A Case Study on Lecture Video Viewing for Before-Class Learning

Chiung-Fang Chiu, Yu-Tze Lin, and Greg C. Lee

***Abstract*—This study addresses learners' before-class lecture video viewing behavior from the perspectives of learner's personal characteristics: learning motivation, computer self-efficacy, Internet access availability, and learning styles. This study involved eighty high school students. Results did not find significant correlation between students' before-class video viewing behavior and learner characteristics such as learning motivation, computer self-efficacy, and Internet access availability. It was found that students with higher degree of learning motivation were more inclined to view the lecture video before class. Those students who viewed more lecture video before class also reported significantly higher level of Internet access availability and higher post-achievement. However, there were no significant differences in before-class lecture video viewing and post-achievement among the students with different learning styles.**

***Index Terms*—Distance learning, learner characteristics, streaming video.**

I. Introduction

The preview of lecture contents before class can give learners relevant background knowledge so as to reduce mental loading during in-class lecture. Similar to the function of advance organizers [1], preview is able to activate concepts already existing in the learners' cognitive structure and thereby facilitate knowledge acquisition. Based on the background knowledge established in before-class preview, learners will be able to structure knowledge effectively in class. With the emergence of the Internet and information technologies, digital video technology is a good tool to facilitate before-class preview activities. Many researchers suggest that the recorded-lecture videos can be an effective resource to improve learning. Spickard, Alrajeh, Cordray and Gignate [2] compared the learning outcomes of medical students who were provided with live lecture and those received online lecture. The results did not find significant differences in the learning outcomes between the two groups. In the e-learning courses offered by many universities, it was also found that video-based instruction had similar learning outcome when compared to in-class instruction [3]-[4]. The above research results suggest that lecture video can be chosen as an effective media to present learning content for before-class preview.

Under the Taiwan Ministry of Education's high-school CS curriculum guideline [5], the computer course is supposed to be of one-hour duration per week for a full school year. Due to the time constraints, there is often insufficient time for students to engage in hands-on practices after the lecture. Viewing lecture video online to preview contents would allow teachers to make better use of the class time and give students more opportunities for in-class practices. The effectiveness of the video + lab learning model has been reported in our previous study [6]. This study further analyzed the relationship between students' characteristics and before-class lecture video viewing.

With the development of the Internet, many researchers have investigated the relationship between learners' personal characteristics and learning behavior in web-based learning environment [7]-[9]. However, limited is known about how learners' characteristics might affect their online lecture video viewing behavior. Thus, this research aims to address learners' before-class video viewing behavior from the perspective of learners' characteristics: computer self-efficacy, learning motivation, Internet access availability, and learning styles.

Computer self-efficacy can refer to general computing knowledge and skills in specific applications. It has been found to be positively related to performance in software training [10] and academic performance in introductory MIS classes [11]. Application-specific skill is one's perception of efficacy in using a specific computer application or system [12]. Students with greater application-specific self-efficacy are more likely to have more confidence in handling technical difficulties on their own when using new technology to assist learning. Previous research revealed that application-specific self-efficacy has a positive effect on the use of information technology for learning [13]-[14]. As a result, this study aims to explore the relationship between application-specific self-efficacy and the behavior of before-class lecture video viewing.

The motivation to learn is another learner characteristic that can affect learning outcomes. Many studies have reported positive correlations between learning motivation and achievement in traditional learning environment [15]-[16]. Motivated learners have also been found to make better use of learning strategies and achieve higher proficiency [17]-[18]. In web-based learning environment, students' learning motivation might also be related to their system usage and achievement. Oxford, Park-Oh, Ito and Sumrall [19] reported that motivation affected performance in a foreign language course delivered by distance education.

Manuscript received April 14, 2012; revised June 20, 2012. This work was supported in part by the National Science Council of Taiwan, ROC, under the Grant numbers NSC 99-2515-S-003-002 and NSC99-2631-S-003-002.

Chiung-Fang Chiu is with the Graduate Institute of Curriculum Instruction and Technology, National Chi-Nan University, Taiwan (e-mail: cfchiu@ncnu.edu.tw).

Yu-Tze Lin is with the Graduate Institute of Information and Computer Education, National Taiwan Normal University, Taiwan (e-mail: linyt@ntnu.edu.tw).

Greg C Lee is the Department of Computer Science and Information Engineering, National Taiwan Normal University, Taiwan (e-mail: leeg@csie.ntnu.edu.tw).

DOI: 10.7763/IJEEEE.2012.V2.167

Shih and Gamon [20] analyzed the relationships among students' motivation, attitude, learning styles and achievement in two web-based courses. They found that motivation was the only significant factor that determined student achievement. Robertsand Dyer [21] explored the relationship between self-efficacy, motivation, and critical thinking disposition to achievement and attitudes when a web lecture is used in an online learning environment. The results indicated that, while motivation and computer proficiency tend to influence students' attitudes, motivation and prior knowledge influence achievement. It was concluded that when a web lecture is used to deliver content, students with higher levels of motivation tend to exhibit higher achievement and more favorable attitudes.

In this study, students' learning motivation will be examined from the perspective of achievement goals (i.e., mastery goals, performance goals). Mastery goals represent an individual's desire to master the domain knowledge whereas the performance goals emphasize the degree to which someone focuses on comparing his or her performance capabilities to those of others [22]. Mastery goals can be seen as intrinsic learning motivation. The typical characteristics may be that they tend to learn as much as they can in the course, or try to achieve a sense of mastery based on self-referenced standards. In contrast, performance goals can be noted as extrinsic-oriented motivation easily affected by external requirements or destinations. Because students with high performance goals focus on getting better grades, they may apply short-term learning strategies and avoid challenging tasks [22]-[23].

Additionally, learning styles may also influence how individual process information and choose strategies when they learn [24]. In this study, learning styles are defined as the students' preferred perceptual mode (i.e., auditory, visual, and tactile). Auditory learners refer to the ones who learn best from listening. Thus, they learn more effectively through listening to lectures or tapes. Visual learners perform best with visual stimuli like diagrams and charts. As to tactile learners, they learn well by doing hands-on activities, such as working on experiments. The research of Dunn and Dunn [25] indicated that visual and auditory learners usually outperformed tactile learners in school because the conventional teaching methods primarily involve listening to lecture and reading textbooks. Thus, it is important to investigate the effects of learning styles on learning outcomes when the traditional in-class lecture is replaced with the before-class lecture video viewing and in-class lab activities. Therefore, this research also aims to evaluate the performance outcomes of students of different preferred perceptual modes as well as the relationships between learners' preferred perceptual mode and lecture video viewing behavior.

II. Research Method

A. The Course

The topic of image processing (IP)in high school was selected in accordance with the mandated Computer Science curriculum. The recognition of handwritten numerals was chosen as the lecture topic because it is understandable for high school students and a common computerized application in their daily life. The lecture videos were recorded by the course instructor who prepared the lectures with PowerPoint slides first before recording the presentation of these PowerPoint slides with a screen-capturing software program. One week before class, the videos were uploaded to an in-house course-supporting website, which contains the lecture video, the presentation slides, the course handouts, and a discussion forum. By accessing the course website, students could watch lecture video before class at anytime from any place where Internet is available. A more detailed description of the system can be found in [6].

B. Participants

This study was conducted at a senior high school. Two classes taught by the same course instructor were randomly chosen to participate in this study. A total of 80 students comprising 38 male and 42 female were involved.

C. Procedure

The learning process consisted of two phases. First, students learned about the basic concepts through the pre-recorded lecture videos before class to gain basic knowledge about IP. Second, students worked on the lab exercises in class to reinforce the concepts covered in the lecture and built their own handwritten numeral recognizer. One week before the experiment, the instructor demonstrated the procedure to view the streaming lecture videos to the students. Students were instructed to view these videos before each class for the duration of the experiment. Each class was conducted for one hour per week. Each week, students watched the pre-recorded lecture video before class and worked on lab exercise in-class for about 45 minutes. The contents of the lecture videos were detailed in [6]. Students had no need for in-class lecture as the lecture was replaced by pre-class video viewing. Students were told that the instructor knew when and how many times each of them had viewed the online videos from the system log file. The entire experiment lasted for four weeks, including the time for the post-experiment achievement test.

D. Instruments

1) Application-specific self-efficacy scale, learning motivation scale, accessibility to the internet

The application-specific self-efficacy scale was adapted from [12] and contains 6 questions. On the other hand, the learning motivation was measured with the mastery goals and performance goals developed by Harackiewicz *et al*. [22]. Both the mastery and performance goals were assessed with6 questions, respectively. The responses of these instruments can be ranged from "strongly disagree" (1) to "strongly agree" (5). These questions were translated into Chinese and piloted with 41 senior high school students. Cronbach's alpha was calculated to assess the internal reliability of the questionnaire. The coefficients of the application-specific self-efficacy, mastery goals and performance goals were 0.86, 0.83 and 0.81, respectively. Furthermore, students were also asked to rate their accessibility to the Internet. The reply ranged from "very convenient" (rating = 5) to "very inconvenient" (rating = 1).

2) Learning style preferences

Learning style preferences adapted from Dunn, Dunn and

Price's Learning Style Inventory [26] was also administered to determine students' learning style preferences, or, the modality of stimuli from which they best process new information. Based on the results, students were classified as visual learners, auditory learners, or tactile learners.

III. Results and Discussion

A. Correlational Analyses

Pearson's correlations were used to examine associations between students' before-class video viewing and each of the learner characteristics variables (i.e., mastery goals, performance goals, application-specific self-efficacy and Internet access availability). The results were depicted in Table I. Inspection of Table I indicated no significant relationships between students' before-class video viewing and the variables mentioned above.

TABLE I: Pearson's Correlation Coefficients between Before-Class Video Viewing and Selected Variables.

Variables	Before-class video viewing
Mastery goals	.166
Performance goals	.086
Application-specific self efficacy	.169
Internet access availability	.174

B. Frequent Users and Non-Users

Although no significant relationships were found between students' before-class video viewing and the learner characteristics, it is speculated that differences might exist between students who viewed more videos and those who viewed fewer videos in learner characteristics. Further analysis was needed to understand the differences. Based on video viewing statistics, students were classified into two subgroups. Students who viewed all lecture video before the post-achievement test were classified as frequent *users*, whereas the students who did not view all lecture videos before the post-achievement test were classified as *non-users*. The numbers of *users* and *non-users* were 57 and 23, respectively. T-tests were conducted to compare the learner characteristics of the two subgroups. Analyses are reported as significant when p <.05. Furthermore, we also examined whether students' learning style might influence their before-class lecture video viewing behavior.

1) Mastery goals and performance goals

Table II and Table III depicted the t-test results for mastery goals and performance goals between users and non-users. In the results of mastery goals, t-test revealed that users had significantly higher mastery goals than non-users. However, the difference between users and non-users on the performance goals did not reach the .05 significance level. Such finding is contrary to that of the previous study [8] where frequent users of online lecture notes were found to have significantly higher performance goals toward the course than those who used it as a replacement for class attendance. Nevertheless, this finding corresponds to the line of research showing the strong impacts of intrinsic motivation on achievement [19]-[21]. This result signifies the essential role of learning motivation on how students might approach learning tasks. This finding is especially relevant for regions with educational systems similar to ours. In Taiwan, the Computer Science courses are usually not considered important because it is not one of the components included in the university entrance exams. As a result, students with higher learning motivation would be willing to devote themselves to study hard in Computer Science class.

TABLE II: T-Test for Equality of Means on Mastery Goals.

Group	N	Mean	S.D.	*t*-value	*p*
Users	57	3.75	0.61	2.99**	< 0.01
Non-users	23	3.28	0.71		

***p< .01*

TABLE III: T-Test for Equality of Means on Performance Goals.

Group	N	Mean	S.D.	*t*-value	*p*
Users	57	3.35	0.57	1.59	0.12
Non-users	23	3.11	0.67		

2) Application-specific self-efficacy

Results of application-specific self-efficacy did not reveal significant differences between users and non-users as shown in Table IV. In other words, the users and non-users had similar application-specific self-efficacy toward using the course website to view video, and, the degree of application-specific self-efficacy did not influence student lecture video viewing behavior. Given the nature of the technology used in online learning environment, it is reasonable to expect that students with greater application self-efficacy would have viewed the before-class videos more frequently. However, the results of the present study are inconsistent with previous research, including [7], [13], [22], and [23], which reported that application-specific self-efficacy has a positive effect on the use of information technology for learning. Such findings could be due to the fact that the web interface is user-friendly and easy to use. In addition, participants in this study could discuss their technical difficulties in school.

TABLE IV: T-Test for Equality of Means on Application-Specific Self-Efficacy.

Group	N	Mean	S.D.	*t*-value	*p*
Users	57	3.76	0.64	1.95	>0.05
Non-users	23	3.44	0.70		

3) Internet access availability

T-test results of Internet access availability are revealed in Table V. Significant differences were found between users and non-users. Users reported significantly higher rate than non-users in Internet access availability.

TABLEV: T-Test for Equality of Means on Internet Access Availability

Group	N	Mean	S.D.	*t*-value	*p*
Users	57	3.88	1.55	2.30**	0.02
Non-users	23	3.61	1.44		

***p<.05*

4) Post-achievement test

The differences of post-achievement test scores between users and non-users were further analyzed. One-way Covariance Analysis (ANCOVA) was performed with computer course grades from the previous semester as the

covariate. The descriptive statistics of the achievement test are showed in Table VI. The ANCOVA results (F=9.45, p<.01) indicate that users had significantly higher achievement test score than non-users. Therefore, before-class video viewing tendency was an important factor in students' achievement in terms of course grades.

TABLE VI: DESCRIPTION OF MEANS ON POST ACHIEVEMENT TEST.

Group	No. of students	Covariate		Achievement Test	
		Mean	S.D.	Mean	S.D.
Users	57	76.33	5.01	66.28	11.88
Non-users	23	72.78	6.32	56.35	15.96

5) Learning style preferences

We further examined whether students' learning style influenced their before-class lecture video viewing behavior, and, students of which learning style performed best in this learning approach. Computer course grades from the previous semester were used as covariate. The result is depicted in Table VII. The data shown in Table VII reveals that nearly half of students (54%) were classified as visual learners, whereas nearly 30% of students were tactile learners (29%). The number of auditory learners is the fewest among the three learning style preferences (17%). The ANOVA results (F=2.73, p=.072) indicated no significant differences in before-class lecture video viewing among the students with different learning styles. Furthermore, the ANCOVA results (F=.44, p=.65) also showed no significant differences in achievement test among students with different learning styles.

TABLE VII: DESCRIPTIVE STATISTICS OF BEFORE-CLASS LECTURE VIDEO VIEWING AND POST-ACHIEVEMENT TEST IN DIFFERENT LEARNING STYLE STUDENTS.

Learning style	No. of students (percent)	Mean number of video viewing	Covariate	Achievement test
Visual	43 (54%)	10.28	75.51	62.74
Auditory	14 (17%)	8.71	73.57	61.36
Tactile	23 (29%)	12.74	76.00	65.96

IV. CONCLUSION

This study aims to address learners' before-class lecture video viewing behavior from four perspectives: learning motivation, computer self-efficacy, Internet access availability, and learning styles. The findings indicated that no significant relationships were found between students' before-class video viewing and the following learner characteristics: learning motivation, computer self-efficacy, and Internet access availability. Moreover, those students with higher mastery goals were more inclined to view the recorded lecture video before class. Frequent users (i.e., students who viewed all lecture video before post-achievement) had significantly higher Internet access availability and higher post-achievement. In terms of application-specific self-efficacy, no significant differences were found between users and non-users. Additionally, no significant differences were discovered in before-class lecture video viewing and post-achievement among learners with different learning styles.

In recent years, video technology has reached the maturity to serve as an effective medium for before-class preview. More research is needed to investigate the relationships between learner characteristics and before-class video viewing behavior. Based on our findings, we recommend that instructors should encourage students to engage in the preview activities and try to understand factors associated with students' intrinsic motivation towards the class. The explanation on the theorem should be taught along with interesting applications to raise students' learning motivation. On the other hand, students' learning motivation could also be promoted by applying relevant teaching strategies. For instance, students may be required to complete online quizzes or assignments before attending the class to ensure the lecture video is viewed. Giving bonus credits to students who view more videos is also a good strategy. Additionally, it is also important to provide more opportunities for students to gain Internet access in school. This study paves a way for improving the effectiveness of such practice. Findings of our research can also shade lights on how to engage students in learning tasks related to lecture video preview activities.

REFERENCES

[1] D. P. Ausubel, "The use of advance organizers in the learning and retention of meaningful verbal material," *Journal of Educational Psychology*, vol. 51, pp. 267-272, 1960.

[2] A. Spickard, A. Alrajeh, D. Cordray, and J. Gignate, "Learning about screening using an online or live lecture: does it matter?" *Journal of General Internal Medicine*, vol. 17, no. 7, pp. 540-545, 2002.

[3] R. B. Dannenberg and P. Capell. Are Just in Time lectures effective at teaching. [Online]. Available: http://www.jitl.cs.cmu.edu/effectiv.pdf

[4] J. Foertsch, G. Moses, J. Strikwerda, and M. Litzkow, "Reversing the lecture/homework paradigm using eTEACH Web-based streaming video software," *Journal of Engineering Education*, vol. 91, no. 3, pp. 267-274, 2002.

[5] Taiwan-MOE. Junior high school curricula 1998. [Online]. Available: http://www.edu.tw.

[6] C.-F. Chiu and G. C. Lee, "A video lecture and lab based approach to learning of image processing concepts," *Computers and Education*, vol. 52, no. 2, pp. 313-323, 2009.

[7] I. T. J. Brown, "Individual and technological factors affecting perceived ease of use of Web-based learning technologies in a developing country," *Electronic Journal on Information Systems in Developing Countries*, vol. 9, no. 5, pp. 1-15, 2002.

[8] M. Grabe, "Voluntary use of online lecture notes: Correlates of note use and note use as an alternative to class attendance," *Computers & Education*, vol. 44, no. 4, pp. 409–421, 2005

[9] A. Y. Wang, and M. H. Newlin, "Predictors of web-student performance: the role of self-efficacy and reason for taking an on-line class," *Computer in Human Behaviors*, vol. 18, no. 2, pp. 151-163, 2002.

[10] J. J. Martocchio, "Effects of conceptions of ability on anxiety, self-efficacy, and learning in training," *Journal of Applied Psychology*, vol. 79, no. 6, pp. 819-825, 1994.

[11] E. J. Rozell and W. L. Gardner, "Computer-related success and failure: A longitudinal field study of the factors influencing computer-related performance," *Computers in Human Behavior*, vol. 15, no. 1, pp. 1-10, 1999.

[12] G. M. Marakas, M. Y. Yi, and R. D. Johnson, "Multilevel and multifaceted character of computer self-efficacy: Toward clarification of the construct and an integrative framework for research," *Information Systems Research*, vol. 9, no. 2, pp. 126-163, 1998.

[13] M. Tsai and C. Tsai, "Information searching strategies in web-based science learning: The role of Internet self-efficacy," *Innovations in Education and Teaching International*, vol. 40, no. 1, pp. 43-50, 2003.

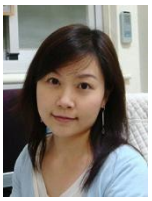
[14] M. Y. Yi and Y. Hwang, "Predicting the use of web-based information systems: Self-efficacy, enjoyment, learning goal orientation, and the technology acceptance model," *International Journal of Human-Computer Studies*, vol. 59, no. 4, pp.431–449, 2003.

[15] Y. M. Lukmani, "Motivation to learn and language proficiency," *Language Learning*, vol. 22, no. 2, pp. 261-273, 1972.

[16] K. A. Noels, R. Clement, and L. G. Pelletier, "Intrinsic, extrinsic, and integrative orientations of French Canadian learners of English," *The Canadian Modern Language Review*, vol. 57, no. 3, pp. 424-442, 2001.

[17] P. D. MacIntyre and K. Noels, "Using social-psychological variables to predict the use of language learning strategies," *Foreign Language Annals*, vol. 29, no. 3, pp. 373-386, 1996.
[18] I. N. Peng, *EFL motivation and strategy use among Taiwanese senior high school learners*, unpublished Master's Degree thesis, National Taiwan Normal University, Taipei, Taiwan, 2002.
[19] R. Oxford, Y. Park-Oh, S. Ito, and M. Sumrall, "Factors affecting achievement in a satellite-delivered Japanese language program," *The American Journal of Distance Education*, vol. 7, no. 1, pp. 11-25, 1993.
[20] C.-C. Shih and J. Gamon, "Web-based learning: Relationships among students motivation, attitude, learning styles, and achievement," *Journal of Agricultural Education*, vol. 42, no. 4, pp. 12-20, 2001.
[21] T. B. Roberts and J. E. Dyer, "The relationship between self-efficacy, motivation, and critical thinking disposition to achievement and attitudes when an illustrated Web lecture is used in an online learning environment," *Journal of Agricultural Education*, vol. 46, no. 2, pp. 12-23, 2001.
[22] J. Harackiewicz, K. Barron, J. Tauer, S. Carter, and A. Elliot, "Short-term and long-term consequences of achievement goals: Predicting interest and performance over time," *Journal of Educational Psychology*, vol. 92, no. 2, pp. 316-330, 2000.
[23] J. M. Brophy, "Fostering student learning and motivation in the elementary school classroom," in S. Paris, G. Olson & H. Stevenson (Eds.), *Learning and motivation in the classroom*, pp. 283–305, Hillsdale, NJ: Erlbaum, 1983.
[24] J. P. DeCecco, *The psychology of learning and instruction*, Englewood Cliffs, NJ: Prentice-Hall, 1968.
[25] R. Dunn and K. Dunn, *Teaching secondary students through their individual learning styles: Practical approaches for grades 7-12*, Boston, MA: Allyn & Bacon, 1993.
[26] R. Dunn, K. Dunn, and G. Price, *Learning style inventory manual*, Lawrence, KS: Price Systems, 1989.

Chiung-Fang Chiu received the B.S., M.S., and Ph.D. degrees in information and computer education from National Taiwan Normal University, Taiwan. She is currently an assistant Professor in the Graduate Institute of Curriculum Instruction and Technology, National Chi Nan University, Nantou, Taiwan. Her research interests include computer science education, educational technologies, and teacher education.



Yu-Tzu Lin received the B.S. and M.S. degrees in information and computer education from National Taiwan Normal University, Taiwan, in 1994 and 1997, and Ph.D. degree in computer science from National Taiwan University in 2007. She is currently an Assistant Professor in the Graduate Institute of Information and Computer Education, National Taiwan Normal University, Taiwan. Her research interests include computer science education, educational technologies, digital content analysis, multimedia security, pattern recognition, and image processing. Dr. Lin is a member of IEEE and CIES (Comparative & International Education Society).

Greg C. Lee received a B.S. degree from Louisiana State University in 1985, and M.S. and Ph.D. degrees from Michigan State University in 1988 and 1992, respectively, all in Computer Science. Since 1992, he has been with the National Taiwan Normal University where he is currently a Professor atthe Department of Computer Science and Information Engineering. His research interests are in the areas of image processing, video processing, computer vision, educational technology and computer science education. Dr. Lee is a member of IEEE and ACM.