

APPLYING THE TECHNOLOGY ACCEPTANCE MODEL AND FLOW THEORY TO ONLINE E-LEARNING USERS' ACCEPTANCE BEHAVIOR

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ABSTRACT

Streaming e-Learning systems have become widely available lately. Web-based streaming media, due to its low production cost, are generally the most popular way of providing e-learning services. However, considering the many different media formats (text, graphics, audio, video, and animations) that can be integrated into a streaming e-learning, how should a cost-effective streaming media system be implemented in the web? This study proposes an integrated theoretical framework for users' acceptance behavior on web-based streaming e-learning. This study considers the e-Learning systems user as both a system user and a learner. Constructs from information systems (Technology Acceptance Model) and Human Behavior and Psychology (Flow Theory) are tested in an integrated theoretical framework of online e-learning users' acceptance behavior. The data collected from our experiment show significant evidence in support of our hypothesis. The analytical results confirm the dual identity of the online e-learning user as a system user and a learner, since both the flow and the perceived usefulness of the e-learning system strongly predict intention to continue using e-learning. The study provides a more rounded, albeit partial, view of the online e-Learning user and significantly improves understanding of e-learning user acceptance behavior on the Web. The validated metrics should be valuable to both researchers and practitioners.

Keywords: E-learning, technology acceptance model (TAM), flow theory

INTRODUCTION

The internet enables receiving, updating and processing of information immediately worldwide. E-learning has played an important role in realizing, broadcasting and deploying the new technology and engineering through the internet. Most colleges and universities in Taiwan currently already offer Internet-based coursework. With a PC connected to the web, e-learning allows students to attend any courses from anywhere at any time. The continuous growth of the e-learning market has drawn much discussion about the user's acceptance of various e-learning methods. Among these, web-based media streaming, due to its low production cost, is usually the most popular way of providing e-learning services. However, with all the different media formats (text, graphics, audio, video, and animations) that can be integrated into a streaming-based e-learning system, how should a cost-effective web media streaming be implemented? This study proposes an integrated theoretical framework for user acceptance behavior in web-based streaming e-learning. This research framework considers the e-Learning user as both a system user and a learner. Constructs from information systems (Technology Acceptance Model) and Human Behavior, and Psychology (Flow Theory) are tested with regard to the adoption of web based streaming e-learning.

Technology Acceptance Model (TAM) appears to be the most widely accepted theory among information systems research for studying users' system acceptance behavior. Our research framework draws on TAM for its basic model and integrated with flow theory in order to predict user's acceptance behavior. The research presented here is guided and motivated by two specific questions. First, can the flow variables be integrated into the original TAM model to accurately predict individual's intentions to use the web-based media streaming e-learning system? The second research objective is to determine which combinations of media (text, graphics, audio, video, and animations) are most cost-effective for use in web-based streaming e-learning systems.

During learning, students sometimes become totally immersed in the activity to the point of losing awareness of time, surroundings and other factors except the activity itself. Csikszentmihalyi [2] used the term 'flow' to describe this optimal psychological state. An individual in "flow," concentrates entirely on an activity. Therefore, concentration is a significant measure of flow and can play a role in online learning behavior. Users only have short attention spans due to their limited time and information processing resources [5]. Therefore, concentration can be critical for efficient learning. Concentration as a measure of flow has been found to positively influence the overall experience of computer users [7] and their intention to use a system repeatedly [8]. Therefore, high concentration is expected to influence the intention to use a streaming-based e-Learning system.

The Research Model

Figure 1 shows the Research Model to be empirically tested in this study. This model was constructed to answer the research questions raised earlier and is derived from the theories described in the previous section.

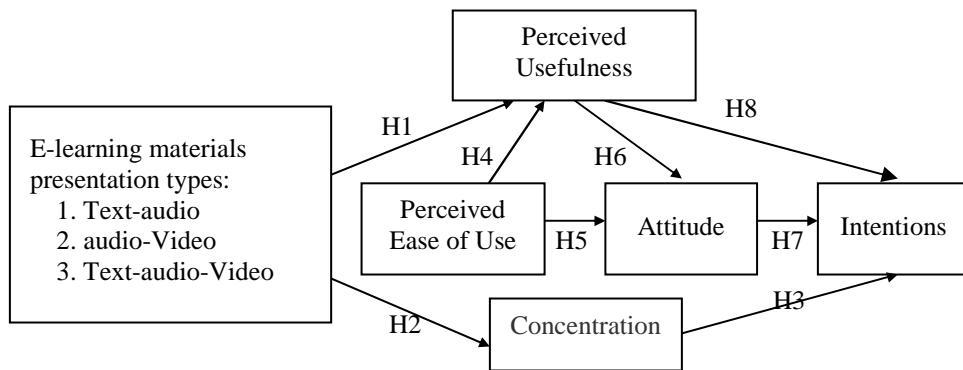


Figure 1. Research Model

Hypotheses

A series of testable hypotheses can be developed from the proposed research model, as shown below:

- H1: E-learning materials presentation types are related to perceived usefulness of the technology.
- H2: E-learning materials representation types are related to user concentration level when using this technology.

- H3: Concentration is positively correlated with intention to use the technology.
- H4: Perceived ease of use is positively associated with perceived usefulness.
- H5: Perceived ease of use is positively associated with attitude to the technology.
- H6: Perceived usefulness is positively associated with attitude to the technology.
- H7: Users' attitude to the technology is positively associated with intention to use the technology.
- H8: Users' perceived usefulness is positively associated with intention to use the technology

METHODOLOGY

This study employed a field survey to empirically test the research hypotheses. The study context, operationalization of research constructs, data analysis and results are as described below.

Characteristics of the Sample and Study Context

To test the research model, a survey was conducted on students of the MIS department at a comprehensive university. Students enrolled in several systems analysis and software development courses were the test subjects. A streaming e-Learning course on project management during software development was made available to the students. The subjects were divided into three groups through random sampling, and received a one-hour, hands-on demonstration on the streaming e-Learning systems before the course began. The subjects were asked to use the streaming-based e-Learning system during the subsequent four-week e-learning course. After completing the first section of the course, the students were asked to complete a survey to indicate their intentions about continuing usage of the streaming e-Learning system. A total of 121 surveys were distributed, with 102 usable responses being returned, making a response rate of 84%. The subjects who had finished all four sections of the course were asked to complete the questionnaire again at the end of the 4-week session, and 88 usable responses were returned, indicating a response rate of 73%.

The Experimental System

The system used in the experiments was designed explicitly for this study, and ran on a Pentium IV PC with a 15" monitor. The system was implemented as a simulated internet environment. Subjects used Internet Explorer 6 to browse the teaching materials stored in a university server. Retrieval of information, including video clips, was almost instantaneous with this configuration. The streaming e-Learning system was developed using the Wisdom Master LMS platform. Wisdom Master, which was developed by SUN NET Technology Corporation, is one of the most popular Learning Management System (LMS) platforms in Taiwan. Wisdom Master is also the first software package in Taiwan that meets the highest standard (RTE3) of SCORM 1.2. The high-resolution monitor used in this experiment allowed subjects to see clearly the facial expressions of the people in the video clips.

The experimental materials used were developed using the streaming organizer in Wisdom Master. To fully test the theory developed, several presentations that differed significantly in terms of media richness were selected. The e-learning course had three versions which applied different presentation types: text-audio, audio-video and text-audio-video. The text-audio-video-based version displayed information in real-time, full motion video, while the text-audio-based version displayed the same information (but with no video) on the system interface.

Measures

TAM variables were operationalized according to the recommendations made by Davis [4]. In his study, Davis [4] used two 10-item scales as measure of perceived usefulness and ease of use. To keep the length of the instrument reasonable, eight items were selected from his set to measure perceived usefulness, and seven were selected for perceived ease of use. Attitude was measured by a four-item scale constructed according to the guidelines provided by Ajzen and Fishbein [1], and future use intentions were measured by two items constructed following the recommendation of Davis et al. [3] with one item added according to the study context. Concentration was measured with a three-item scale adapted from Ghani et al. [6]. Participants responded to questions regarding the streaming e-learning systems by scoring a 7-point Likert-type scale with the end points being "strongly disagree" and "strongly agree."

Cronbach's alpha was calculated for each scale to ensure internal consistency among the items; scale reliabilities are reported in Table 1. All reliabilities except that for intentions were above the 0.7 level, generally considered acceptable for field research. Table 1 shows that items exhibit an acceptable level of reliability ($\alpha > 0.70$). Factor analysis to confirm the construct validity of the scales could be performed adequately. Table 2 shows the loadings for all items and indicates that the individual items had discriminant validity.

Table 1. Scale Reliabilities

Scale	Number of Items	Reliability for This Sample
Perceived Usefulness	4	0.8773
Perceived ease of use	4	0.9034
Attitude	3	0.8772
Intention	3	0.8677
Flow	3	0.8274

RESULTS AND DISCUSSION

Table 3 shows the correlations for all research variables. Data associated with perceived usefulness, perceived ease of use and concentration were analyzed using a repeated-measures ONE-WAY-ANOVA test with the independent variable. Table 4 and Table 5 report the analytical results.

Table 2. Factor Loadings for Measures of Constructs

Scale	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Perceived Usefulness	0.870				
Perceived ease of use	0.863				
	0.844				
	0.856				
Attitude		0.873			
		0.813			
		0.885			
		0.946			
Intention			0.854		
			0.937		
			0.899		
				0.905	
				0.927	

		0.834
Flow		0.814
		0.917
		0.882

Table 3. Pearson Correlation Coefficients

	Perceived Usefulness	Perceived Ease of Use	Attitude	Intention	Concentration
Perceived Usefulness	1.000				
Perceived Ease of Use	0.605**	1.000			
Attitude	0.696**	0.467**	1.000		
Intention	0.526**	0.607**	0.644**	1.000	
Concentration	0.394**	0.337**	0.390**	0.424**	1.000

** p<0.01 *p<0.05

Both the first and the final surveys had some significant differences between different presentation types in terms of perceived usefulness and concentration. The result supports our hypotheses H1 and H2. The text-audio-video presentation was found to have the highest media richness and thus always led to the highest level of perceived usefulness and concentration.

Table 4. The Impact of E-Learning Material Representation Type on Perceived Usefulness

Time	Group	Number	Means	SD	F	p-value
First experiment	Text-audio	37	4.3176	1.0210	6.462	0.002**
	Audio-video	30	4.6750	0.8463		
	Text-Audio-video	35	5.0571	0.7073		
Second experiment	Text-audio	33	3.9318	0.8392	4.888	0.010**
	Audio-video	24	3.6250	1.0860		
	Text-Audio-video	31	4.3871	0.8437		

*** P < 0.001 ** P < 0.05 * P < 0.1

The residuals were also analyzed to verify the assumptions underlying regression analysis. All assumptions were confirmed. For those tests corresponding to Hypotheses H3 – H8, the null hypotheses tested, t statistic and significance level are shown in Figure 3, as is whether the hypotheses were supported. As expected, H7 and H8 supported the statement that attitude and perceived usefulness were significant predictors of users' intentions. Hypotheses H5 and H6 were supported, indicating that user attitude was determined by the perceived usefulness and ease of use. Finally, as posited in TAM, perceived ease of use was a significant predictor of perceived usefulness (H4). The direction of all relationships was precisely as specified in TAM. Additionally, for those subjects who used text-audio-video and audio-video presentations,

participation concentration was positively associated with their intention to use streaming-based e-learning (H3).

Table 5. The Impact of E-Learning Material Representation Type on Concentration

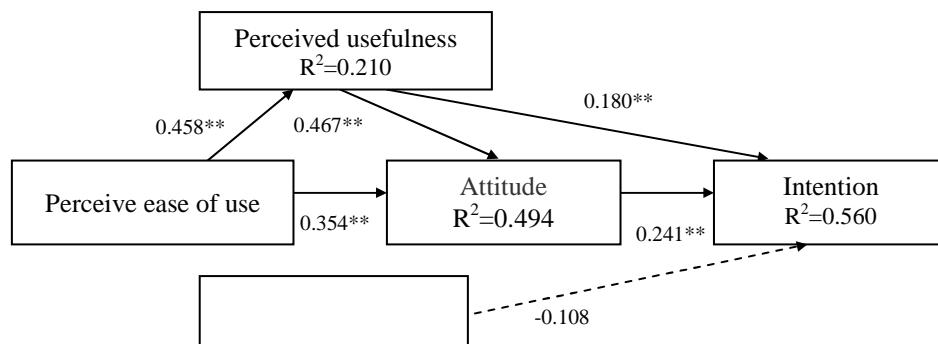
Time	Group	Number	Means	SD	F	p-value
First experiment	Text-audio	37	3.0811	1.0316	39.460	0.000***
	Audio-video	30	4.4444	1.2203		
	Text-Audio-video	35	5.0857	0.6228		
Second experiment	Text-audio	33	3.0000	1.3099	17.212	0.000***
	Audio-video	24	3.1818	1.3831		
	Text-Audio-video	31	4.6774	0.9087		

*** P < 0.001 ** P < 0.05 * P < 0.1

CONCLUSIONS

The data obtained in this study support the notion that e-learning presentation types and users' intention to continue use of the tested technology are related. User concentration and perceptions of the usefulness are both intermediate variables inside this relationship. The most media-rich presentation interface (text-audio-video based presentation) generated higher levels of perceived usefulness and concentration than text-audio and audio-video based presentations. Moreover, perceived usefulness and concentration influenced user intentions. Therefore, the study concludes that the acceptance rate of text-audio-video based presentations is high not only because of its perceived usefulness but also because it generates the highest user concentration.

Comparing different acceptance models among different presentation types reveals the importance of media richness influences on users' e-learning acceptance. In general, users' concentration (which represented users' "flow" state) tends to be positively correlated to their intention to use the technology (H3). However, the test on hypotheses H3 among subjects who used the least media-richness presentation (text-audio based presentation type) was not supported. The results here demonstrate that in addition to users' perceived usefulness, the design philosophy of media rich e-learning programs should emphasize presentations that build up users' concentration. Thus, E-learning providers should recognize their users as not only system users but also learners.



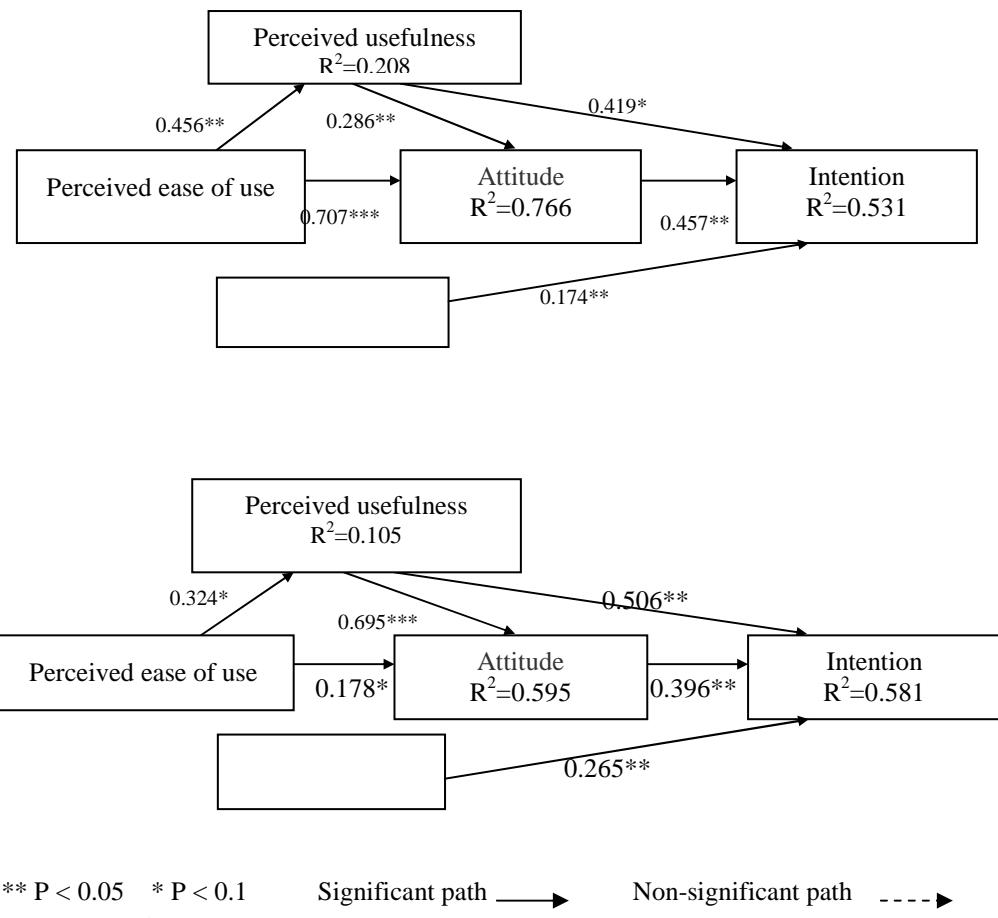


Figure 3 : Results of Model Testing

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