Journal of Applied Sciences

ISSN 1812-5654

Journal of Applied Sciences 8 (22): 4079-4087, 2008
ISSN 1812-5654

An Empirical Study on Students' Acceptance of Learning Objects

[1]Siong-Hoe Lau and [2]Peter C. Woods
[1]Faculty of Information Science and Technology, Multimedia University,
Jalan Ayer Keroh Lama, 75450 Melaka, Malaysia
[2]FCM, Multimedia University, Jalan Multimedia, 63100 Cyberjaya, Selangor, Malaysia

Abstract: In this study, the Learning Object Acceptance Model (LOAM) was developed to examine the underlying factors and causal relationships that determine students' behavioral intention to use learning objects in higher education. The target population for the study consisted of undergraduate students who enrolled in Digital Systems course. Two sample data were collected via online survey instruments resulting in a total sample of 601 potential users of learning objects. This study called for the respondents in two samples to progress through two phases of learning objects participation: Introduction and Direct-use experience. Structural Equation Modeling (SEM) was used to evaluate data from the resultant surveys by using the two-step approach to model construction and testing with the computer program AMOS 4.0. The results showed that the study model produced measurement and structural models with adequate model fits. Learners' perceived of usefulness and ease of use fully mediated the relationship between learning object characteristics and behavioral intention. However, individual characteristics were found to have no statistically significance on behavioral intention in this context. This indicated that learning object characteristics were important external stimuli for learners as they formed the perception and intention to use learning objects.

Key words: Learning object, online learning, technology acceptance model, structure equation modeling, individual characteristics

INTRODUCTION

In the past decades, computer and Internet technologies offer educators and learners an innovative learning environment that can stimulate and enhance the teaching and learning process (Reader and Hammond, 1994). In an attempt to make the instructional resources more efficient and meet the diverse needs of learners, many organizations and higher education institutions around the world, have been integrated and utilized learning objects into their e-learning systems. It is an idea to decompose existing course materials into smaller (relative to the size of an entire course), self-contained and modular pieces of instructional components that can be reused a number of times in different learning contexts (Parrish, 2004). Now, this concept has gained such broad acceptance and has filtered into the fields of education. Many learning object repositories, such as Multimedia Educational Resource for Learning and Online Teaching (http://www.merlot.org/), Connexions (http://cnx.org/), Campus Alberta Repository of Educational Objects (http://careo.netera.ca/), Educational Object Economy (http://www.eoe.org) and Wisconsin Online Resource Centre (http://www.wisc-online.com) have been developed to cater for a variety of knowledge domains.

Like any information systems (Doll and Torkzadeh, 1994), the success of learning object technology also depends on user satisfaction and acceptance. A high level of user satisfaction reflects the users' willingness to accept and continue using the technology (Stokes, 2001). The measurement of the user perception (McMahon *et al*., 1999) and understand the factors that promote the effective use of systems (Yi and Hwang, 2003) become increasingly important to enhance our understanding and prediction of the acceptance and utilization of educational technologies. Thus, learners' behavioral intentions and acceptance of learning objects need to be explored.

As the Management Information Systems (MIS) discipline has much empirical research of information technology acceptance in the management area, it would be beneficial to study information technology acceptance in educational contexts by building upon the foundations in both the education and MIS areas. Several intention-

Corresponding Author: Siong-Hoe Lau, Faculty of Information Science and Technology, Multimedia University, Jalan Ayer Keroh Lama, 75450 Melaka, Malaysia Tel: +606-2523348 Fax: +606-2318840

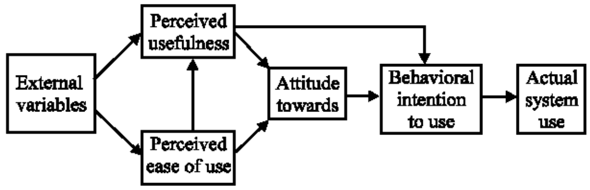

Fig. 1: Technology acceptance model

based models such as the Technology Acceptance Model (TAM) (Davis, 1989) and the Theory of Planned Behavior (TPB) (Ajzen, 1991) have been proposed and empirically tested in the last decade in understanding user adoption and usage of IT innovations. Those frameworks have been applied to a variety of information technologies in different contexts and populations (Ong *et al.*, 2004; Saade and Bahli, 2005). Among them, the TAM is one of the most influential and frequently tested models and widely applied to explain general information technology adoption in the MIS literature.

The TAM as shown in Fig. 1 is a specific model developed to explain and predict users' computer usage behavior. It predicts user acceptance based on the influence of two use beliefs: Perceived Usefulness (PU) and Perceived Ease of Use (PEU). Both PU and PEU are posited as having significant impact on a user's attitude (AT) toward using the system. Behavioral Intentions (BI) to use is jointly determined by a person's attitude toward using the system and its perceived usefulness. BI then determines the Actual Use (AU) of the system. Davis (1993) had also suggested that external factors might be important determinants in order to gain more specific information that can more accurately assess the adoption of the information systems.

The aim of this study was to examine and identify the underlying factors and hypothesized causal relationship that determined learners' behavioral intentions to adopt learning objects in higher education.

MATERIALS AND METHODS

Research model and hypotheses: The study model is formulated with the constructs and variables gleaned from the literature of education and MIS research to determine underlying factors and causal relationships in predicting learners' acceptance of learning objects. A total of five external variables from two perspectives (learning object characteristics and individual characteristics) and four constructs were identified.

Based on the review of MIS research studies, within this study framework, three learning object characteristics (technical quality, content quality and pedagogical quality) were proposed as they are considered to be important attributes for the development of digital content resources (Nesbit and Han, 2005). Technical quality refers to technical attributes, such as ease of use, turnaround time, accessibility and flexibility of the learning objects. It is an implicit expectation that is important in supporting and raising learners' confidence in learning object usability. Content quality is related to how well the content is tailored to the needs of the intended users. Learning objects should come with accurate, complete and sufficient depth of content for a particular curriculum activity in order to be meaningful. Pedagogical quality is related to whether the learning object's potential effectiveness as a teaching and learning tool fits the context(s) in which it will be used to support the learning goal that it claims. They are antecedent to perceive usefulness and perceived ease of use of learning objects. Thus, the interrelationship of learning object characteristics to perceived usefulness and perceived ease of use will be used to evaluate the beliefs learners have toward the adoption of learning objects.

Venkatesh and Davis (1996) theorized that perceptions about a new system's usefulness and ease of use are anchored on an individual's general computer self-efficacy. Thus an analysis from the learner perspective, such as user general characteristics and specific entry competencies must be conducted for the educational technology to be used effectively. Davis (1993) suggested user characteristics to be mediated by the TAM that have an impact upon behavioral intention to use. On the other hand, there have been numerous studies involving the experience and attitude-behavior relationship. Ventatesh and Davis (2000) found that experience directly and indirectly influences system usage behavior through perceived usefulness and perceived ease of use. This study posited self-efficacy and Internet/computer experience as being mediated by perception of usefulness and ease of use to influence behavioral intentions. Building upon prior related research foundations, Fig. 2 portrays the preliminary Learning Object Acceptance Model (LOAM) for this study which integrates not only the core determinants of TAM, but also two external variables was studied.

This research model involves testing four sets of hypotheses as follows:

H_1: Perceived usefulness of learning object is positively influenced by the learning object characteristics of technical quality (H_{1a}), content quality (H_{1b}) and pedagogical quality (H_{1c}), the individual characteristics of self-efficacy (H_{1d}) and Internet experience (H_{1e}) and perceived ease of use (H_{1f}).

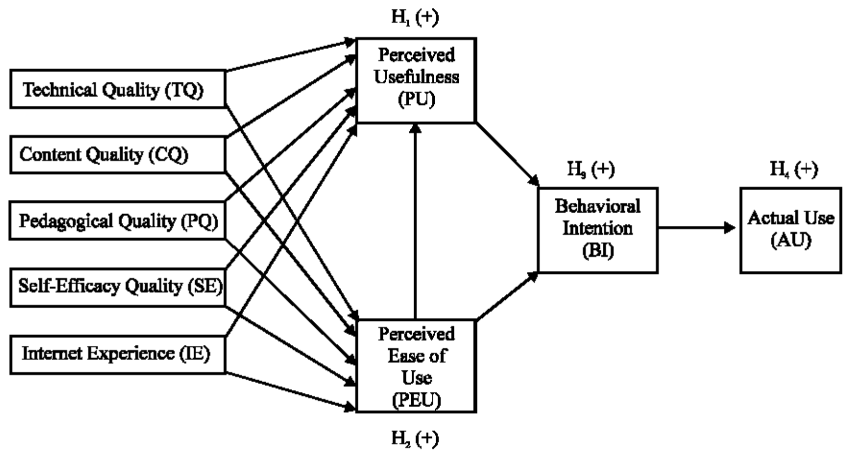

Fig. 2: Learning object acceptance model

H_2: Perceived ease of use of learning object is positively influenced by the learning object characteristics of technical quality (H_{2a}), content quality (H_{2b}) and pedagogical quality (H_{2c}) and the individual characteristics of self-efficacy (H_{2d}) and Internet experience (H_{2e}).

H_3: Behavioral intention to use learning object is positively affected by perceived usefulness (H_{3a}) and perceived ease of use (H_{3b}).

H_4: Actual use of the learning object is positively influenced by behavioral intention to use.

Research design and procedures: This study utilized a web-based survey to collect data for quantitative testing of the research model. A review of the MIS literature was used to identify existing measures for constructs, which had been used in previous research studies. The scales for SE, IE, PU, PEU, BI and AU were adapted from MIS literature studies (Compeau *et al.*, 1999; Henry and Stone, 1995; Venkatesh and Davis, 2000). However, for the learning object characteristics, no previously validated items that matched our constructs of interest were located. Therefore, items were developed based on features considered to be important for learning objects as cited in the literature (Nesbit and Han, 2005). Items were rewritten as necessary to fit the context of this study.

The target population for the study consists of undergraduate IT students who were enrolled in Faculty of Information Science and Technology (FIST), Multimedia University. This study sought experience online learning users who are familiar with web technologies in general sense and had the basic ability using online learning system, in this regard the in house develops online Multimedia Learning System (MMLS) so that they could evaluate the learning objects based on their current online learning experience. All students enrolled in Digital Systems course (sessions 2005/06 and 2006/07) agreed to participate in this study, resulting in a sample of 601 potential users of learning objects.

In this study, relevant learning objects for this course were retrieved from various general repositories (e.g., Connexions-http://cnx.org/, Multimedia Educational Resource for Learning-http://www.merlot.org/ and Online Teaching and Wisconsin Online Resource Centre-http://www.wisc-online.com), which provide higher education level learning objects. These repositories where selected for being among the few learning objects repositories that permits public access, which made the study possible. In order to produce cohesive and pedagogically sound learning materials and to effectively search for relevant learning objects, the researcher designed a generic structure of the Digital Systems course consisting of a series of electronic folders, similar to the traditional course hierarchy (chapters, lessons and topics) to hold the retrieved learning objects. Relevant learning objects were linked into the syllabus each week from the lecture notes with the aim of helping students to understand the more abstract and complex aspects of learning content.

At the beginning of the semester, e-mails were sent to the instructors to seek permission and to arrange time for their class students to participate in the study. For both samples, the instructors provided a brief in-class introduction to learning objects, describing the benefits of learning objects and their relevance to the curriculum. Following a demonstration of learning objects session, respondents completed the first survey which consists of the demographics questionnaires. After 12 weeks, the second survey questionnaire was conducted to evaluate their post-usage of learning objects. Responses from the two surveys for sample 1 and sample 2 were matched to create a single record for each respondent.

DATA ANALYSIS AND RESULTS

For data analysis, the two-step approach to model construction and testing was adapted (Gerbing and Anderson, 1988), by using the computer program AMOS 4.0. Sample 1 was used to derive a final structural model while sample 2 was used to further ensure the consistency of the structural model from sample 1.

Demographic data: In all, 660 respondents participated in the study. There were 312 respondents from a total of 342 students in Sample 1 with a response rate of 91.2% and 289 respondents from a total of 318 students in sample 2 with a response rate of 90.8%. Of the 660 students, a total of 601 respondents completed the surveys with a response rate of 91.1%. Majority of the respondents have 2 to 4 years of computer experiences and spend about 2 to 4 h on the Internet everyday.

The measurement model: The analysis of the measurement model was to refine the LOAM by eliminating measured variables or latent constructs that did not fit in well with the initial Confirmatory Factor Analysis (CFA) using Sample 1 observations. The overall fit for the initial measurement model as presented in Table 1 was reasonable fit. All the fit criteria were within the acceptance level except Goodness of Fix Index (GFI) (0.873) which was below the 0.90 acceptance level. Based on the standardized residuals and modification indices, the initial measurement model could be further improved.

As a result, the final measurement model indicated a good model fit. The ratio of Chi-square statistics and its degree of freedom (χ^2/df) (1.030) measure was less than 3.0, the Root Mean Squared Error of Approximation (RMSEA) (0.010) was less than 0.05 indicating a close fit, the Goodness of Fix Index (GFI) (0.919), Normed Fit Index (NFI) (0.963) and Comparative Fit Index (CFI) (0.999) were all above the 0.90 acceptable levels and the Adjusted Goodness of Fix Index (AGFI) (0.900) was also above its 0.80 threshold value. In summary, results from the final measurement model showed a good fit.

The next step assessed the reliability and validity of constructs and indicators. Convergent validity of scale items was assessed using three criteria (reliability, composite reliability and average variance extracted) as recommended by Fornell and Larcker (1981). The standardized CFA loadings for all scale items exceeded the minimum loading criterion of 0.70. Furthermore, the composite reliabilities of all factors also exceeded the required minimum of 0.80. The average variance extracted values of all constructs exceeded the threshold value of 0.50. Hence all three conditions for convergent validity were met as shown in Table 2.

For discriminant validity testing, this was obtained by comparing the square roots of the average variances extracted from each latent construct with the correlations between factors (Segars and Grover, 1998). As shown in Table 3, all the square roots of the average variances extracted were greater than the correlations between factors. Hence the discriminant validity criterion was also met for CFA models, giving further confidence in the adequacy of the measurement scales. The results of the confirmatory factor analysis indicated that the best fitting measurement model was acceptable. Therefore, the derived measurement model was incorporated into the structural equation model analysis with latent variables.

The structural model: Building upon the best fitting measurement model, a path analysis for the Structure Equation Model (SEM) with latent variables was performed to evaluate the hypothesized causal relationships that predict learners' behavioral intention to use and actual use of learning objects. As shown in Table 4, this initial SEM model indicated a reasonable fit to the data with χ^2/df = 1.957, RMSEA = 0.055, GFI = 0.854, AGFI = 0.830, NFI = 0.926 and CFI = 0.962. Further inspection of the modification indices suggested the addition of three correlation paths for technical quality, content quality and pedagogical quality. We respecified the initial SEM model. As a result, the initial SEM model after modification performed satisfactorily with GFI, NFI and CFI exceeding 0.90 and AGFI of 0.899. The values of RMSEA and χ^2/df were within acceptable thresholds.

Table 1: Measurement model fit comparison

Model	χ^2	df	χ^2/df < 3.0[a]	RMSEA < 0.08[a]	GFI >0.90[a]	AGFI >0.80[a]	NFI >0.90[a]	CFI >0.90[a]
Initial CFA Model	1014.599	783	1.296	0.031	0.873	0.854	0.942	0.986
Final CFA Model	472.9580	459	1.030	0.010	0.919	0.900	0.963	0.999

N = 312, [a]: Recommended values

Table 2: Convergent validity for best fitting measurement model

Constructs/ factors	Indicators	Standardized loadings (> 0.707)	Reliability (R^2) (> 0.50)	Composite reliability (> 0.70)	Average variance extracted (> 0.50)
Actual use	AU1	0.932	0.869	0.952	0.868
	AU2	0.917	0.842		
	AU3	0.945	0.892		
Behavioral intention	BI1	0.927	0.859	0.959	0.887
	BI2	0.964	0.930		
	BI3	0.934	0.872		
Perceived usefulness	PU1	0.812	0.661	0.927	0.762
	PU2	0.876	0.769		
	PU5	0.905	0.821		
	PU6	0.891	0.795		
Perceived ease of use	PEU2	0.895	0.801	0.928	0.763
	PEU3	0.847	0.719		
	PEU4	0.864	0.747		
	PEU6	0.885	0.786		
Technical quality	TQINT	0.947	0.897	0.965	0.875
	TQFLX	0.952	0.906		
	TQFOC	0.936	0.877		
	TQTAT	0.904	0.818		
Content quality	CQUS	0.931	0.866	0.970	0.890
	CQCOM	0.944	0.890		
	CQTL	0.932	0.868		
	CQVOC	0.967	0.936		
Pedagogical quality	PQCOH	0.934	0.873	0.965	0.874
	PQFOP	0.949	0.900		
	PQLC	0.932	0.868		
	PQPR	0.924	0.854		
Self-efficacy	SE1	0.952	0.906	0.951	0.831
	SE3	0.942	0.887		
	SE4	0.808	0.652		
	SE6	0.936	0.877		
Internet experience	IE1	0.910	0.835	0.933	0.822
	IE2	0.897	0.804		
	IE3	0.914	0.827		

Table 3: Inter constructs correlations

Construct	1	2	3	4	5	6	7	8	9
Actual use	**0.931**								
Internet experience	-0.006	**0.907**							
Behavioral intention	0.544	-0.012	**0.942**						
Self-efficacy	0.016	0.000	0.030	**0.912**					
Perceived ease of use	0.345	-0.022	0.635	0.050	**0.873**				
Perceived usefulness	0.405	-0.012	0.744	0.033	0.710	**0.873**			
Pedagogical quality	0.308	0.000	0.566	0.000	0.644	0.723	**0.935**		
Content quality	0.305	0.000	0.560	0.000	0.740	0.678	0.680	**0.943**	
Technical quality	0.297	0.000	0.546	0.000	0.745	0.652	0.661	0.753	**0.935**

Diagonals represent the square roots of average variances extracted and the other matrix entries are the factor correlations

Table 4: Structural model fit comparison-between initial and final SEM model

Model	χ^2	df	χ^2/df < 3.0[a]	RMSEA < 0.08[a]	GFI > 0.90[a]	AGFI > 0.80[a]	NFI > 0.90[a]	CFI > 0.90[a]
Initial SEM model	941.308	481	1.957	0.055	0.854	0.830	0.926	0.962
Final SEM model	496.731	478	1.039	0.011	0.914	0.899	0.961	0.998

N = 312, [a]: Recommended values

Finally, in order to test the consistency of the structural model in predicting the adoption of learning object, the final SEM model was tested using sample 2 data collected from learners who underwent a similar process. Application of the final SEM model to the 289 subjects in sample 2 generated acceptable fit indices (χ^2/df = 1.151, RMSEA = 0.023, GFI = 0.900, NFI = 0.958, CFI = 0.994, AGFI = 0.883) as shown in Table 5. The same significant paths were once again significant and the non-significant paths remained non-significant. This result provided further evidence of the consistency of the final SEM model.

Hypotheses testing: The proposed LOAM hypothesized fourteen relationships. The results of the analysis of the final structural model, including standardized direct (path coefficients), indirect, total effects, path significances and variance explained (R^2-values) for each dependent

Table 5: Comparison of fit indices for sample 1 and 2

Sample	N	χ^2	df	χ^2/df < 3.0[a]	RMSEA < 0.08[a]	GFI > 0.90[a]	AGFI > 0.80[a]	NFI > 0.90[a]	CFI > 0.90[a]
Sample 1	312	496.731	478	1.039	0.011	0.914	0.899	0.961	0.998
Sample 2	289	550.205	478	1.151	0.023	0.900	0.883	0.958	0.994

[a]: Recommended values

Table 6: Standardized causal effects for the final structural model

Endogenous variables	Determinant	Standardized causal effects Direct	Indirect	Total	Results
Perceived Usefulness (R^2 = 0.638)	H_{1a}: Technical quality	0.089	0.132	0.221	Not supported
	H_{1b}: Content quality	0.089	0.123	0.212	Not Supported
	H_{1c}: Pedagogy quality	**0.374***	**0.052**	**0.426**	**Supported**
	H_{1d}: Self-efficacy	0.014	0.017	0.032	Not supported
	H_{1e}: Internet experience	0.002	-0.007	-0.005	Not supported
	H_{1f}: Perceived ease of use	**0.347***		**0.347**	**Supported**
Perceived ease of use (R^2 = 0.653)	**H_{2a}: Technical quality**	**0.381***		**0.381**	**Supported**
	H_{2b}: Content quality	**0.355***		**0.355**	**Supported**
	H_{2c}: Pedagogy quality	**0.151****		**0.151**	**Supported**
	H_{2d}: Self-efficacy	0.050		0.050	Not supported
	H_{2e}: Internet experience	-0.020		-0.020	Not supported
Behavioral intention (R^2 = 0.557)	**H_{3a}: Perceived ease of use**	**0.228***	**0.196**	**0.424**	**Supported**
	H_{3b}: Perceived usefulness	**0.564***		**0.564**	**Supported**
	Technical quality		0.212	0.212	
	Content quality		0.201	0.201	
	Pedagogy quality		0.275	0.275	
	Self-efficacy		0.029	0.029	
	Internet experience		-0.007	-0.007	
Actual Use (R^2 = 0.296)	**H_4: Behavioral intention**	**0.544***		**0.544**	**Supported**
	Perceived usefulness		0.307	0.307	
	Perceived was of use		0.231	0.231	
	Technical quality		0.115	0.115	
	Content quality		0.109	0.109	
	Pedagogy quality		0.150	0.150	
	Self-efficacy		0.016	0.016	
	Internet experience		-0.004	-0.004	

N = 312, *p< 0.001, **p<0 01

variable are shown in Table 6. Overall, none of the individual characteristics variables had significant effect on the users' beliefs. However, all of the remaining hypothesized effects were positive and statistically significant, indicating that the three learning objects characteristics and two users' beliefs were important determinants, more so than the individual characteristics.

Starting from the perceived usefulness of learning objects, pedagogical quality (β = 0.374, p<0.001) had significant positive effects on it. The total effect of this determinant on perceived usefulness was 0.426, primarily due to its significant direct effects. As expected, perceived ease of use had significant positive effects on perceived usefulness (β = 0.347, p<0.001). These determinants explained about 64% of the variance of perceived usefulness of learning objects. Therefore, hypotheses H_{1c} and H_{1f} were supported. The total effects of self-efficacy, Internet experience technical quality and content quality were insignificant.

As to perceived ease of use, the major determinant of perceives ease of use was technical quality (β = 0.381, p<0.001), followed by content quality (β = 0.355, p<0.001) and pedagogical quality (β = 0.151, p<0.01). All total effects were statistically positive significant and solely due to direct effects. The total effect of self-efficacy and Internet experience were insignificant. Therefore, hypothesized H_{2a}, H_{2b} and H_{2c} were supported. These determinants accounted for approximately 65% of the variance of perceived ease of use.

With regard to behavioral intention to use learning objects, about 58% of the variance in behavioral intention could be explained by perceived ease of use (β = 0.228, p<0.01) and perceived usefulness (β = 0.564, p<0.001). The major determinant was perceived usefulness with a total effect of 0.564, solely due to the direct effect followed by perceived ease of use with a total effect of 0.424, mainly due to direct effect (0.228) and partly due to indirect effect (0.196). Therefore, hypotheses H_{3a} and H_{3b} were supported.

Finally, behavioral intention to use had a significant positive effect on actual use (β = 0.544, p<0.001). Therefore, hypotheses H_4 was supported. The model accounted for approximately 30% of the variance of actual use of learning objects.

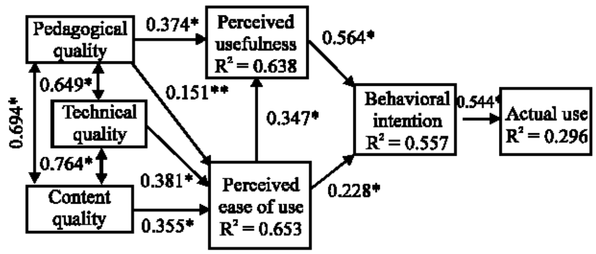

Fig. 3: Revised LOAM; *p<0.001, **p<0.01

The proposed Learning Object Adoption Model (LOAM) hypothesized fourteen relationships. Most of the parameter estimates exhibit correct signs, appropriate standard errors and significant critical ratios. The paths between IE/PEU, SE/PEU, TQ/PU, CQ/PU, IE/PU and SE/PU were insignificant across all data sets. Given that the model behaved consistently between data sets, all insignificant six paths (IE/PEU, SE/PEU, TQ/PU, CQ/PU, IE/PU and SE/PU) dropped and two constructs (IE and SE) deleted. The remaining coefficients were all significant. The revised LOAM is shown in Fig. 3.

DISCUSSION

A test of the proposed model indicated that the learning objects characteristics had significant effect on the users' belief constructs which, was consistent with the influence of more general system characteristics reported in studies of other information technologies (Jackson *et al*., 1997). On the other hand, individual characteristics were found to have no significant effect on users' belief constructs.

After taking into account the learning object characteristics and users' beliefs, individual characteristics (Internet experience and self-efficacy) was found to have no statistically significant causal relationships on the belief constructs and behavioral intention. This means that individual with computer efficacy and Internet experiences do not guarantee the usage of learning objects. This is especially true for learning objects where the contents are the essence and the technical and pedagogy aspects play supportive roles in promoting the use of learning objects. Thus, educators and instructional designers of learning objects should ensure the compatibility between learning objects and users' needs in order to enhance learning objects' adoption for individual learning.

The importance of the learning objects characteristics and user's beliefs in influencing the behavioral intention and actual use of learning objects have several implications for researchers and practitioners. First, it highlights the importance of attending to learning objects characteristics, especially in usefulness and ease of use when learning objects are designed and developed. Thus, educators and instructional designers of learning objects should carefully consider the needs and values of learning object users. For example, learners who perceived that the learning objects had better turnaround time and flexible which allowed for a better feeling of control over course content would indicated that the learning objects were easier to use. Moreover, learners who indicated that the learning objects fitted in with their learning contexts with comprehensive, up-to-date, easy to comprehend contents together with appropriate pedagogy features to support their learning goals helped them to become committed towards the learning.

Thought should be given to the functionality of the learning objects and any interactions to be used should be carefully designed as the interactivity is influenced by the degree of the availability of learners' control (Robertson, 1998; Stoney and Wild, 1998) as well as the availability of the functional features that encourage users to actively learn. Several recommendations serve as useful guidelines for the design of learning objects which stem from the research literature and study cited above, supplemented by the personal experience of the researchers are described here.

Learners' control: Learners' control plays an important part in creating a learning environment to fulfill students' needs. By giving learners greater control over various aspects of instruction, such as pacing and sequencing, they can tailor the instructions to their own style of learning, thereby enhancing the efficacy and efficiency of learning. The following recommendations may provide greater freedom and should motivate students, thus enhancing learning even more.

- **Sequence control:** Learning objects should have the ability for non-linear instruction which allow users to branch off and explore different content through links may be used to foster control of sequence such as to skip and revisit topics.
- **Content control:** Learning objects should provide learners with the opportunity to control over the learning activities they wish to explore such as viewing content, examples and practicing problems.
- **Pace control:** Learning objects should allow learners to cover the learning content and activities at the level that they are comfortable with (e.g., slower, faster or take a break and return at a later date or time).

Graphics and animations: Students are particularly receptive to non-textual elements such as graphics and animations because these can motivate them to focus and help recall information to assist in the development of the learning concept (Rieber, 1996). Rieber (1996) also pointed that students under animation-based instruction required less time to retrieve the information they learned. The following recommendations may encourage students to make appropriate use of learning objects:

- Analyze the relevance of graphics or animations to the particular learning objectives. It is important that they should be used for instructional and motivational purposes to achieve the learning outcome.
- Maintain a balance between text and graphical information to avoid overloading the learners' working memory. When graphics are used, there should be a text alternative to the image to enable the student to relate the two simultaneous representations. But text-intensive content should be avoided to overcome the split attention effect as suggested by Kalyuga *et al.* (2000).
- Complex animations may not be optimal for beginners (Rieber, 1996). It is better to opt for graphics or animations which are simpler in design to provide learners with experience of each of the learning components separately before presenting an entire interactive complex concept.

Audio assets: Three types of audio assets commonly used are music, narration voice-overs and sound effects. They can be used for both effects and information and together with print to form a useful alternative and aid to reading alone. The following recommendations are seen as important and may encourage students to make appropriate use of learning objects:

- Audio assets can be toggled on and off with ability for user to control the volume.
- Narration voice-overs must occur simultaneously with the relevant animation and accessible transcripts should always be provided in conjunction with audio or animations. All the key steps in the learning activities should be emphasized by speaking important words or phrases in a louder and deeper voice to direct the attention of the learner.
- Audio effects should be free from extraneous information (e.g., background noise) which can distract some groups of learners and impede their learning.

Feedback: Feedback has been shown to play an important role in the students' learning. In general, instructional feedbacks provide information to students about the correctness of their learning activities. Because of the importance of feedback in online environments, the following recommendations will increase the effectiveness of learning objects:

- Learning object should design with feedback to explain what makes the right answer correct and what's wrong about the learner's answer in order to lead to more meaningful learning for completing the assignments (Moreno and Mayer, 2005).
- The feedback should focus on improving the skills needed to achieve the learning objectives.

CONCLUSION

Given the increasing use of learning objects, a better understanding and implementation of effective learning objects will enhance the use and educational value of such educational technology. This study contributes to the understanding of user acceptance of learning objects by identify the underlying factors and causal relationships that predicted learners' behavioral intention and subsequent actual use of learning objects. The proposed study model, LOAM demonstrated that the learning objects characteristics (pedagogical quality, technical quality and content quality) were all important determinants of users' belief constructs. Specific characteristics of the learners (self-efficacy and Internet experience) had no influence upon users' belief constructs. This indicated that learning object characteristics were important external stimuli for learners as they formed the perception and intention to use learning objects. This study provides new insight on the determinants of perceptions and user acceptance of learning objects. However, it is merely a stepping stone in the realm of learning object diffusion; no single research is conclusive of facts. More studies in the future are needed to verify and refine the findings of this study to expand the knowledge base on important determinants of learning objects use that will assist educators to understand the factors leading to an effective and efficient adoption of learning objects.

REFERENCES

Ajzen, I., 1991. The theory of planned behavior. Organ. Behav. Hum. Decision Processes, 50: 179-211.

Compeau, D.R., C.A. Higgins and S. Huff, 1999. Social cognitive theory and individual reactions to computing technology: A longitudinal study. MIS Q., 23: 145-158.

Davis, F.D., 1989. Perceived usefulness, perceived ease of use and user acceptance of information technology. MIS. Q., 13: 318-340.

Davis, F.D., 1993. User acceptance of information technology: System characteristics, user perceptions and behavioral impacts. Int. J. Man Mach. Stud., 38: 475-487.

Doll, W.X. and G. Torkzadeh, 1992. A confirmatory factor analysis of the end-user computer satisfaction instrument. MIS. Q., 18: 453-461.

Fornell, C. and D.F. Larcker, 1981. Evaluating structural equation models with unobservable variables and measurement error. J. Mar. Res., 18: 39-50.

Gerbing, D.W. and J.C. Anderson, 1988. An updated paradigm for scale development incorporating unidimensionality and its assessment. J. Market. Res., 25: 186-192.

Henry, J.W. and R.W. Stone, 1995. Computer self-efficacy and outcome expectancy: The effects on the end-user's job satisfaction. SIGCPR Comput. Pers., 16: 15-34.

Jackson, C.M., S. Chow and R.A. Leitch, 1997. Towards an understanding of the behavioral intention to use an information system. Decision Sci., 28: 357-389.

Kalyuga, S., P. Chandler and J. Sweller, 2000. Incorporating learner experience into the design of multimedia instruction. J. Edu. Psychol., 92: 126-136.

McMahon, J., J. Gardner, C. Gray and G. Mulhern, 1999. Barriers to student computer usage: Staff and student perceptions. J. Comput. Assisted Learn., 15: 302-311.

Moreno, R. and R.E. Mayer, 2005. Role of guidance, reflection and interactivity in an agent-based multimedia game. J. Edu. Psychol., 97: 117-128.

Nesbit, J. and K. Han, 2005. Rating learning object quality with distributed bayesian belief networks: The why and the how. Proceedings of the 5th IEEE International Conference on Advanced Learning Technologies. July 05-08, ICALT. IEEE Computer Society, Washington, DC, pp: 685-687.

Ong, C.S., J.Y. Lai and Y.S. Wang, 2004. Factors affecting engineers acceptance of asynchronous e-learning systems in high-tech companies. Inform. Manage., 41: 795-804.

Parrish, P., 2004. The trouble with learning objects. Edu. Technol. Res. Dev., 52: 49-67.

Reader, W. and N. Hammond, 1994. Computer-based tools to support learning from hypertext: Concept mapping tools and beyond. Comput. Edu., 22: 99-106.

Rieber, L.P., 1996. Seriously considering play: Designing interactive learning environments based on the blending of microworlds, simulations and games. Edu. Technol. Res. Dev., 44: 43-58.

Robertson, J., 1998. Paradise lost: Children multimedia and the myth of interactivity. J. Comput. Assisted Learn., 14: 31-39.

Saade, R. and B. Bahli, 2005. The impact of cognitive absorption on perceived usefulness and perceived ease of use in on-line learning: an extension of the technology acceptance model. Inform. Manage., 42: 317-327.

Segars, A.H. and V. Grover, 1998. Strategic information systems planning success: An investigation of the construct and its measurement. MIS. Q., 22: 139-163.

Stokes, S.P., 2001. Satisfaction of college students with the digital learning environment: Do learners' temperaments make a difference?. Internet Higher Edu., 4: 31-44.

Stoney, S. and Mild, 1998. Motivation and interface design: Maximizing learning opportunities. J. Comput. Assisted Learn., 14: 40-50.

Venkatesh, V. and F.D. Davis, 1996. A model of the antecedents of perceived ease of use: Development and test. Decision Sci., 27: 451-481.

Venkatesh, V. and F.D. Davis, 2000. A theoretical extension of the technology acceptance model: Four longitudinal field studies. Manage. Sci., 46: 186-204.

Yi, M.Y. and Y. Hwang, 2003. Predicting the use of web-based Information systems: Self-efficacy, enjoyment, learning goal orientation and the technology acceptance model. Int. J. Hum. Comput. Stud., 59: 431-449.