Chen, W. et al. (Eds.) (2017). Proceedings of the 25th International Conference on Computers in Education. New Zealand: Asia-Pacific Society for Computers in Education

Teaching Influence for Perceived Usefulness of Interactive Whiteboard - Based on the Perspective of College Students

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Abstract: The application of interactive whiteboard (IWB) in classroom teaching is more and more widely. In order to provide reference for teachers' classroom teaching, we measured the perceived usefulness and its influence factor of IWB. Based on the analysis of the IWB classroom instructor characteristics, we set up the students who had had IWB class in Central China Normal University as the research object. The results show that the instruction characteristics, engagement and perceived ease of use have a significant impact on perceived usefulness.

Keyword: Interactive whiteboard; Perceived usefulness; Classroom teaching

1. Introduction

Information teaching equipment is the medium that help students acquire more information in limited area. The IWB is one of the most popular information teaching equipment. IWB is typically considered as a kind of computer connected with the projector. It enhances teaching efficiency in the classroom through sharing information beyond time and space, as well as adaptability. However, most teachers only utilize IWB at the level of displaying the powerpoint and seldom combine the teaching content with multi-form information. Therefore the functions and tools of IWB are not completely used in the teaching process.

In order to make the IWB classroom teaching more optimized, the existing studies mainly suggested the technical characteristics, teaching mode, strategy design, the analysis of teaching process, application effect, application status and so on. These studies are not enough to explore the subjective experience of the IWB teaching from the perspective of the students.

As mentioned previously, we attempted to find the factors which have influenced on perceived usefulness of IWB teaching. Based on the review of the existing literature and the teaching characteristics of the IWB, we chose four factors: students' perceived ease of use, instructor characteristics, teaching content design and student's engagement.

2. Theoretical Background

2.1 Perceived Usefulness and Perceived Ease of Use

In 1989, Davis proposed two core beliefs: perceived usefulness and perceived ease of use (Davis, 1989). Davis defines perceived usefulness as the degree to which a specific system improves performance, and defines perceived ease of use as the ease of using the system. He stressed that the external variables (system characteristics, development process, and training) affect the behavior intention through perceived usefulness and perceived ease of use. In subsequent research, different scholars continue to verify and enrich the theory of Davis's. Pituch and Lee (2006) confirmed that perceived ease of use in the online learning environment can affect perceived usefulness. Lee and Yoon (2009) used the

characteristics of teachers, teaching materials and teaching content design as external variables to influence students' online learning through perceived usefulness and perceived ease of use. This paper focuses on influencing factors for perceived usefulness and perceived ease of use of IWB teaching.

2.2 Perceived Usefulness and Instructor Characteristics

The characteristics of teachers are the degree of care, help and acceptance. Dillon and Gunawardena (1995) confirmed that the three characteristics (teachers' attitudes toward technology, teaching methods and the degree of control over technology) affect the learning outcomes of distance education. According to Webster and Hackley (1997), three teachers' characteristics (information technology ability, teaching style, attitude and thinking) are the factors that influence the success of online learning. Jepsen (2005) demonstrated that the characteristics of teachers have a significant impact on students' performance. Based on existing research, we can summarize that the whole characteristic of teacher applying IWB possibly affect the construction of students' knowledge and experience and the usage situation of IWB. Therefore, this paper assumes that teachers' characteristics can affect perceived usefulness.

2.3 Perceived Usefulness and Student Engagement

Engagement is the degree of interaction between teachers and students in the classroom teaching. From the perspective of constructivism, it is important for students to join social communication to promote the learners' understanding of knowledge and the development of advanced psychological functions. Interaction is a key factor in the success of learners, Martin and Rimm-Kaufman (2015) confirm that the interaction quality of teachers and students can affect the perceived participation. In addition, the quality of interaction can also have an impact on perceived usefulness. For example, Lin (2011) suggested that the frequency of negative critical events in communication would hinder perceived usefulness. Therefore, this paper assumes that interaction affects students' perceived usefulness.

2.4 Perceived Ease of Use and Teaching Content Design

We define learning content design as the degree of learning content teacher have designed meeting the needs of students. Lederer et al. (2000) summarized previous research and put forward that when the website content such as the pictures, tables, text is easy to understand, provide more detailed information, and accurately search the information they need, it can be predicted better perceived ease of use. Lee and Yoon (2009) continued to study and demonstrate that the design of the teaching content has impact on perceived ease of use, and he believes that online learning services will provide accurate and easy to understand learning content, which will facilitate the perceived ease of use. It indicated that the content of IWB classroom teaching according with students' cognitive level and cognitive load will improve the students' perceived ease of use. Through the above theoretical research, this paper constructs the model of this study, shown in Figure 1.

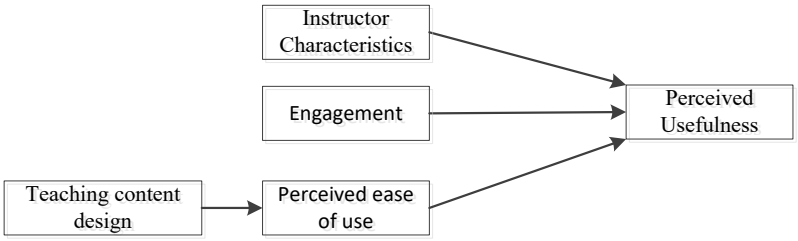

Figure 1. IWB classroom teaching research model

3. Research Methodology

We carried out an empirical study to verify whether the hypothesis is established, the research process

includes three stages, the preparation of the instrument, data collection and data analysis. A questionnaire was designed to measure the different variables. In order to ensure the content validity, the scale was based on the findings of prior studies and combined with the actual situation and characteristics of IWB classroom teaching. The scale of this study (Table 1) include the 11 observed variables and 5 potential variables, and finally the questionnaire are formed based on scale.

The final questionnaire comprised three parts. The first part is the demographic information, including gender, grade, class and professional. The second part is the scale of perceived usefulness and perceived ease of use, which is based on the study of Davis and contains two items. The third part is the scale of influence factors. It contains the scale of teaching characteristics and teaching content design. These are based on Lee and Yoon's scale, each of it including two items. The scale of engagement from Martin's research, which contains a total of three items. The quality attributes was measured using a five-point Likert scale with anchors ranging from "strongly agree" to "strongly disagree.

An empirical study was conducted at Central China Normal University. The teachers had gain training of IWB before and fundamentally use it in the classroom. They display various teaching contents according to their course requirement. So, the questionnaires were distributed to the students who have accepted the IWB classroom teaching. Because the senior students are few have lessons. We choose only freshman, sophomore and junior students investigated. Finally, 200 questionnaires were returned. The valid response rate is 91%.

Table 1: Constructs and items

Constructs	Questionnaire items
Perceived Usefulness (Davis, 1989)	
PU1	IWB enhance my learning effectively
PU2	IWB improves my learning performance
Perceived ease of use (Davis, 1989)	
PE1	On the whole, IBW is easy to use
PE2	The interaction function of IBW is clear and understandable.
Instructor Characteristics (Lee and Yoon, 2009)	
IC1	The instructor provides high-quality instruction through using IWB
IC2	The instructor delivers instructions clearly through using IWB
Teaching content design (Lee and Yoon, 2009)	
LC1	The level of difficulty of the learning contents is appropriate
LC2	The amount of learning contents is appropriate
Engagement (Martin and Rimm-Kaufman, 2015)	
ENG1	Use the IWB during classroom teaching, I am willing to share ideas with other students and study materials
ENG2	Use the double IWB classroom teaching, I am willing to carry on the classroom interaction and teacher
ENG3	In the IWB classroom teaching, I'd like to help other students solve their doubts

4. Results

4.1 Measurement Model

All of the survey participants majored in one of the six disciplines (communication, biology, information management, digital media, physics and history). 30.5% of the survey participants are boys, 69.5% girls, 37% of the survey participants are freshmen, 16% sophomores, 47% juniors. The average of the five construct is about 2.5, indicating that almost half of the students do not acceptance the IWB teaching. The average value of perceived usefulness is the 2.709, which shows that the user's perceived usefulness of IWB teaching is not very good.

SPSS version 22.0 was used to analyze the collected data. Scale validation was done using confirmatory factor analysis. The factor analysis utilized the principal component extraction method and Varimax rotation. It required that factor loadings exceed 0.40. The factor loading values of all

indicator variables are over 0.7, far exceeding 0.40.

Table 2 summarizes factor loadings, Cronbach's alpha, Composite reliability and Average variance extracted of all indicator variables. Convergent validity exists when factor loadings are greater than the threshold value of 0.50 (Hair, Black, Babin, Anderson and Tatham, 2006) and the average variance extracted (AVE) is at least 0.50 (Fornell and Larcker, 1981). As demonstrated in Table 2, the AVE values ranged from 0.553 to 0.651, thus demonstrating adequate convergent validity. As suggested by Gefen and Straub (2005), AVE is greater than the inter-construct correlations. As shown in Table 3, the AVE values were greater than the square of inter-construct correlations, thus demonstrating adequate discriminant validity. This questionnaire used the Cronbach's a coefficient to test the internal consistency among items of the same construct. According to Cuieford (1965), a Cronbach's a value that is greater than 0.7 indicates high reliability. Thus, all constructs can be considered reliable.

Table 2: Reliability and validity

Construct		Factor loading	CA	CR	AVE.
Perceived Usefulness	PU1	.813	.741	.741	.589
	PU2	.719			
Perceived ease of use	PE1	.799	.740	.769	.624
	PE2	.781			
Instructor Characteristics	IC1	.863	.772	.788	.651
	IC2	.747			
Engagement	ENG1	.809	.784	.787	.553
	ENG2	.714			
	ENG3	.703			
Teaching content design	LC1	.751	.747	.713	.554
	LC2	.738			

Notes.
CA =Cronbach's alpha; CR =Composite reliability; AVE = Average variance extracted

Table 3: Validity

	PU	PE	IC	ENG	LC
PU	.589				
PE	.257	.624			
IC	.268	.272	.651		
ENG	.414	.233	.302	.553	
LC	.348	.376	.328	.313	.554

The number of diagonal bold is AVE value, were greater than the square of Pearson's correlations

4.2 Regression Analysis of the Research Model

In this study, we tested the research model using monadic regressive analysis and multiple regression analysis. Monadic regressive analysis is the correlation between an independent variables and a dependent variable. Multiple regression analysis is the correlation analysis between two or more independent variables and a dependent variable.

4.2.1 Multiple Regression Analysis for Perceived Usefulness

Table 5 shows the findings of the multiple regression analysis used to examine how well the influence of instructor characteristics, engagement, and perceived ease of use explain students' perceived usefulness for the IWB. It can be seen from table 4 that the Durbin-Watson value is 2.005, between 1.5 and 2.5, which indicates that the independence of the samples is established, and the value of R square is about 0.478, which indicates that the research model possess moderate explanatory power. The teacher's characteristics was significantly associated with perceived usefulness ($p=.014<0.05$). The engagement was significantly associated with perceived usefulness ($p=.000<0.05$). The perceived ease of use was significantly associated with perceived usefulness ($p=.001<0.05$).

Table 4: An overview of the model

Model	R	R Square	Adjust R Square	Std. Error of the Estimate	Durbin-Watson
1	.691(a)	.478	.470	.64000	2.005

a Predictors(Constant)□Instructor Characteristics□ Engagement，Perceived ease of use

Table 5: Coefficient matrix

Model	Unstandardized Coefficients		Standardized Coefficients	t	sig
	B	Std. Error	Beta		
（Constant）	.503	.171		2.938	.004
Engagement	.495	.070	.453	7.063	.000
Instructor Characteristics	.169	.069	.163	2.470	.014
Perceived ease of use	.194	.060	.204	3.249	.001

4.2.2 Regression Analysis for Perceived Ease of Use

Table 7 shows the findings of the linear regression analysis used to examine how well the influence of design of learning contents explain students' perceived ease of use for the IWB. It can be seen from Table 6 that the Durbin-Watson value is 1.846, between 1.5 and 2.5, which indicates that the independence of the samples is established, and the value of R square is about 0.376, which indicates that the research model possess moderate explanatory power. The design of learning contents was significantly associated with perceived ease of use ($p=.000<0.05$).

Table 6: An overview of the model

Model	R	R Square	Adjust R Square	Std. Error of the Estimate	Durbin-Watson
1	.614(a)	.376	.373	.73162	1.846

a Predictors(Constant)，Teaching content design

Table 7: Coefficient matrix

Model	Unstandardized Coefficients		Standardized Coefficients	t	sig
	B	Std. Error	Beta		
（Constant）	1.143	.146		7.820	.000
Design of learning contents	.623	.057	.614	10.933	.000

5. Discussion

In this empirical study, we analyzed students' perceived usefulness of IWB teaching. First, we analyzed the relationships between the three constructs (instructor characteristics, engagement, and perceived ease of use) and the one constructs (perceived usefulness). Second, we analyzed the relationships between the design of learning contents and perceived ease of use. From the regression analysis, instructor characteristics, engagement and perceived ease of use are positively related to perceived usefulness. The teaching contents design positively affects perceived ease of use.

The teachers possessing better teaching ability will provide a clear and effective teaching, which will enhance the students' perceived usefulness of IWB teaching. Educational institutions need to provide some course to instructors and need to train them to enhance the comprehensive abilities. Design of learning contents was found to affect perceived ease of use (Pituch and Lee, 2006). In the IWB classroom, teachers transform the abstract knowledge into text, image, sound, video, 3D model

and other forms, consequently increase the students' cognition. When the content displayed through the IWB is very different from student's cognitive experience, students may think that participation is very difficulties.

And compared with the traditional teaching, students' participation in classroom can be more improved. According to the result, perceived ease of use has a direct positive impact on perceived usefulness. This results has been verified by many scholars. For example, Lin suggests that perceived ease of use of online learning services has an impact on perceived usefulness (Lin, 2011). Perceived ease of use was found to be a significant antecedent of perceived usefulness (Imamoglu, 2007).

6. Conclusion

Teachers are the main operator of IWB. Most of the previous studies explained teachers' teaching process and its influence, without examining the students' perspective. To address this research gap, a research model was developed and tested to explain students' perceived usefulness of IWB teaching.

Learners in the traditional classroom is restricted in terms of time and space, In the informatization IWB classroom, understanding and investigating the perception of students to IWB teaching and its influencing factors are of great importance. By investigating critical factors, our study attempts to fill a gap in the IWB research. Our survey results confirm the research model. Our findings indicate that instructor characteristics, engagement and perceived ease of use are the predictors of the perceived usefulness of IWB teaching. And teaching content design are the predictors of perceived ease of use.

This study contributes to theory and practice in three ways. First, it examined perceived usefulness of IWB teaching from the students' standpoint. Second, it developed a research model to gain a better understanding of students' perceived usefulness of IWB teaching. Third, a longitudinal studywas used to test the derived hypotheses.

References

Saltan, F., & Arslan, K. (2009). A new teacher tool, interactive white boards: a meta analysis. In *Society for Information Technology & Teacher Education International Conference*, 2115-2120. Association for the Advancement of Computing in Education (AACE).

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS quarterly*, 319-340.

Dillon, C. L., & Gunawardena, C. N. (1995). A framework for the evaluation of telecommunications-based distance education. *In D. Sewart (Ed.), 17th world congress of the International Council for Distance Education. Milton Keynes: UK Open University.*

Webster, J., & Hackley, P. (1997). Teaching Effectiveness in Technology-Mediated Distance Learning. *Academy of Management Journal, 40(6), 1282-1309.*

Lee, B., Yoon, J., & Lee, I. (2009). Learners' acceptance of e-learning in South Korea: Theories and results. *Computers in Education, 53(4), 1320-1329.*

Martin, D. P., & Rimmkaufman, S. E. (2015). Do student self-efficacy and teacher-student interaction quality contribute to emotional and social engagement in fifth grade math?. *Journal of School Psychology, 53(5), 359-373.*

Pituch, K., & Lee, Y. (2006). The influence of system characteristics on e-learning use. *Computers and Education, 47(2), 222–244.*

Lederer, A. L., Maupin, D. J., Sena, M. P., & Zhuang, Y. (2000). The technology acceptance model and the World Wide Web. *decision support systems, 29(3), 269-282.*

Lin, K. (2011). e-Learning continuance intention: Moderating effects of user e-learning experience. *Computers in Education, 56(2), 515-526.*

Jepsen, C. (2005). Teacher characteristics and student achievement: evidence from teacher surveys. *Journal of Urban Economics, 57(2), 302-319.Guilford, J. P. (1973). Fundamental statistics in psychology and education. British Journal of Educational Studies, 5(2).*

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18(1), 39e50.*

Gefen, D., & Straub, D. W. (2005). A practical guide to factorial validity using PLS-Graph: Tutorial and annotated example. *Communications of the Association for Information Systems, 16, 91e109.*

Imamoglu, S. Z. (2007). An empirical analysis concerning the user acceptance of e-learning. *Journal of American Academy of Business, 11(1), 132–137.*