, information quality (β=0.218, p<0.01), also has a significant effect on perceived usefulness, so H3a and H3b are valid. System quality (β=0.198, p<0.01) has a significant effect on perceived ease of use, and teacher support (β=0.199, p<0.01) has a significant effect on perceived usefulness, so H4a and H4b are valid. Goal orientation

(β=0.429, p<0.01) showed a significant effect on knowledge sharing intention, so H5 is valid. Perceived ease of use (β=0.154, p<0.05) has a significant effect on knowledge sharing intention, so H6 is valid. Perceived usefulness (β=0.192, p<0.05) has a significant effect on knowledge sharing intention, so H7 is valid. Knowledge sharing intention (β=0.434, p<0.01) has a significant effect on knowledge sharing behavior, so H8 is valid. The normalized path coefficient diagram for model 1 is shown in Figure 2.
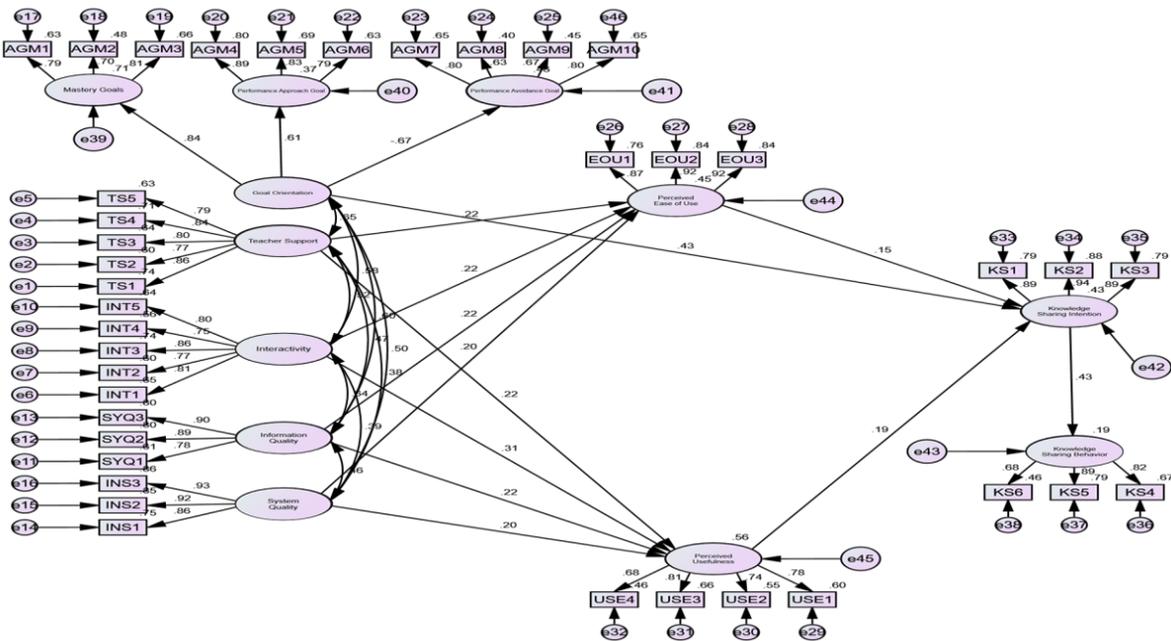

Fig. 2 Diagram of normalized path coefficients for model 1

Model 2 hypothesis testing

The target orientation was included in the model as three first–order variables, and the overall model fit was found to be good by testing. (χ^2/df=1.594, GFI=0.846, IFI=0.948, TLI=0.942, CFI=0.948 SRMR=0.075, RMSEA=0.046). The path influence relationships between the variables are shown in Table 5.

Table 5 Model 2 path test results

	Path		Unstandardized Estimate	Standardized Estimate	S.E.	C.R.	P
Teacher Support	⟶	Perceived Ease of Use	0.243	0.223	0.068	3.551	***
Interactivity	⟶	Perceived Ease of Use	0.267	0.224	0.088	3.018	0.003
Information Quality	⟶	Perceived Ease of Use	0.244	0.217	0.083	2.927	0.003
System Quality	⟶	Perceived Ease of Use	0.198	0.199	0.058	3.409	***
Teacher Support	⟶	Perceived Usefulness	0.224	0.222	0.064	3.510	***
Interactivity	⟶	Perceived Usefulness	0.349	0.316	0.084	4.164	***
Information Quality	⟶	Perceived Usefulness	0.229	0.218	0.078	2.937	0.003
System Quality	⟶	Perceived Usefulness	0.184	0.198	0.054	3.388	***
Mastery Goals	⟶	Knowledge Sharing Intention	0.228	0.190	0.098	2.338	0.019
Performance Approach Goal	⟶	Knowledge Sharing Intention	0.149	0.145	0.066	2.261	0.024
Performance Avoidance Goal	⟶	Knowledge Sharing Intention	–0.162	–0.143	0.079	–2.063	0.039
Perceived Ease of Use	⟶	Knowledge Sharing Intention	0.187	0.180	0.066	2.850	0.004
Perceived Usefulness	⟶	Knowledge Sharing Intention	0.246	0.219	0.078	3.133	0.002
Knowledge Sharing Intention	⟶	Knowledge Sharing Behavior	0.395	0.433	0.059	6.692	***

From table 5, H1–H8 still holds and mastery goal (β=0.190, p<0.01) has a significant positive effect on knowledge sharing intention. Performance approach goal (β=0.145, p<0.01) positively and significantly affects knowledge sharing intention. Performance avoidance goal (β=–0.143, p<0.01) shows a significant negative effect on knowledge sharing intention. The normalized path coefficients for model 2 are shown in Figure 3.
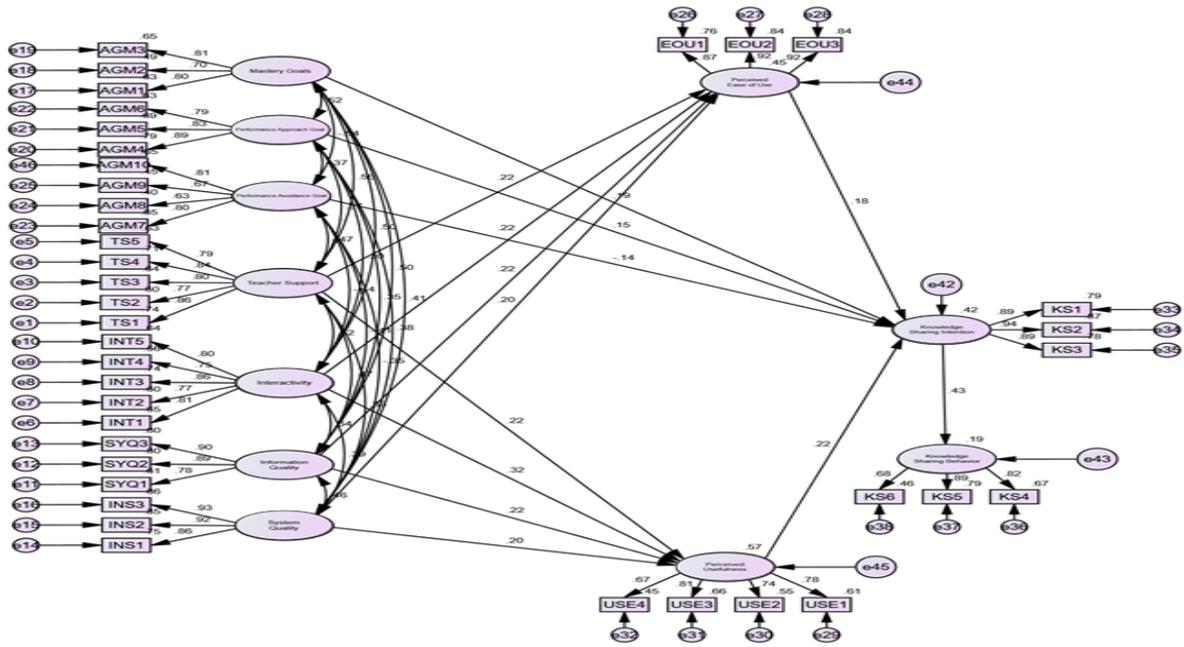
Fig. 3 Model 2 Standardized path coefficient diagram

Intermediation test

To further investigate the mediating role of perceived usefulness and perceived ease of use between teacher support, interactivity, information quality, system quality, and knowledge sharing intention. The study was validated by the Bootstrap method, and 5,000 bootstrap samples were drawn for 95% confidence interval estimation. The test results are shown in Table 6. The indirect effects of teacher support, interactivity, information quality, and system quality on knowledge sharing intention through perceived ease of use are identified in Table 6 with 95% confidence intervals that do not contain 0. The outcome illustrates that perceived ease of use mediates significantly between teacher support, interactivity, information quality, system quality, and knowledge sharing intention, so H9, H10, H11, and H12 are valid. The indirect effects of teacher support, interactivity, information quality, and system quality on knowledge sharing intention through perceived usefulness do not contain 0 at the 95% confidence interval, indicating that the mediating effect of perceived usefulness between teacher support, interactivity, information quality, system quality, and knowledge sharing intention is significant, thus H13, H14, H15, and H16 are valid.

Table 6 Results of intermediate test

Path	Effect Size	LLCI	ULCI	P
Teacher Support→Perceived Ease of Use→Knowledge Sharing Intention	0.034	0.006	0.087	0.019
Interactivity→Perceived Ease of Use→Knowledge Sharing Intention	0.034	0.004	0.087	0.022
Information Quality→Perceived Ease of Use→Knowledge Sharing Intention	0.033	0.004	0.089	0.020
System Quality→Perceived Ease of Use→Knowledge Sharing Intention	0.031	0.006	0.074	0.019
Teacher Support→Perceived Usefulness→Knowledge Sharing Intention	0.043	0.009	0.096	0.013
Interactivity→Perceived Ease of Use→Knowledge Sharing Intention	0.060	0.012	0.138	0.013
Information Quality→Perceived Usefulness→Knowledge Sharing Intention	0.042	0.006	0.109	0.016
System Quality→Perceived Usefulness→Knowledge Sharing Intention	0.038	0.008	0.088	0.012

Conclusion

The research focuses on flipped classroom students on knowledge sharing behaviors. The factors influencing knowledge sharing behavior are extracted from the TAM model based on the characteristic of the flipped classroom. The factors and mechanisms of flipped classrooms influencing students' knowledge sharing behavior are explored according to the S–O–R model.

Firstly, improving the quality of the online learning platform plays a direct role in contributing to enhancing the perception of course evaluation, which in turn influences knowledge sharing behavior. The study found that system quality and information quality of online learning positively affect perceived ease of use and perceived usefulness. Therefore, the online learning platform should upgrade the visibility and readability of the platform interface and facilitate the operation of the teaching platform in terms of smoothness, simplicity and convenience of operation and logical continuity. Next, attention should be paid to the abundance and effectiveness of teaching resources, providing high-quality online learning content to deliver more effective support for student learning. In addition, the learning platform should offer students opportunities to communicate and learn by setting up "comment boards" and "discussion forums" to create a "live" learning environment and promote knowledge sharing as well as interaction.

Secondly, improving perceived evaluation by promoting teacher support, thereby influencing knowledge sharing intentions. The study revealed that teacher support significantly and positively impacts the perceived usefulness and perceived ease of use of flipped classroom learners. Hence, teachers should improve students' evaluation of course quality in terms of course content, teaching activity design, and learning resources delivered. Teaching strategies and methods that contribute effectively to students' mastery of learning content can be useful in increasing the generation of students' intention and behavior to share by promoting perceived usefulness and ease of use.

Third, enhancing the interactive atmosphere and improving perceptual evaluation, which consequently affects knowledge sharing. An empirical demonstration of the role of teacher–student interaction and student–student interaction on students' perceived usefulness and ease of use was conducted in this study. Communication and interaction were important drivers of students' perceived usefulness of the flipped classroom, and there was also a significant positive effect on perceived ease of use. Teachers should have a real-time overview of student learning status depending on course data analysis and can establish a space for communication with students through virtual chat rooms regarding student concerns and questions. During the class, timely and targeted guidance and Q&A are given according to the key points of students' independent learning and class discussion, to enhance the effect of teacher–student interaction. In addition, teachers can set up topic discussion areas, student Q&A areas, etc., so that students can participate in Q&A with each other, strengthen student–student interaction in the form of group mutual evaluation of homework, etc., to create a favorable online and offline interactive atmosphere, and promote the knowledge sharing in an active communication atmosphere.

Finally, establishing the right goals promotes students' knowledge sharing intentions and behaviors. This study found that achievement goals positively predicted willingness to share knowledge. Where mastery tendency and achievement tendency positively affect knowledge sharing intention, performance avoidance has a negative effect on knowledge sharing intention. Therefore, teachers should stimulate students' interest in independent learning by inspiring and guiding them to take the initiative in thinking and cultivating them in improving their mastery of goal orientation and correctly appreciating the test scores. The formation of target orientation should also be circumvented by performance avoidance. Teachers should guide students to engage in learning with a positive attitude and encourage mutual communication. Students are

also expected to interact and share the course content among themselves through joint activities, with the goal of promoting the internalization of knowledge.

Suggestions

This study reveals the mechanism of students' knowledge sharing intention and behavior by integrating the technical features and characteristics of the flipped classroom teaching model, which has practical implications for improving teaching effectiveness. However, there are some shortcomings in the study, such as that the characteristics of the flipped classroom possess multiple dimensions, and the influence of other dimensions on knowledge sharing behaviors needs to be further examined. In addition, this paper focuses on the effects of achievement goal orientation, perceived usefulness, and ease of use on student knowledge sharing from an S–O–R theory perspective. Future research could explore multiple theories with more relevant factors.

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