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Impact of media richness and flow on e-learning technology acceptance

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ABSTRACT

Advances in e-learning technologies parallels a general increase in sophistication by computer users. The use of just one theory or model, such as the technology acceptance model, is no longer sufficient to study the intended use of e-learning systems. Rather, a combination of theories must be integrated in order to fully capture the complexity of e-learners, who are both system users and learners. The current research presents an integrated theoretical framework to study users' acceptance of streaming media for e-learning. Three streams of research provide the basis for this integrated framework: the technology acceptance model, flow theory and media richness theory. Students enrolled in an online section of an information systems course used one of three different combinations of text, streamed audio and streamed video. Regression analysis was used to test the hypotheses in this field experiment. Perceived ease of use was a predictor of perceived usefulness; both the perceived usefulness and the attitude of the user were predictors of intention to use. Richer content-presentation types were positively correlated with higher concentration levels but showed mixed results when correlated with perceived usefulness. Results from this study have practical implications for those interested in integrating streaming media into e-learning.

1. Introduction

The rapid development of information and communication technologies has led to its increased use in instruction and learning (Cappel & Hayen, 2004; Kim & Ong, 2005). International Data Corporation (IDC) estimates that the value of the e-learning market worth will be between $21 billion and $28 billion by 2008 (Brown, 2006). IDC states that the revenue from synchronous e-learning exceeded $5 billion by 2006 (Mackay & Stockport, 2006). The continuous growth of the e-learning market stimulated discussion regarding effective e-learning methodology, including choice of media. A relatively new e-learning media is 'streaming' media. Streaming media is considered an effective method for providing e-learning, because 'streaming' enables large files (e.g. audio or video) to begin playing before the entire file has been downloaded, thus creating a more interactive learning environment.

Various combinations of text, graphics, audio, video and animations can be integrated into an e-learning system. Media selection can be a critical issue because of the increased costs of developing non-textual e-learning materials (Sun & Cheng, 2007; Timmerman & Kruepke, 2006). For example, the development time (and therefore costs) for e-learning streaming media can take up to five times the development time for a lecture (Weiser & Wilson, 1999). Few previous studies proposed that multimedia presentation influenced perceived usefulness. More research is necessary to determine the relationship between specific media-presentation types and acceptance behaviour.

This research is designed to determine the influence of different media on a user's acceptance of e-learning and to assess the influence of user concentration on acceptance of e-learning. User concentration positively influences the overall experience of online shoppers (Novak, Hoffman, & Yung, 2000; Webster, Trevino, & Ryan, 1993), thereby creating a compelling environment to which to return. Extended research is necessary to determine a similar relationship between user concentration and acceptance behaviour in an e-learning environment.

This study proposes an integrated theoretical framework for the user's acceptance behaviour of web-based streaming media for e-learning. This research framework considers the e-learning user as both a system user and a learner. Concepts from information systems (technology acceptance model – TAM) and human behaviour and psychology (flow theory) have been tested with reference to the adoption of web-based streaming media for e-learning. TAM is the most widely accepted theory among information-system researchers for studying the system-acceptance behaviour of users. Flow theory was used to study the influence of user concentration on task activity. The current

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research framework draws on TAM for its basic model and then integrates TAM with flow theory so as to predict the acceptance behaviour of learners.

The research presented herein is guided and motivated by two specific questions. First, can the flow variables be integrated into the original TAM model to accurately predict the intention of the individual to use the web-based streaming media for e-learning? Second, do the presentation types of e-learning materials play a role in the acceptance behaviours of the learners as regards e-learning?

2. Theoretical background

Our research is founded on previous advances in research related to the technology acceptance model, flow theory and media richness theory. A description of each of these follows, along with hypotheses related to the current research. This section culminates with a research model integrating the foundational research.

2.1. Technology acceptance model

The TAM (Fig. 1) attempts to explain and predict the determinants of individual behaviour towards a system. The model proposes two key beliefs for the use of a technology: perceived usefulness (PU) and perceived ease of use (PEU). PU captures the extent to which a potential adopter views the target technology as offering better value over alternative methods of carrying out the same task. Ease of use encapsulates the degree to which a potential adopter views the usage of the target technology to be relatively free of effort (Davis, Bagozzi, & Warshaw, 1989). PEU is hypothesised to be a predictor of PU. Additionally, PU is postulated to have a direct effect on the behavioural intentions to use the technology. The beliefs about using the target system greatly influence the usage intentions and behaviour through their effect on a potential adopter's attitude (Al-Gahtani & King, 1999; Davis et al., 1989).

Davis et al. (1989) suggested that the internal psychological variables (i.e. the beliefs) that are central to TAM mediate the effects that all other variables in the external environment might have on an individual's use of an innovation. External variables bridge the internal beliefs, attitudes and intentions represented in TAM and the various individual differences, situational constraints and managerially controlled interventions impinging on behaviour (Davis et al., 1989). Conversely, external variables provide only indirect influence on usage intentions or usage behaviour (Agarwal & Prasad, 1999; Davis et al., 1989; Huang, 2005). PU and PEU have a direct influence on intended technology use (Lu, Yu, & Liu, 2005; Seyal, Rahman, & Rahim, 2002; Venkatesh & Davis, 1996; Venkatesh, Speier, & Morris, 2002) and well as actual technology use (Yi, Wu, & Tung, 2005/2006) across varied organisational contexts and general business technologies (Jieun, Ha, Choi, & Rho, 2005).

However, previous research applying the TAM to e-learning technologies produced mixed results. In two studies, (Lee, Cheung, & Chen, 2005; van Raaij & Schepers, 2008), PEU was not a good predictor of the intention to use a learning-management system (LMS). In another study (Ngai, Poon, & Chan, 2007), PEU was a significant predictor of both attitude and intention to use an LMS. PU was a significant predictor of both perceived enjoyment and intention to use e-learning technologies (Lee et al., 2005; Liaw, 2008; Ngai et al., 2007; van Raaij & Schepers, 2008). PU combined with multimedia quality was a significant predictor of e-learning effectiveness (Liaw, 2008). However, the Liaw (2008) survey did not include appropriate controls for different types or quality of multimedia instruction.

More research is needed to assess the influence of media types on intention to use e-learning systems. Therefore, based on the original study by Davis et al. (1989), the following hypotheses were tested:

H1: PEU is positively associated with PU.
H2: PEU is positively associated with the attitude towards the technology.
H3: PU is positively associated with the attitude towards the technology.
H4: PU is positively associated with the intention to use the technology.
H5: Attitude towards the technology is positively associated with the intention to use the technology.

2.2. Flow theory

A user's level of concentration might also contribute to both actual and intended use of e-learning systems. Concentration is generally understood to be exclusive, focused attention on an experience and places the user in a separate state of mind—a state in which the user is not conscious of anything outside the experience. Flow theory can be used to measure concentration.

When people are in flow, they 'shift into a common mode of experience' as they become absorbed in their activity. This mode is characterised by the following: a narrowing of the focus of awareness, so that irrelevant perceptions and thoughts are filtered out; a loss of self-consciousness; responsiveness to clear goals and unambiguous feedback; and a sense of control over the environment (Csikszentmihalyi & Csikszentmihalyi, 1988). Therefore, flow is defined as 'the holistic sensation that people feel when they act with total involvement'

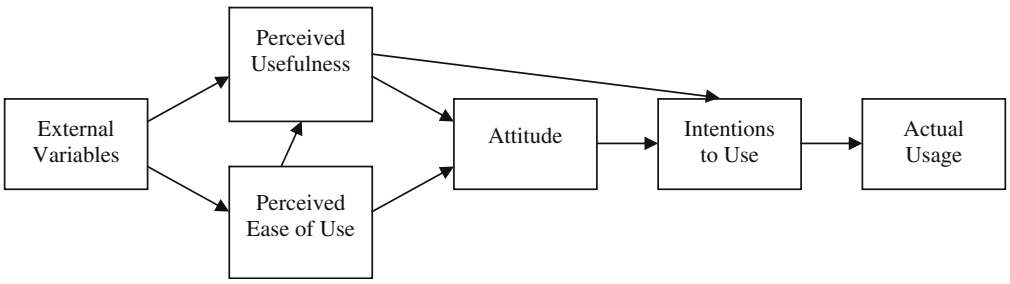


Fig. 1. Technology acceptance model.

(Csikszentmihalyi & Csikszentmihalyi, 1988). For individuals to be in 'flow', they have to become totally immersed in the concerned activity to the point of losing an awareness of time, surroundings or other factors.

The influence of flow on a variety of online shopping activities has been studied. Agarwal and Karahanna (2000) defined a construct called "cognitive absorption" based in large part on the theory of flow. They combined cognitive absorption and the TAM and found that cognitive absorption contributed significantly to both PU and PEU (17% and 32.5%, respectively), which together accounted for about 50% of the variance in behavioural intention to use the Web. Novak et al. (2000) found that skill, challenge and telepresence (belief that the virtual environment is more real than the physical environment) led directly to flow and resulted in a compelling online shopping experience. In a similar study, Koufaris (2002) integrated flow theory and the TAM in an online shopping environment so as to study the influence of concentration on a consumer's intention to return to a website. Koufaris (2002) identified consumers as both shoppers and computer users, with factors related to both roles influencing intention to return to a given website. Results from that study indicated that product involvement, web skills and positive challenge were all correlated with concentration, but concentration was not a good predictor of the intention to return to the online store. The current study extends the above studies by acknowledging the dual role (learner and system user) of the learner and extending the study of flow theory and the TAM to an e-learning environment.

The integration of the flow theory and the TAM and in an e-learning environment has not been studied empirically. It is expected that a user's high concentration level will have a positive impact on the intention to use e-learning technology. Therefore the following hypothesis was tested:

H6: Concentration level is positively correlated with the intention to use e-learning technology.

2.3. Media richness theory

User concentration might be enhanced by the level of media richness, defined as the "capacity to process rich information" (Daft & Lengel, 1986, p. 560). Media classifications range from rich (face-to-face) to lean (numeric documents). A primary goal of media richness theory (MRT) is to determine which technologies best reduce uncertainty and equivocality in various business settings. Lean media communicates effectively in analysable, certain environments; richer media facilitates communication in equivocal, uncertain environments (Daft & Lengel, 1986). Advances in technology and user sophistication with new media necessitate continued assessment of MRT.

Current studies involving MRT in business (Lim & Benbasat, 2000; Matarazzo & Sellen, 2000; Otondo, Van Scotter, Allen, & Palvia, 2008; Yeung & Lu, 2004) incorporated video, audio or web technologies. Findings from these studies generally supported MRT: lean (text) media was as effective as and more efficient than rich (video) media in presenting analysable tasks (e.g. communication or analysis of facts and computation of mathematical procedures). Rich media using more communication channels was more effective in presenting less-analysable tasks (e.g. subjective interpretation of equivocal situations). Additionally, higher-quality video can distract users from their tasks, resulting in higher satisfaction levels and faster completion times associated with poor-quality video (Matarazzo & Sellen, 2000). Transmission ability, more than content or task, determines media selection (Yeung & Lu, 2004).

Media selection has also been the focus of abundant research in education. For example, the famous "media vs. message" debate started by Richard Clark and Robert Kozma in the nineties (Clark, 1991; Kozma, 1991) continues today. Aligned with MRT, Kozma states that certain media types "possess particular characteristics that make them both more and less suitable for the accomplishment of certain kinds of learning tasks" (Kozma, 1994). Alternatively, Clark states that media selection does not influence learner achievement; rather, multiple types of media can produce the same achievement results (Clark, 1994). A meta-analysis of MRT applied to computer-assisted instruction studies revealed that audio was associated with higher learner achievement scores than the richer medium of video, and text was associated with higher learner achievement scores than the richer medium of text with graphics (Timmerman & Kruepke, 2006). The focus of most MRT research was on learning effectiveness.

More recent MRT research also includes user satisfaction, which is related to intent to use. Learners benefit from the use of richer media in courses containing equivocal and uncertain content; however, learners achieve no significant benefit in either learner score or learner satisfaction from the use of richer media in courses containing low equivocal (numeric) content (Sun & Cheng, 2007). When assessing learner-perceived satisfaction separately from learning achievement, the richer media video and audio were more closely associated with learner satisfaction, but the leaner medium text was associated with learner achievement (Otondo et al., 2008). Underlying socio-psychological factors influence users to select a media based on perceived satisfaction with the media rather than effectiveness of information processing capabilities. Different media combinations (presentation types) represent different levels of media richness, which could then be associated with the perceived usefulness of the e-learning experience (Lim & Benbasat, 2000).

Streaming media, the real-time playing of audio or video over the Internet, is a fairly new addition to e-learning. Advances in technology enable the incorporation of streamed audio and video into e-learning environments and the subsequent study of the influence of that streamed media. This research is the first to assess the influence of different media (herein referred to as presentation types) on a user's concentration level and intention to use an e-learning system.

In summary, prior research on media richness indicate that text as a presentation type might be primarily suitable for communication of factual information whereas a multimedia presentation (including the newer streaming media) could communicate both factual and equivocal information. There is a dearth of empirical studies investigating the influence of streaming media on learner performance and satisfaction. This research is designed to fill that gap. Hence, the following hypotheses were tested:

H7: E-learning presentation types are related to the PU of the technology.

H8: E-learning presentation types are related to the concentration levels of the user.

2.4. The research model

The research model empirically tested in this study is shown in Fig. 2. The core of the model is the technology acceptance model (TAM). We extended the TAM by addressing the fact that users' of e-learning systems are both sophisticated computer system users and learners. Many e-learning systems utilise advanced technology similar to that used in other Web-based applications (e.g., e-commerce or gaming sites). Therefore, learning achievement is influenced both by how the content is presented to users as well as how useful users perceive the system is in delivering that content.

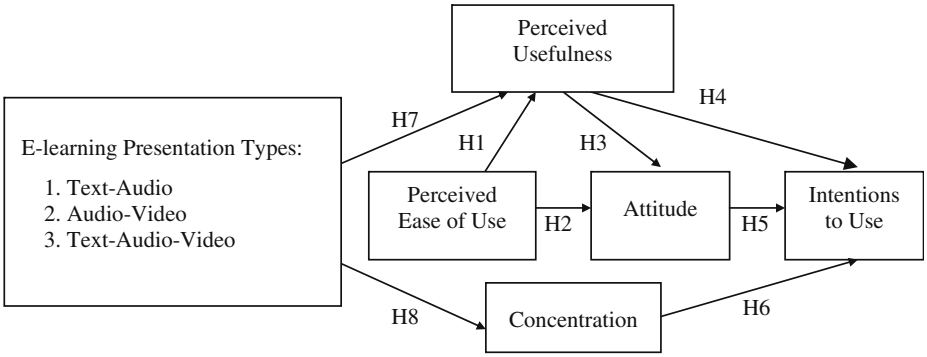


Fig. 2. The research model.

Based on media richness theory, we acknowledge an influence of media on the learning activity. Since media are generally used in combination with one another, we propose three typical categories of e-learning presentation types that influence users' perceptions: text with audio, video with accompanying audio, and audio–video with a display of coordinated text. To meet learner/user expectations of advanced system technology, the audio and video were both streamed to the users. We expect the presentation types to influence users' intentions to use e-learning systems in two ways. First, if e-learning content is delivered via an appropriate presentation type, then users should perceive value in the e-learning system and subsequently express intention to use the e-learning system. Second, the ability of a presentation type to draw users into a concentrated "flow" of learning should positively influence users' intentions to use the e-learning system. Table 1 provides the definitions of the variables used in the research model.

3. Methodology

This study used a field experiment to empirically test the research hypotheses. This section describes the participants, the experimental system, instrument development, procedures and measures.

3.1. Participants

The sample population for this study was students enrolled in a systems analysis and software development course in a management information system department at the Chung Yuan University in Taipei, Taiwan. All subjects, ranging in age from 20 to 25, were management information systems majors. The sample population was comprised of 55% female and 45% male students.

3.2. The experimental system

The system used in the experiment was designed explicitly for this study. It ran on a Pentium-IV PC with a 38.1-cm monitor. The system was implemented as a simulated Internet environment. Subjects used Internet Explorer v. 6.0 to browse the teaching materials stored on a university server. Retrieval of information, including video clips, was almost instantaneous with this configuration. The streaming-media e-learning system was developed using the Wisdom Master–LMS platform. Wisdom Master, which was developed by the SUN NET Technology Corporation, Taipei, Taiwan, is one of the most popular LMS platforms in Taiwan. Wisdom Master is also the first software package in Taiwan that meets the highest run-time environment standard of the shareable content object reference-model initiative. The high-resolution monitors used in this experiment allowed subjects to see clearly the facial expressions of the people in the video clips.

The experimental materials used in this study were developed using the streaming organiser in Wisdom Master. To test the revised TAM-research model completely, three content-presentation types that differed significantly in terms of their media richness were selected. Three versions of the e-learning course were developed to implement different combinations of the selected presentation types: text–audio, audio–video and text–audio–video. The text–audio–video version displayed information in real-time, full-motion video, whereas the text–audio version displayed the same information without motion video. On the basis of previous research (Webster et al., 1993; Weiser & Wilson, 1999) indicating the student-perceived importance of being able to see the instructor and having the ability to replay the lecture, the video content was comprised primarily of lectures of professors.

Table 1
Research variables and definitions.

Research variables	Definition
Perceived ease of use	Degree to which a technology is considered by the potential adopter as relatively easy to use and understand
Perceived usefulness	Degree to which the technology is considered as superior to its predecessor
Concentration	Degree to which users maintain exclusive, focused attention on their activity
Attitude	Degree to which users like using the technology
Intentions	Degree to which users intend to adopt the technology or increase their use of it in the future
E-learning Presentation types	E-learning presentations are divided into three types: (1) text–audio, (2) audio–video and (3) text–audio–video

3.3. Instrument development

TAM variables were operationalised according to the recommendations made by Davis (1993). In his study, Davis (1993) used two 10-item scales as measures of PU and PEU. To keep the length of the instrument reasonable, four items were selected from his set to measure the PU, and four were selected for measuring PEU. Attitude was measured by a three-item scale constructed according to the guidelines provided by Ajzen and Fishbein (1980); future-use intentions were measured by two items constructed following the recommendation of Davis et al. (1989), with one item added according to the study context. Concentration was measured with a three-item scale adapted from Ghani and Deshpande (1994). Participants responded to questions regarding the streaming e-learning systems by scoring a positively anchored seven-point Likert scale, with the end points in the scale being 'strongly disagree' and 'strongly agree'. The survey questions are included in the Appendix.

3.4. Procedures

Random sampling was used to assign students to three groups. Subjects in each group were provided access to a self-study e-learning module on 'Microsoft Project 2003' while learning how to implement project management during software development. Only the presentation type of the streaming media for e-learning differed among the groups. Group 1 received a text–audio presentation, Group 2 received an audio–video presentation and Group 3 received a text–audio–video presentation. All subjects received a 1-h, hands-on demonstration of the e-learning system before the course began. Subjects were encouraged to use the streaming-media e-learning system during the subsequent four weeks.

After completing the first section of the course, the subjects were asked to complete a survey indicating their intentions to continue using the streaming-media e-learning system. A total of 121 surveys were distributed, of which 102 usable responses were returned, resulting in a response rate of 84%. The subjects who finished all four sections of the course were asked to complete the questionnaire again at the end of the 4-week session. A total of 88 usable responses were returned, resulting in a response rate of 73%.

3.5. Measures

The construct reliability and validity of the survey instrument were evaluated. Cronbach's α was calculated for each scale to ensure internal consistency among the items. The scale reliabilities are reported in Table 2. Factor reliabilities, as represented by Cronbach's α, were between 0.82 and 0.90 for each factor. Analysis of the herein-considered sample showed a reasonable level of reliability ($\alpha > 0.70$).

Factor analysis also confirmed that the construct validity of the scales could be carried out adequately. Using the 'principal component' method with varimax rotation, construct validity was examined. Table 2 reports the factor loadings and explains the variance for each of the factors. The factor loadings for all items exceeded 0.8 and indicated that the individual items also had discriminant validity.

4. Results

Correlation coefficients were first analysed to avoid the high linearity that is inherent among independent variables and also to determine the appropriateness of regression analysis. The Pearson correlation coefficients of different variables so obtained are listed in Table 3. All these coefficients were found to be significant.

Table 2
Scale reliabilities and factor loadings for measures of constructs.

Scale	Perceived usefulness	Perceived ease of use	Attitude	Intentions	Concentration
Cronbach's α = 0.88					
PU Q1	0.870				
PU Q2	0.863				
PU Q3	0.844				
PU Q4	0.856				
Cronbach's α = 0.90					
PEU Q1		0.873			
PEU Q2		0.813			
PEU Q3		0.885			
PEU Q4		0.946			
Cronbach's α = 0.88					
A Q1			0.854		
A Q2			0.937		
A Q3			0.899		
Cronbach's α = 0.87					
I Q1				0.905	
I Q2				0.927	
I Q3				0.834	
Cronbach's α = 0.83					
C Q1					0.814
C Q2					0.917
C Q3					0.882

PU, perceived usefulness; PEU, perceived ease of use; A, attitude; I, intentions; C, concentration.

Table 3
Pearson correlation coefficients.

	Perceived usefulness	Perceived ease of use	Attitude	Intentions	Concentration
Perceived usefulness	1.000				
Perceived ease of use	0.605**	1.000			
Attitude	0.696**	0.467**	1.000		
Intentions	0.526**	0.607**	0.644**	1.000	
Concentration	0.394**	0.337**	0.390**	0.424**	1.000

* $p < 0.05$.
** $p < 0.01$.

Data associated with PU and concentration were analysed using a repeated-measures one-way-ANOVA test with the independent variable. The result of the independent sample *t*-test on PU and concentration, together with the respective means and the standard deviations, for the three content-presentation types in both the surveys are summarised in Table 4. Both the first and the final surveys had some significant differences between different presentation types in terms of PU and concentration. The data also indicate that the average scores decreased between the first and final surveys. Thus, the overall PU and concentration with respect to the streaming e-learning system was significantly lower after the students had finished all four sections. Further inspection showed that the decline in PU and concentration was associated with a decreased-novelty effect. In other words, after the curiosity of the subjects as regards the novelty of the new technology faded, and they were faced with the reality of the learning requirements, they not only perceived a lower usefulness for the technology but also indicated less concentration when using the e-learning system.

The results obtained support Hypothesis H8: e-learning presentation types are related to user concentration levels. The presentation type with the highest media richness (the text–audio–video presentation type) was found to have the highest level of concentration, whereas the presentation type with the lowest media richness (the text–audio presentation type) was found to have the lowest level of concentration.

However, the results only partially support Hypotheses H7 (e-learning presentation types are related to PU of the technology) as compared to Hypothesis H8 (e-learning presentation types are related to the user concentration levels). A higher level of PU is expected to be associated with higher media richness. Although Table 4 indicates that the text–audio–video presentation type had the highest level of PU in both surveys, results of the final survey indicate that subjects using the audio–video presentation types perceived the technology as less useful (3.625) than subjects using the text–audio presentation types (3.9318). Post-experiment interviews with subjects in the audio–video group showed that although the audio–video technology could enhance their concentration, the absence of text might have obstructed their learning, thus lowering their PU of the e-learning system.

The residuals were also analysed to verify the assumptions underlying the regression analysis. All the assumptions were confirmed. For those tests corresponding to Hypotheses H1–H5, the null hypotheses were tested. The revised TAM for each combination of tested presentation type, along with their '*t*' statistics and significance levels are shown in Fig. 3. As expected, H4 and H5 supported the statement that attitude and PU were significant predictors of the intentions of users. Hypotheses H2 and H3 were also supported by the results, indicating that user attitude was determined by both PU and PEU. Finally, as posited in the TAM, the PEU was a significant predictor of PU (H1). The orientation of all relationships was precisely as specified in the TAM.

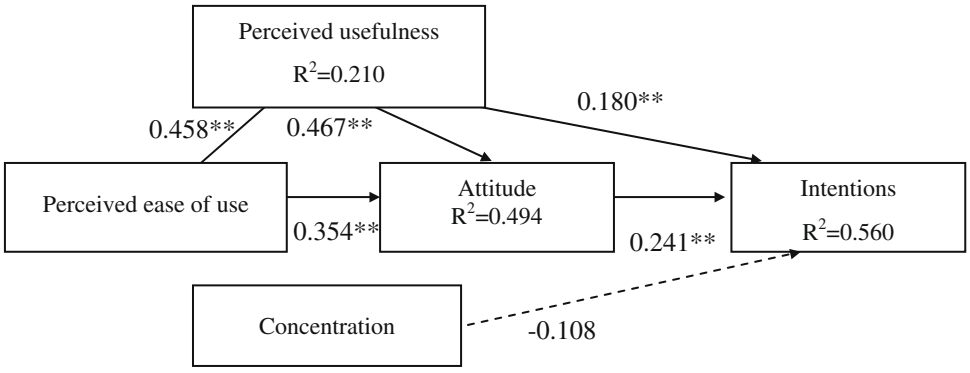
Moreover, the results suggest that for learners using streaming media for e-learning, different models might be necessary to explain and predict the acceptance behaviours under different media richnesses. For those subjects who used text–audio–video and audio–video presentations, the concentration levels were positively associated with their intention to use the streaming media for e-learning (H6). However, for those subjects who used text–audio presentations, their concentration levels were not statistically significantly related to the intention to use. Attitude and PU were the key predictors of intention to use ($R^2 = 0.56$). Only the model containing the subjects in the text–audio group was equal to the original TAM. In conclusion, these results suggest that models for e-learning adoption should take the nature of the technology into account, as not all perceptions may be salient for all technologies.

Table 4
The impact of e-learning presentation types on perceived usefulness and concentration.

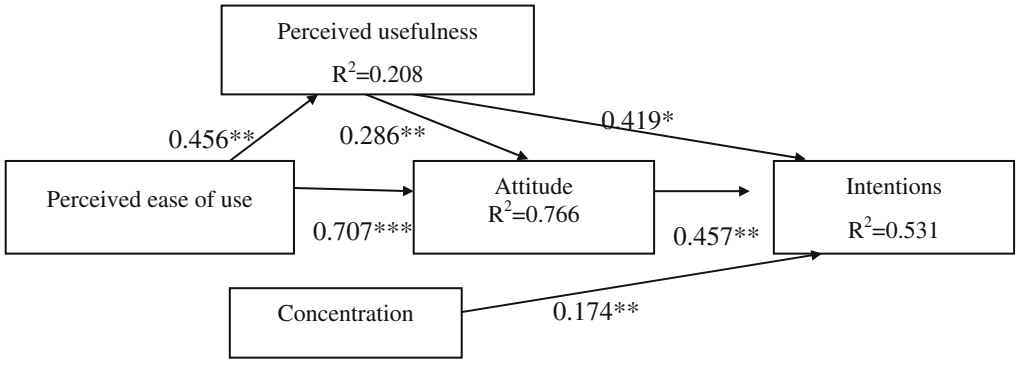
Time	Group	Number	Means	Standard deviation	*F*	*p*-Value
E-learning presentation types → perceived usefulness						
First survey	Text–audio	37	4.318	1.021	6.462	0.002**
	Audio–video	30	4.675	0.846		
	Text–audio–video	35	5.057	0.707		
Final survey	Text–audio	33	3.932	0.839	4.888	0.010**
	Audio–video	24	3.625	1.086		
	Text–audio–video	31	4.387	0.844		
E-learning presentation types → concentration						
First survey	Text–audio	37	3.081	1.032	39.460	0.000***
	Audio–video	30	4.444	1.220		
	Text–audio–video	35	5.086	0.623		
Final survey	Text–audio	33	3.000	1.310	17.212	0.000***
	Audio–video	24	3.182	1.383		
	Text–audio–video	31	4.677	0.900		

* $P < 0.1$.
** $P < 0.05$.
*** $P < 0.001$.

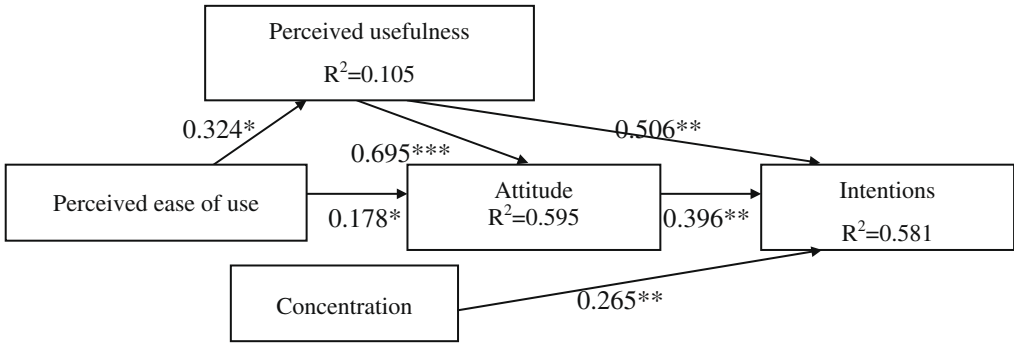
Text-audio Presentation



Audio-video Presentation



Text-audio-video Presentation



*** P < 0.01 ** P < 0.05 * P < 0.1
⟶ Significant path
- - - -▶ Non-significant path
Path coefficients are reported

Fig. 3. Statistical significance of correlated factors for three combinations of media-presentation types.

5. Conclusions

The current study contributes to the growing body of research on TAM by introducing and confirming the influence of media richness as an external variable on the user's intention to use e-learning technology. The findings support previous research reports (Agarwal & Prasad, 1999; Al-Gahtani & King, 1999; Davis et al., 1989; Huang, 2005; Seyal et al., 2002) indicating the indirect influence of external variables on usage intention while simultaneously introducing an internal variable, concentration, as an intermediate between the variables of media richness and usage intention.

The data obtained in this study support the notion that e-learning presentation types and users' intentions to continue the use of streaming media for e-learning are related. User concentration and perceptions of the usefulness of streaming media are both intermediate variables within this relationship. The most media-rich presentation interface (text–audio–video presentation) always generates higher

levels of PU and concentration than text–audio-based or audio–video-based presentations. This study further confirms that course materials that use rich media can promote higher user acceptance through stimulating a higher PU and concentration. This finding extends Lim and Benbasat's (2000) study on media richness in information systems by incorporating audio as a factor along with both text and video. This finding is in conflict with Lee et al.'s (2005) study, wherein rich media (comprised of streaming videos of lectures, downloadable lecture notes and chat-room facilities) was not a significant factor in the usage intention. It also contradicts Matarazzo and Sellen's (2000) study, which reports that a higher-quality video presentation was considered as a distraction from task completion.

Comparing different acceptance models with different presentation types shows the important influence of media richness on the users' acceptance of e-learning. One explanation might be that the influence of different media-presentation types on the attitude differs depending upon the user's current stage of technology adoption (Seyal & Pijpers, 2004). More important to acceptance is the proper connecting of the technology (media) to the user's required task. Thus, learners using different levels of media richness might adopt different acceptance behaviours. Further research is required in this area for a complete evaluation of the acceptance behaviour.

The results of this study also indicate that concentration of the users stimulated by the course materials developed using rich media might be a critical factor in the users' acceptance of streaming media for e-learning. In general, the concentration of the users (which represents their 'flow' state) tends to be positively correlated with their intention to use the technology (H6). However, the hypothesis that concentration level would be positively correlated with the intention to use the technology is not supported by the subjects who used the least media-rich presentation (text–audio). This finding is similar to that of Koufaris (2002), who has found that concentration level was not positively correlated with users' intentions to return to a site. Further research is needed to develop a complete set of external variables, including media richness, which might be associated with the concentration of the e-learning users.

Results of this study are important to educators faced with the challenge of developing online instruction that motivates learners sufficiently to get them into a state of flow while simultaneously allowing developers to stay within the development budget. This study provides support for providing different combinations of media presentations, including streaming media such as audio and video. Future research might determine the propensity with which user selection of accessible media combinations leads to increases in usage intentions.

Appendix. Scales and items

Perceived ease of use

1. It is easy for me to remember how to carry out tasks using the e-learning system.
2. I believe that it is easy to get the e-learning system to do what I want it to do.
3. My interaction with the e-learning system is clear and understandable.
4. Overall, I believe that the e-learning system is easy to use.

Perceived usefulness

1. Using the e-learning system improves my schoolwork performance.
2. Using the e-learning system improves my productivity.
3. Using the e-learning system enhances my effectiveness as regards schoolwork.
4. Overall, I find that using the streaming e-learning system is useful in my schoolwork.

Attitude

1. I like using the e-learning system.
2. The e-learning system is fun to use.
3. The e-learning system provides an attractive working environment.

Usage intentions

1. I intend to completely switch over to the e-learning system.
2. I intend to increase my use of the e-learning system in the future.
3. Assuming that I have access to the e-learning system, I intend to use it.

Concentration

1. I was absorbed intensely in the e-learning activity.
2. My attention was focused on the e-learning activity.
3. I was deeply engrossed in the activity.

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