Research Journal of Applied Sciences, Engineering and Technology 4(20): 4132-4137, 2012
ISSN: 2040-7467

Submitted: March 23, 2012 Accepted: April 08, 2012 Published: October 15, 2012

A Study on Interactive Video-based Learning System for Learning Courseware

Yuh-Tyng Chen,
Department of Information Management, Tainan University of Technology, Yung-Kang District, Tainan 710, Taiwan

Abstract: This study proposed an Interactive Learning Video (ILV) on the web which integrated modularity concepts and multimedia technologies to promote the learning effectiveness and motivation of courseware. An empirical study was conducted to examine the effects of the ILV by comparing three different types of presentation with 124 freshmen who would be divided into three groups from a university of technology in Taiwan. Three different tests and one questionnaire were conducted to assess to the students' learning achievement and motivation. The results showed that the ILV group had higher grades in retention test than those of two groups. And the questionnaire results revealed that the ILV group also had more positive attitude in learning motivation. All findings collectively demonstrated that the ILV could benefit to enhance students' learning achievement and promote their motivation.

Keywords: Interactive Learning Video (ILV), learning motivation, learning performance, modularity concept, multimedia technology

INTRODUCTION

Courseware for learning computer application software is very commonly used in many e-learning courses. This courseware focuses on the learning procedure which belongs to psychomotor skills. Repeated practice is the best way for the learning of psychomotor skills, because the increased smoothness and timing are resulted from practice of a motor skill (Lee and Chao, 2007). Accordingly, video-based instruction materials are widely accepted by learners. Because those materials allow students to view actual objects and realistic scenes, to see sequences in motion and to listen to narration (Zhang *et al*., 2004). Although it is easier for videos to show than to verbalize, videos, however, the linear nature often cause superficial learning and limited sustainability of learning outcomes and low/no transfer that is the well known 'couch-potato-attitude' (Ertelt and Spada, 2006). Recently, due to the development of network bandwidth and multi-media technology, the interactive video has been used widely in e-learning system. Interactive video used a non-linear, interactive digital video technology which allows students to pay full attention to the learning material and to review any video part as many times as they want (Dimou *et al*., 2009; Weston and Barker, 2001). Users can randomly select or play a segment with minimal search time (Llinares and Valls, 2010; Zhang *et al*., 2004). This may enhance learner engagement and so improve learning effectiveness. Nevertheless, when the learning process occurs in the working memory and a cognitive load which is essential for learning will be imposed (Plass *et al*., 2003; Adenubi *et al*., 2011). In addition, according to cognitive load theory (Aggarwal *et al*., 2001), human working memory capacity is limited and overloading working memory may hinder learning. In order to boost and transfer learning, the solution process of a complex task may be divided into small, purposeful building blocks (Ertelt and Spada, 2006; Leung, 2009). Probing the researches, modularity concept can effectively serve these tasks (Chen, 2012a, b). Modularity can be described as modules of a complex object to simpler objects. The modules are simplified either by the structure or function of the object and its subparts (Lin *et al*., 2007; Hewahi, 2007). Modules are independent of one another but can communicate with each other. Modules can be developed, tested, and/or shared on independent manners (Cheong *et al*., 2003; Karamouzis, 2005; Shakiba *et al*., 2008). Using modularity concept in lecturing/or learning can help the instructor and students because modular design offers the benefits including providing more expedited course creation for instructors, simplifing the course updates and affording the consistency for users (Badre and Cooper, 2008; Li *et al*., 2011). Accordingly, the aim of this study is to integrate the modularity concept and multimedia technology into video-based instruction for empirical study and evaluate the outcomes. The research question is "Does the Interactive Learning Video (ILV) really meet the users' needs of learning courseware when interacting with the system during lectures?". We hypothesized that ILV would improve learning outcome and retention. The hypotheses were:

H1: Learners who use the ILV will achieve better post-test scores than learners who use non-interactive video or traditional face-to-face training.

H2: Learners who use the ILV will achieve better learning retention test than learners who use non-interactive video or traditional face-to-face training.

It is unquestionable that motivation plays an important role to affect learners' success in learning and performance. Keller indicated that learners who were motivated to learn tended to engage in activities they believed more helps to learn (Keller, 1983; Lin *et al*., 2007). Therefore, we hypothesized that ILV would improve learning motivation.

H3: Learners who use the ILV will have better motivation than learners who use non-interactive video or traditional face-to-face training.

The rest of this study was organized as follows. First, we described the study design and results. Then, we presented our discussion and conclusion.

METHODOLOGY

Participants: The experiment was motivated by the need of 141 students of a university of technology in southern Taiwan to learn Adobe Photoshop. Exclude the unusable surveys which were either incomplete tests or questionnaire or not followed instructions were identified and discarded. As a result, 124 respondents (87% of 141 cases) were used as the basis for data analysis. Of these participants, 44% were males and 56% were females. Each subject participated in the study was randomly assigned to one of three groups (Table 1). Total workshop duration was 36 h and lectures were spread over twelve weeks at a 3 h rate.

Research instrument:

Tests and questionnaire: The research instrument consisted of three tests including pretest, posttest and retention test, questionnaire and instructional materials (ILV). All the items in the instrument were carefully constructed so as to be in line with the purpose of the study. This study adopted the ARCS motivation model including four components: attention, relevance, confidence and satisfaction proposed by Keller (1983). The questionnaire, the IMMS that developed around Keller's ARCS model Keller (1983) of motivational design was designed to evaluate how instructional materials affected motivation to learn. It contains a 36 7-point Likert scale statements, ranging from extremely dissatisfied (1) to extremely satisfied (7), as well as provides open comments on the system. Each statement measures an individual ARCS component. In order to minimize possible error because of participants' varying levels of English comprehension, a Chinese version of the questionnaire was used, with the Chinese version of IMMS administered by ESL/EFL and translation experts to prevent any translation mistakes. Three different experimental conditions were divided in this study. The lecture contents were the same but the presentations were different (Table 1). The post-test, learning retention test and learning motivation questionnaire were conducted after the experimental session.

Table 1: Groups and treatments in experiment

Groups	Learning environments	Sizes
1. ILV group	Interactive learning video provided	41
2. Non-interactive video group	Visual and verbal cues provided	41
3. Traditional group	Psychomotor domain learning, face to face	42

The Interactive Learning Video (ILV): Considering the limitation of human working memory capacity and boost and transfer learning, the solution process of a complex task may be divided into small, purposeful building blocks (Ertelt and Spada, 2006). Hence, first, we cataloged the content with the same themes into modules from the textbook. Second, we adapted the concepts of modularity for building the hierarchically organized structures called presentation networks; each module represented a set of related concerns which included a collection of related units. Modules were individual of one another but could interact with each other in a relatively coupled way. Finally, we borrowed the navigation technology in the presentation networks to provide instructors or learners with the ability to rapidly find and display whatever content they needed and whenever they needed it. In addition, in order to enable the learners to focus and understand the key points, the ILV timely provided the rich visual indicators such as arrow prompt lines, focusing technology (zoom and lighted technology) and concise tips (Fig. 1). On line feedback and narrative also have been included.

Procedure: The learning environment of this research was designed and framed as a software tutorial where participants had to learn a new computer application. Participants in all groups went through the same procedure. In the first week, the objective and procedure of the experiment were clearly described. Participants who were in group 1 and 2 received about 10 min of training during which they saw a brief live demonstration about how to watch an online lecture using the video learning materials. They were given the same amount of time to familiarize themselves with the learning system. At the next sections, we conducted the experimental activities. For group 1 and group 2, they were given 50 min to watch the online lecture and then practiced the homework by themselves. They could repeatedly watch the learning materials. The traditional classroom group was given the face-to-face demonstrated instruction. Post-

Fig. 1: The presentation of ILV, (Using The hyperlink technology, interactive menu cataloged by modularity concept allowed learners random ''on-demand'' access to any particular part. ILV also provided noticeable visual indicators to attract learns' attention and help students to enhance their comprehension and remember more ideas. The narrative and control bar also have been included)

test and questionnaire were given to all participants at the end of the experimental session. And two weeks later, the retention test was given to all participants. The duration of the lecture session and tests were the same for all experimental groups.

RESULTS

Declarative knowledge acquisition: The One-way analysis of variance (abbreviated one-way ANOVA) with repeated measurements (post-test and retention test) was chosen in this research to test the hypothesis that ILV helps to improve short-term and medium-term learning outcomes. The ANOVA tests showed that before the teaching experiment, regarding the learning pretest, the differences were not significant ($f = 0.346$, $p = 0.711>0.05$), indicating that the discrete distributions of the samples of three groups did not have obvious differences.

Therefore, the posttest was employed to three groups. The posttest that conducted from the instructional materials was validated by three university instructors (each with ten years' working experience in the related field). Reliability testing was also conducted. There were 20 questions in the post-test and the Cronbach's coefficient alpha (a) was 0.862. That means the posttest is an appropriate instrument for learning performance measurement. The results of posttest show that there is no significant difference among the group means ($f (2, 121) = 21.375$, $p>0.05$, $\eta^2 = 0.26$). This could due to the posttest which was the final term examination at school so as to make three groups study very hard and spend sufficient time in learning no matter what kind of tools were provided (Lai *et al*., 2011). And the results of retention test point out that there is a significant difference among the group means ($f (2, 121) = 33.328$, $p<0.05$, η^2

Table 2: Descriptive statistics of learning outcome (post-test and retention test) in different groups

	Group (1)[1]		Group (2)[1]		Group (3)[1]	
	Mean	SD	Mean	SD	Mean	SD
Post-test	29.41	4.50	26.15	4.62	22.83	4.62
Retention test	20.20	3.93	16.81	3.79	12.83	4.56

[1]: Group (1): ILV group (interactive instructional video provided), Group (2): Non-interactive video group (visual and verbal cues provided), Group (3): Traditional group (psychomotor domain learning, face to face)

Table 3: Mean differences (p-value) on retention test between groups

Groups	2	3
1	3.97 (0.000)**	7.36 (0.000) **
2		3.39 (0.101)

*: p<0.05; **: p<0.01; ***: p<0.001; Group (1): ILV group (interactive instructional video provided); Group (2): Non-interactive video group (visual and verbal cues provided); Group (3): Traditional group (psychomotor domain learning, face to face)

deviations of learning outcomes of participants in different experimental groups. Table 3 shows the results of post-hoc Scheffe test which pointed out that the retention test of the ILV group is significantly higher than that of the other two groups. Consequently, hypotheses 1 did not receive support but hypotheses 2 received support. And especially, the post-hoc results of retention test between non-interactive video group and traditional group are not significantly different.

Motivation with the learning material: The reliability of the IMMS, as assessed by Cronbach alpha for internal consistency, was 0.883. For the four components (attention, relevance, confidence and satisfaction) of IMMS, Cronbach alpha was between 0.827~0.881. Considering all three experimental conditions, there are differences in motivation (ARCS model) among the different conditions: attention: $f (2,121) = 11.10$; $p<0.01$, relevance: $f (2,121) = 14.86$; $p<0.01$, confidence: $f (2,121)$

Table 4: Descriptive statistics of learning motivation (ARCS model) in different groups

	Group (1)		Group (2)		Group (3)	
	Means	SD	Means	SD	Means	SD
Attention	28.73	6.44	24.68	5.84	21.45	8.54
Relevance	21.05	6.05	16.63	5.73	13.86	6.36
Confidence	28.59	6.91	25.73	6.55	22.19	9.26
Satisfaction	23.98	4.31	19.12	4.07	18.41	3.57

Group (1): ILV group (interactive instructional video provided); Group (2): Non-interactive video group (visual and verbal cues provided); Group (3): Traditional group (psychomotor domain learning, face to face)

Table 5: Mean differences (p-value) on learning motivation (ARCS model) between groups

ARCS model	Groups	2	3
Attention	1	3.23 (0.118)	7.28 (0.000)**
	2		4.05 (0.007)*
Relevance	1	2.28 (0.117)	7.20 (0.000)**
	2		4.41 (0.005)**
Confidence	1	3.34 (0.005)**	6.39 (0.001)**
	2		2.85 (0.04)**
Satisfaction	1	4.85 (0.000)**	5.56 (0.000)**
	2		2.71 (0.000)**

*: p<0.05; **: p<0.01; ***: p<0.001; Group (1): ILV group (interactive instructional video provided); Group (2): Non-interactive video group (visual and verbal cues provided); Group (3): Traditional group (psychomotor domain learning, face to face)

= 17.39; p<0.01, satisfaction: f (2,121) = 21.38; p<0.01). Table 4 shows the means and standard deviations of learning motivation of participants in different experimental groups. Table 5 shows the results of post-hoc Scheffe test which points out that the motivation of the ILV group is significantly higher than that of the other two groups. Therefore, hypothesis 3 received support. In particular, the post-hoc results of "attention" and "relevance" between ILV group and non-interactive video group are not significantly different. This might due to ILV provided the rich visual technologies and interactivity which could efficiently impress learners and then motivate them to learn. These results fit into Ertelt and Spada (2006) finding that videos are highly acceptable and motivational in comparison to other learning conditions. The videos are commonly accepted by the two group participants despite of the different presented ways.

DISCUSSION AND CONCLUSION

The results of the tests and survey supported our hypotheses; in other words, ILV had the positive effects on both learning outcome and learner motivation. The findings provided some insights on how to achieve higher learning effectiveness with the presentation of instructional video in an e-learning environment.

- Through the experiment, participants in the ILV group got higher retention test scores than those in the linear video group and traditional group. This could be due to the apparent visual indicators and self-controlled learning environment. Learning courseware not only has a visible muscular component but also is dependent on a cognitive component, usually a procedural rule that organizes the kind and sequence of actions (Lee and Chao, 2007; Badre and Cooper, 2008). In this study, through the interactive menu students could control their learning experience and tailor it to their individual needs. Based on the schema acquisition and the reorganizing principles of cognitive load theory, the recorded materials could benefit students to construct the plentiful information in long-term memory (Leahy and Sweller, 2008; Cheong *et al*., 2003; Karamouzis, 2005). Namely, the video-based ILV could help them almost recall learning activities in the class situation.
- The results of the IMMS showed that the learning attitude of ILV group was the most positive in groups especially higher than group 3. This could be ILV offered active interaction between learners and instructional video and then potentially motivated participants to increase learning effectiveness (Li *et al*., 2011). Hence, students could easily hyperlink the particular segment they needed so as to reduce student's extraneous cognitive load. Also, the video presented the related textual and pictorial learning elements simultaneously which could benefit to reinforce their learning. Under this situation, students felt confident and satisfaction with the instructional activity.

Overall, the results of this study revealed that the students found the ILV to be relevant and effective. This was because relevant and effective materials enabled students to acquire specific skills, knowledge and attitudes (Ghee and Heng, 2008; Roszanadia and Norazmir, 2011). In doing so, students felt confident that they could achieve the expected outcomes of the course and satisfaction which derived from the instruction (Johnson and Aragon, 2003; Onasanya *et al*., 2010).

The findings in this study were encouraging, but we were not in a position to claim that ILV was always superior to traditional video or classroom learning. It was because the effectiveness of e-learning might depend on many elements, including learners, instructors, presentation of media, technology, content and company policy. However, this study did show that, under certain circumstances and limitation of time and expenditure, ILV could produce better results than other methods.

REFERENCES

Adenubi, O.S., S.R. Adaramaja and O. Rhoda, 2011. achieving sustainable academic growth through courseware integration: The experience of a Nigerian University. Asian J. Inform. Manage., 5: 1-11, DOI: 10.3923/ajim.2011.1.11.

Aggarwal, A.K., J. Hatfield, E. Kemery, S. Valenti and L. Esnault, 2001. Web-based Education: Changing the Equilibrium in Managing Information Technology in a Global Economy, 2001 IRMA International Conference, Toronto, Ontario Canada, Idea Group Publishing: Hershey London Melbourne Singapore, 1197.

Badre, N.H. and R.L. Cooper, 2008. Reduced calcium channel function in drosophila disrupts associative learning in larva and behavior in adults. Int. J. Zool. Res., 4: 152-164, DOI: 10.3923/ijzr.2008.152.164.

Chen, Y.T., 2012a. Integrating anchored instructional strategy and modularity concept into Interactive multimedia PowerPoint presentation. Int. J. Phys. Sci., 7(1): 107-115.

Chen, Y.T., 2012b. The effect of thematic video-based instruction on learning and motivation in e-learning. Int. J. Phys. Sci., 7(6): 957-965.

Cheong, S.N., H.S. Kam, K.M. Azhar and M. Hanmandlu, 2003. Design and development of a web-based course authoring and management system for interactive, multi-lingual and personalized multimedia online notes in distance education. Inform. Techn. J., 2: 87-9, DOI: 10.3923/itj.2003.87.93.

Dimou, A., G. Tsoumakas, V. Mezaris, I. Kompatsiaris and I. Vlahavas, 2009. An empirical study of multi-label learning methods for video annotation. 7th International Workshop on Content-Based Multimedia Indexing (CBMI 2009), Chania, pp: 19-24.

Ertelt, A., A. Renkl and H. Spada, 2006. Making a difference: Exploiting the full potential of instructionally designed on-screen videos. Proceedings of the 7th international conference on Learning Sciences, Bloomington, Indiana. pp: 154-160.

Ghee, T.T. and L.T. Heng, 2008. Efficacy of multimedia teaching instruction in elementary Mandarin class. Proceedings of the Third Centre for Language Studies (CLS) International Conference, pp: 686-697. Retrieved from: http://www.fas.nus.edu.sg /cls/clasic2008/Tan-Lim.pdf.

Hewahi, N.M., 2007. Intelligent tutoring system: Hierarchical rule as a knowledge representation and adaptive pedagogical model. Inform. Techn. J., 6: 739-744, DOI: 10.3923/itj.2007.739.744.

Johnson, S.D. and S.A. Aragon, 2003. An Instructional Strategy Framework for Online Learning Environments. In: Aragon, S.A., (Ed.), Facilitating Learning in Online Environments. New Dir Adult Contin. Educ., 10: 31-44.

Karamouzis, S.T., 2005. A CBR system for predicting student achievement. Inform. Techn. J., 4: 382-386, DOI: 10.3923/itj.2005.382.386.

Keller, J.M., 1983. Motivational Design of Instruction. In: Reigeluth, C.M., (Ed.), Instructional Design Theories and Models: An Overview of their Current Status. Hillsdale, Erlbaum, pp: 118.

Lai, Y.S., H.H. Tsai and P.T. Yu, 2011. Screen-capturing system with two-layer display for powerpoint presentation to enhance classroom education. Edu. Tech. Soc., 14(3): 69-81.

Leahy, W. and J. Sweller, 2008. The imagination effect increases with an increased intrinsic cognitive load. Appl. Cognt. Psychol., 22: 273-283.

Lee, S.C. and C.Y. Chao, 2007. A study on e-learning courseware development software for computer application learning. J. Educ. Media Libr. Sci., 45(2): 233-248.

Leung, C.H., 2009. An inductive learning approach to market segmentation based on customer profile attributes. Asian J. Market., 3: 65-81, DOI: 10.3923/ajm.2009.65.81.

Li, D.Q., X.J. Li, J.F. Duan and W. Cai, 2011. Effects of wuling capsule on hippocampaldependent cognitive changes in post-stroke depression rats. Int. J. Pharmacol., 7: 50-57, DOI: 10.3923/ijp.2011.50.57.

Lin, H.T., T.H. Kuo and S.M. Yuan, 2007. A web-based learning portfolio framework built on blog services. Inform. Techn. J., 6: 858-864, DOI: 10.3923/itj.2007.858.864.

Llinares, S. and J. Valls, 2010. Prospective primary mathematics teachers' learning from on-line discussions in a virtual video-based environment. J. Math. Tea. Edu., 13: 177-196.

Onasanya, S.A., M.A. Fakomogbon, R.A. Shehu and A.K. Soetan, 2010. Learning information and communications technology skills and the subject context of introductory technology learning in Nigeria. J. Arti. Intell., 3: 59-66, DOI: 10.3923/jai.2010.59.66.

Plass, J.L., D.M. Chun, R.E. Mayer and D. Leutner, 2003. Cognitive load in reading a foreign language text with multimedia aids and the influence of verbal and spatial abilities. Comp. Hum. Behav., 19(2): 221-243.

Roszanadia, R. and M.N. Norazmir, 2011. Knowledge, attitude and practice on healthy eating among special needs boarding school students. Int. J. Dairy Sci., 6: 278-286, DOI: 10.3923/ijds.2011.278.286.

Shakiba, M., M. Teshnehlab, S. Zokaie and M. Zakermoshfegh, 2008. Short-term prediction of traffic rate interval router using hybrid training of dynamic synapse neural network structure. J. Appl. Sci.,8:1534-1540, DOI: 10.3923/jas.2008.1534.1540.

Weston, T.J. and L. Barker, 2001. Designing, implementing and evaluating web-based learning modules for university students. Educ. Technol., 41(4): 15-22.

Zhang, D., J.L. Zhao, L. Zhou and J. Nunamaker, 2004. Can e-learning replace traditional classroom learning-evidence and implication of the evolving e-learning technology. Commun. ACM, 47(5): 75-79.