Understanding college students' continuing intentions to use multimedia e-learning systems (MMELS)

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ABSTRACT: With the prevalence of Internet and Web technologies, multimedia e-learning is becoming a popular method for distributing and delivering education resources. This study proposes a theoretical model to explore what factors influence college students' continuing intentions to utilise multimedia e-learning systems. To achieve this aim, a multimedia e-learning system was developed and employed in a technology university in Taiwan to support undergraduate course learning. The empirical results indicate that students show great readiness and positive intentions towards the system for their e-learning activities and thus present a possible benefit from its use in the long term. The research findings can proffer useful suggestions for multimedia e-learning practices and may serve as guidelines for the effective design of multimedia e-learning systems to enhance college students' continuing ongoing interests and activities in a virtual e-learning environment.

INTRODUCTION

Today, Internet and Web technologies as instructional tools are regarded as an alternative form of education to provide a solution for current instructional problems and create an innovative education environment. Miscellaneous multimedia e-learning systems are becoming remarkable channels for distributing and delivering education resources. Multimedia e-learning environments have grown dramatically as emerging technologies and have expanded the possibilities for communication, interaction in the multimedia environment. Various sorts of multimedia e-learning systems (MMELS) have been developed recently to integrate a variety of functions to facilitate learning.

With the mediation of MMELS, instructional delivery and communication between instructors and students can be performed synchronously or asynchronously. Such systems provide a variety of instructional aids and communication methods, and offer learners or instructors great flexibility as to time and place of instruction. As a result, e-learning systems can better accommodate the needs of learners or instructors, who are geographically dispersed or have conflicting schedules [1]. Even though the Internet is becoming a new medium for learning material delivery and skills/knowledge learning, the mechanisms e-learning are not completely understood and the relative theoretical background is not well established. That requires researchers from several disciplines to join together to clarify the factors that actually influence students continuing intentions to prolong to use MMELS, how level of each factor influences the students perceptions, as well as cause and effect in such a virtual learning environment.

As the wide spread use of multimedia e-learning courses continues to influence students all around the world, it is critical to understand the factors that improve teachers instruction and students learning. Moreover, the integration of Internet technology with on-line learning has shifted the focus from the teacher-centred classroom toward a learner-centred environment. This empowers the learners who have control over the course content and the learning process [2]. In this regard, students' continuing intentions to use MMELS needs to be carefully examined. This study contributes to the literature by identifying factors that affect students' propensities and constructed a comprehensive conceptual framework to validate the level of influence of each factor on students' intentions to use a multimedia e-learning platform.

BASIC CONCEPTS AND THEORETICAL FOUNDATION

In the virtual cyberspace, multimedia e-learning systems can provide interactivity, flexibility and repetitive exposure to materials to considerably enhance learning efficiency. These systems can be used to integrate instructional material, e-mail, live chat sessions, on-line discussions, forums, quizzes and assignments. One of the main advances brought by the integration of technology into various learning curricula is increased interaction. As for student learning in cyberspace, it is believed that the establishment of positive relationships between teachers and students plays an essential role in

fostering students' positive perceptions of the learning environment, as well as the creation of a positive on-line classroom atmosphere.

In contrast to traditional classrooms, e-learning environments can provide much more learning resource and more opportunities for interaction in various ways to complement learners' individual differences. E-learning allows learners and instructors to communicate, collaborate, and interact with one another regardless of time or physical location. Faculty members face new challenges related to the increased time spent on course presentation and the interaction with students. Students, who voluntarily take e-learning courses, usually have different needs concerning their learning situations and possess different study patterns compared to students in a conventional classroom. Therefore, a highly flexible environment would be necessary to accommodate a variety of students' needs and levels of proficiency. Studies have suggested that building flexibility into learning environments can fully support students' various learning styles, interests, and skill levels, and consequently draw forth students' positive attitude towards learning. Moreover, students have more opportunities to access learning materials repeatedly, which can translate into more opportunities for comprehension in the e-learning environment.

The Technology Acceptance Model (TAM), proposed by Davis is derived from Fishbein and Ajzen's theory of reasoned action (TRA) and was developed to predict the individual's acceptance of information technology [3]. TAM has been the most widely used model since its introduction in the 1980s. In TAM related research, motivational variables have been identified to be important determinants and predicators of users' intentions toward system usage [4]. Davis et al identified perceived usefulness to be extrinsic motivation and enjoyment to be intrinsic motivation in their study to examine the relationships between motivational variables and continuing intentions to use MMELS. Concerning e-learning environment, according to a survey conducted by Taylor and Gitsaki, students reported that the use of the Web had made the course more enjoyable which results in their willingness to continue to use the Web as a learning tool to assist the learning process [5]. Davis et al suggested that the use of technology is predicted by its perceived usefulness and ease of use [6]. Moreover, in a recent multimedia e-learning survey, Ifinedo indicated that university students experienced in a specific multimedia e-learning tool will be significantly influenced in their continuing intentions to use it [7]. Thus, it may be a reasonable conjecture that students experienced in using e-learning systems will be positively influenced toward their intentions to continue using them. Based upon the above discussions, the following plausible hypotheses are proposed:

H1: Perceived usefulness has a direct effect on students' continuing intentions to use MMELS.
H2a: Perceived ease of use has a direct effect on students' continuing intentions to use MMELS.
H2b: Perceived ease of use has a direct effect on perceived usefulness.

Venkatesh argued that users who perceive training experiences as enjoyable are more likely to perceive the system to be useful and the perceived usefulness has a positive effect on continuing intentions to use the system [8]. Yi and Hwang extended the technology acceptance model by incorporating motivational variables to predict the use of Web-based information systems and the results indicated that enjoyment has a significant effect on usefulness and ease of use [9]. Thus, the following hypothesis is proposed:

H3: Perceived enjoyment has a direct effect on perceived usefulness.

In TAM-related research, system characteristics have been examined as external variables for users' acceptance of information technology through the mediation of perceived usefulness and perceived ease of use. Davis suggested that system characteristics can be fully mediated by the TAM model on behaviour related to a systems use [10]. Igabaria et al confirmed in their study the effects of system characteristics on perceived usefulness and ease of use [11]. Based on the prior research, the following hypothesis is proposed:

H4: System characteristics have a direct effect on perceived usefulness.

Media richness theory can serve as a sound basis for grounding effects of courseware features in a multimedia e-learning context [12]. Richness theorists argue for effective communication to occur, a medium must have a capacity that allows message senders and receivers to achieve shared meaning. Failing to use a medium with the requisite level of richness implies that message recipients may experience ambiguity as a result of multiple, conflicting interpretations of a message [13]. Thus, it makes logical sense to infer that the increased use of various types of media on course Web sites may greatly enhances students' perceived ease of use of an MMELS course. Thus, the following hypothesis is proposed:

H5: Courseware features have a direct effect on perceived ease of use.

In social cognitive theory, self-efficacy is identified as the key factor in judging whether or not an individual can complete a task successfully with his/her own capabilities [14]. Self-efficacy can be achieved when the learner possess the confidence to perform certain tasks. In the context of this study, self-efficacy was interpreted as learner's self-confidence in his or her ability to learn in the e-learning environment. Venkatesh and Davis presented a model of the antecedent to perceived ease of use and the finding indicated that computer self-efficacy has a significant impact on

perceived ease of use [15]. Venkatesh further conducted three longitudinal field studies and found that computer self-efficacy serves as one of the key anchors for an individual to perceive system-specific ease of use [16]. Based on the previous studies, the following hypothesis is proposed:

H6: Self-efficacy has a direct effect on perceived ease of use.

Based upon the above discussions, this study proposed a comprehensive model as shown in Figure 1.

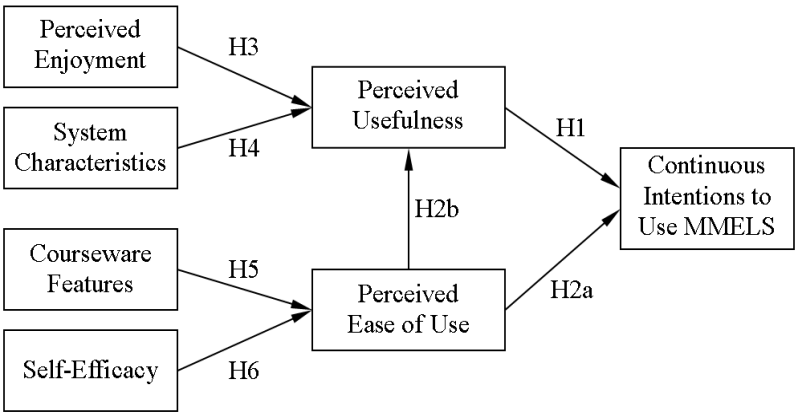

Figure 1: The conceptual framework.

RESEARCH DESIGN

A cross-sectional field survey was conducted with data collected from a technology university in Taiwan. The empirical stage of this study began with the development of relative constructs of students' continuing intentions to use the multimedia e-learning system. The generated relative measures were as broad as possible. Then, an iterative interview process was applied to refine the scales. Next, the partial least squares (PLS) method, a component-based structural equation modelling technique, was employed to structure and to validate the casual relationships in the proposed research model. By considering the tangible expected outcomes of their perceptions and intentions, the researchers expected to assess the nomological and predictive validities of the psychometric properties of these latent variables.

To develop the instrument, a number of prior relevant studies were reviewed to ensure that a comprehensive list of measures were included. All measures for each construct were taken from the previously validated instruments and modified. For instance, those for perceived usefulness, perceived ease of use, continuing intentions to use and actual use were adapted in this model from previous studies on TAM. The construct of system characteristics was derived from the study of Davis et al [4]. The measures for perceived enjoyment were captured using three items derived from Yi and Hwang [9]. The construct for courseware features was derived from the underlying conceptualisation of the research framework. The scales for self-efficacy were based on the work of Venkatesh [16]. The survey questionnaire asked each respondent to indicate his or her degree of agreement with each item. Empirical data were collected using a seven-point Likert's scale.

As mentioned previously, the initial measurement item list of relative constructs in the questionnaire was generated and an iterative personal interview process (including faculties, teaching assistants and representative students) was conducted to refine the instrument. These interviews enabled the researchers to gauge the clarity of the items presented in the survey instrument, to assess whether the instrument was capturing the desired phenomena, and to verify that important aspects had not been omitted. Changes were made and several iterations were conducted. The process was continued until no further modification was needed. Feedback served as a basis for correcting, refining and enhancing the experimental scales. Some scales were eliminated because they were found to represent essentially the same aspects as others with only slight wording differences. Some scales were modified because the semantics appeared ambiguous or irrelevant to the multimedia e-learning system of interest.

The empirical data were collected using a large scale survey administered in a well-known technology university located in the southern part of Taiwan. The subjects for this study were students, who have taken the MIS course and had experience using a multimedia e-learning platform. This MIS course is a compulsory course for all students of the business school at this technology university. Students taking the course have various majors including management information systems, business administration, information technology, healthcare management, and biotechnology. All students, who had enrolled in the course were coded and randomly selected using the administration system of the university. The randomly selected students self-administered the 25-item questionnaire after a final check to ensure that all subjects have used the MMELS. Finally, a total of 252 questionnaires out of the 668 distributed were collected, giving a response rate of 37.72 %. Thirty-eight participants gave incomplete answers and their results were dropped from the study. This left 214 sets of data for statistical analysis or a 32.03 % valid return rate. The profile of respondents is shown in Table 1.

Table 1: The profile of respondents.

Variable	Classification	Freq.	%	Variable	Classification	Freq.	%
Gender	Male	86	40%	Learning Condition	Part time	150	70%
	Female	128	60%		Full time	64	30%
Major	Information Management	60	28%	Experience of Web usage	Less than 1 Yrs	27	13%
	Business Management	65	30%		1 to3 Yrs	57	27%
	Information Technology	38	18%		3 to 6 Yrs	88	41%
	Healthcare Management	32	15%		6 to 10 Yrs	37	17%
	Biotechnology	19	9%		More than 10 Yrs	5	2%

DATA ANALYSIS AND RESULTS

Measurement Properties

The analysis of the model was performed in relation to the attributes individual item reliability, construct reliability, average variance extracted (AVE) and discriminant validity of the indicators as measures of the latent variables. The assessment of item loadings, reliability, convergent validity, and discriminant validity was performed for the latent constructs through a confirmatory factor analysis (CFA). All of the items developed and operationalised definitions of constructs were based on reviews of refereed theories, relevant literature and researches in related fields. The alpha-coefficients were used for each of the constructs in the model [17]. In order to assure the confirmatory nature of the study, the validity and reliability of the scales needed to be confirmed. As shown in Table 2, all items had significant factor loadings above 0.707, as suggested by Hair et al, and clarify 50% of explained variance, as desired [17].

Table 2: Results of confirmatory factor analysis.

Construct	Item #	Questionnaire item	Loading
Continuing intentions(CI)	CI1	I intend to constantly take full advantage of the MMELS to learn on the course.	0.96
	CI2	I intend to use the MMELS constantly to learn on the course.	0.92
Perceived usefulness (PU)	PU1	Using the MMELS would enhance my effectiveness in learning.	0.87
	PU2	Using the MMELS on the course would increase my learning productivity.	0.91
	PU3	Using the MMELS can improve my learning performance on the course.	0.89
	PU4	Using the MMELS can enable me to complete learning activities more quickly.	0.89
Perceived ease of use (PEOU)	PEOU1	Learning to operate the MMELS was easy for me.	0.81
	PEOU2	I find it was easy to get the MMELS to do whatever I want.	0.86
	PEOU3	It was easy for me to become skilful at using the MMELS.	0.85
	PEOU4	My interaction with the MMELS was clear and understandable.	0.87
	PEOU5	I find the MMELS is easy to use.	0.87
Perceived enjoyment (PE)	PE1	I find using the MMELS enjoyable.	0.95
	PE2	The actual process of using the MMELS to learn on the course is pleasant.	0.95
	PE3	I have fun in using the MMELS to learn on the course.	0.94
System characteristics (SC)	SC1	The MMELS enables interactive communications between instructors and students.	0.83
	SC2	The MMELS offers time flexibility in learning.	0.88
	SC3	The MMELS create an unrestrained cyberspace for my learning.	0.87
	SC4	The MMELS allows me control over my learning activities.	0.88
Courseware features (CF)	CF1	The courseware of MMELS allows me to practise repeatedly.	0.91
	CF2	The courseware of MMELS enables repeated exposure to the learning materials.	0.92
	CF3	The courseware of MMELS is effective (email, bulletin board, chat room, etc.).	0.87
Self-efficacy (SE)	SE1	I feel confident using MMELS even if there's no one around to help me.	0.92
	SE2	I feel confident using the MMELS even if I have only the on-line instructions.	0.90
	SE3	I feel confident using the MMELS even if I have never used the system before.	0.88

All constructs in the model exhibited good internal consistency as evidenced by their composite reliability scores. The composite reliability coefficients of all constructs in the proposed conceptual framework (Figure 2) were adequate, ranging from 0.92 for the construct of system characteristics to 0.96 for perceived enjoyment. To assess discriminant validity [18]: 1) indicators should depend more strongly on their corresponding construct than on other constructs in the model; and 2) the square root of the average variance extracted (AVE) should be larger than the inter-construct correlations.

To show discriminant validity, each construct's square root of the AVE had to be larger than its correlation with other factors. As the results in Table 3 show, all constructs met this requirement. Finally, the values for reliability are all above the suggested minimum of 0.7 [17]. Thus, all constructs display adequate reliability and discriminant validity. All

constructs share more variance with their indicators than with other constructs. Thus, the convergent and discriminant validity of all constructs in the research model are definitely assured.

Table 3: Inter-correlations among factors.

Construct	PU	PEOU	BI	PE	CF	SC	SE	Composite Reliability
Perceived usefulness (PU)	0.89							0.94
Perceived ease of use (PEOU)	0.57	0.85						0.93
Continuing intentions (CI)	0.61	0.61	0.96					0.95
Perceived enjoyment (PE)	0.68	0.57	0.78	0.95				0.96
Courseware features (CF)	0.60	0.68	0.64	0.65	0.90			0.93
System characteristics (SC)	0.63	0.60	0.62	0.65	0.86	0.87		0.92
Self-efficacy (SE)	0.54	0.76	0.60	0.62	0.63	0.62	0.90	0.93

**Diagonal elements are the square roots of AVE.*

Test of the Structural Model

The structural model was evaluated to confirm to what extent the causal relationships specified by the proposed model are consistent with the available data. PLS was again used to assess the individual-level structural model. The path coefficients and explained variances for the proposed model in this study are shown in Figure 2. T-statistics and standard errors were generated by applying the bootstrapping procedure. All of the constructs in this study were reflective as modelled and most of the constructs in the model were measured using multiple indicators, rather than summated scales. College students' perceptions on the usefulness and ease of use of the MMELS account for 47.6 % of the variance of their continuing intentions to use MMELS. Perceived enjoyment and system characteristics together explain 54.1% of the variance in perceived usefulness, while courseware features and self-efficacy explain 63.8% of the variance in perceived ease of use. As can be seen from Figure 2, PLS results provide good support for the hypotheses H1, H2a and H2b effectively drawn from the measurement of the TAM. This finding is consistent with that obtained by Davis et al [6]. Hypotheses H3, H4, H5 and H6 are also firmly supported by the significant path coefficients. That is the underlying determinants, PE, SC, CF and SE would apparently influence college students' perceptions on the usefulness and ease of use of the MMELS.

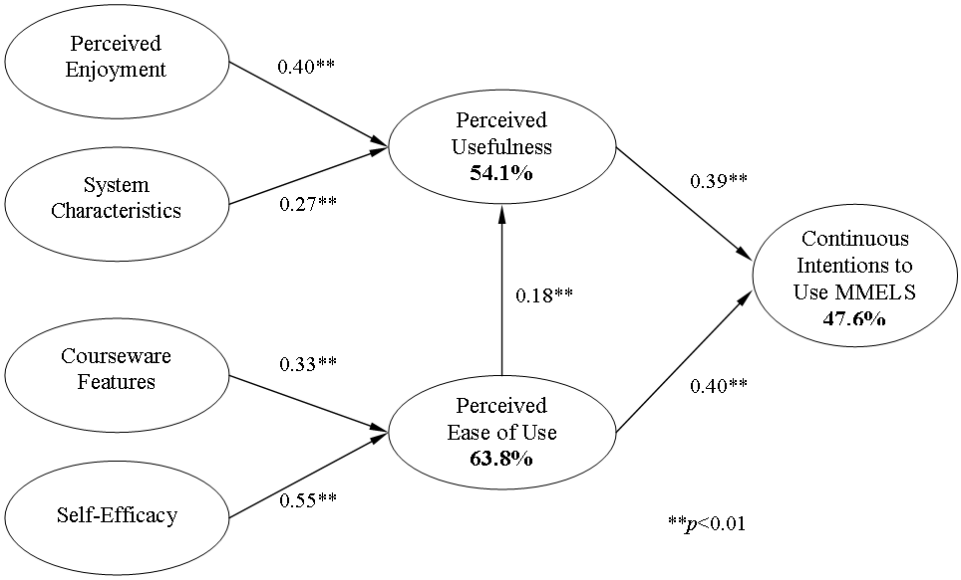

Figure 2: Partial least squares (PLS) analysis results.

DISCUSSION AND CONCLUSIONS

This empirical study was motivated by a broad interest in understanding students' behaviour intentions toward the use of MMELS. In addition, a series of follow-up interviews were conducted with ten subject matter experts including seven instructors and three system developers to justify the results. Most of these experts indicated that the research findings regarding the actual use of this multimedia e-learning system can precisely reflect the real condition in the university.

Some of the interviewees, indeed, argued that the e-learning related education sectors should find effective ways to induce students' interests and motivate students to learn on their own initiative. Six of them even suggested that universities and colleges should place emphasis on providing diverse e-learning courses to satisfy students' diverse needs. They also asserted the importance of innovation in advancing MMELS and courseware.

The results of this study demonstrate the constructs, perceived enjoyment and system characteristics significantly influence students' perceptions of the usefulness of MMELS. The constructs, courseware features and self-efficacy affect students' perceptions on the ease of use of MMELS. Perceived enjoyment and self-efficacy have the most significant direct effects on perceived usefulness and perceived ease of use. MMELS must provide joyful content and be effectively designed and implemented with care to avoid the risks of attenuating students' interests and use. Perceived ease of use was found to be another important antecedent of perceived usefulness. User-friendliness was also important for the success of e-learning and increases students' perceptions of usefulness. TAM can be extended to predict students' continuing intentions and actual use in an e-learning context.

In short, this study aimed to enrich the understanding of university/college students' continuing intentions toward MMLES usage. There is no doubt that the validation of measures or a conceptual framework concerning MMELS cannot be established on the basis of this single study. Measure validation requires the assessments of properties over a variety of samples in similar and different contexts. Future research could emphasise development of the instrument to measure students' continuing intentions to use synchronous or blended MMELS in e-learning environments. Also, more attention could be paid to understanding the antecedents and consequences of other MMELS.

ACKNOWLEDGEMENTS

The authors greatly appreciate the financial support provided by the National Science Council, Taiwan, ROC, under contract No. NSC 95-2520-S-276 -001 & NSC 97-2511-S-276-006-MY3.

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