Exploring the acceptance of a video annotation learning system in a mechanical engineering course

H. C. Chen
Ph.D. Student
Department of Engineering Science, National Cheng Kung University
Tainan, Taiwan
E-mail: luckyqq50@gmail.com

M. C. Liu
Post Doctor
Department of Engineering Science, National Cheng Kung University
Tainan, Taiwan
E-mail: liumingchi@gmail.com

Y. M. Huang
Assistant Professor
Department of Applied Informatics and Multimedia, Chia Nan University of Pharmacy and Science
Tainan, Taiwan
E-mail: ym.huang.tw@gmail.com

Y. M. Huang
Professor
Department of Engineering Science, National Cheng Kung University
Tainan, Taiwan
E-mail: huang@mail.ncku.edu.tw

C. J. Liu
Director
Science Educational Center, National Kaohsiung Normal University
Kaohsiung, Taiwan
E-mail: chiajuju@ms26.hinet.net

Y. L. Jeng
Director
Cloud System Software Institute, Institute for Information Industry, Taiwan
E-mail: jackjeng@iii.org.tw

Conference Key Areas: Engineering education research

Keywords: Video, Annotation, Mechanisms

1 INTRODUCTION

Mechanism is a basic course to introduce the basic concepts of the mechanical components in the field of mechanical engineering, which includes kinematics, mechanics, and mathematics to explain the law of motion of the machinery [1]. Mechanism originated from the first industrial revolution period of the 18th century, and it gradually became a professional discipline in the mechanical engineering area

[2]. Many technology industries, such as flight technology, automotive industry, robotics and consumer electronics products, which were designed the motion of those devices via the concept of Mechanism. Due to Mechanism is an important course in the field of mechanical engineering, learning the basic concepts of Mechanism is the necessary condition to be a mechanical engineering talent.

Since most teaching models of large machines belong to the equipments of high cost, some universities and colleges may be limited to their insufficient finances, resulting that they cannot purchase high-priced equipments. In traditional teaching of Mechanism, using textbook or slides are main teaching approaches for instructors in the classroom. However, traditional mechanical model are presented with static pictures in textbooks, and it's difficult to present the dynamic process of mechanical operation. In order to promote students to understand the dynamic process of mechanical operation, many instructors have attempted to use video, animation and computer simulation software to improve students' learning outcome [3].

Due to multimedia technology can present the dynamic process of mechanical operation, this study attempts to use dynamic media in Mechanism course to facilitate students to understand the principle and mode of mechanical operation. However, several studies indicated dynamic media on students' learning effect is not necessarily better than static media [4]. Mayer and Moreno (2003) further indicated that information is presented rapidly on the playing process of the dynamic media, and the learners cannot receive a lot of information in a short period of time, resulting in students' ineffective learning [5]. Based on the cognitive load theory, dynamic media generates high extraneous cognitive load for learners, thereby affecting their mental activity and knowledge construction [6].

In order to improve the excessive extraneous cognitive load of learners, this study proposed a video annotation learning system which included traditional text annotation and graphical annotation to provide learners can effectively learn the contents of dynamic video via annotation strategies to understand the learning content. At the same time, this study develop a questionnaire to evaluate learning satisfaction, learning interest, intention to use to understand whether annotation is effective to master the focus of the video for students, and then provide advice for the subsequent adjustments teaching activities.

2 RELATED WORK

Annotation is an important skill for students' learning that who can promote students' learning performance when students reading learning materials [7]. Several studies have demonstrated the benefits of annotation on multimedia materials [8][9][10][11]. Ball, et al., (2009) also found that annotation strategy can help students understand the content of learning materials, when students annotate meaningful notes on learning materials [12].

Due to development of technology, novel learning materials have been used more widely in real learning environment, such as e-books, digital content, and multimedia content. More and more educators have applied multimedia learning materials to classroom activities and in learning environments, because they have the advantages of easy to share, easy to carry and easy to annotate more than textbooks.

Previous studies also explored that the effectiveness of using annotation tools on digital learning materials to promote students' learning performance [13], and the results of these previous studies show that using annotation tools can promote the

learning performance of students in their learning environments. In view of our study, we will consider integrate annotation tools into multimedia learning materials of mechanism curriculum, and hope the annotation strategy can help students understand the content of learning materials to promote their learning efficiency.

3 THE PROPOSED VIDEO ANNOTATION LEARNING SYSTEM

To enhance the effects of video learning, this study proposed a video annotation learning system, namely VALS. The system architecture of the VALS is shown in Figure 1. Cloud database is used to store video files and annotation files, which is convenient for learners to access and share the videos files. Figure 2 shows the uploading interface of Cloud database. In addition, a user-friendly interface of this VALS was conducted to support traditional annotation functions. In Figure 3, the interface of VALS was developed by using Adobe Flash Professional CS5 software. The interface was divided into three parts, video display area, annotation time list area, and annotation maker bar.

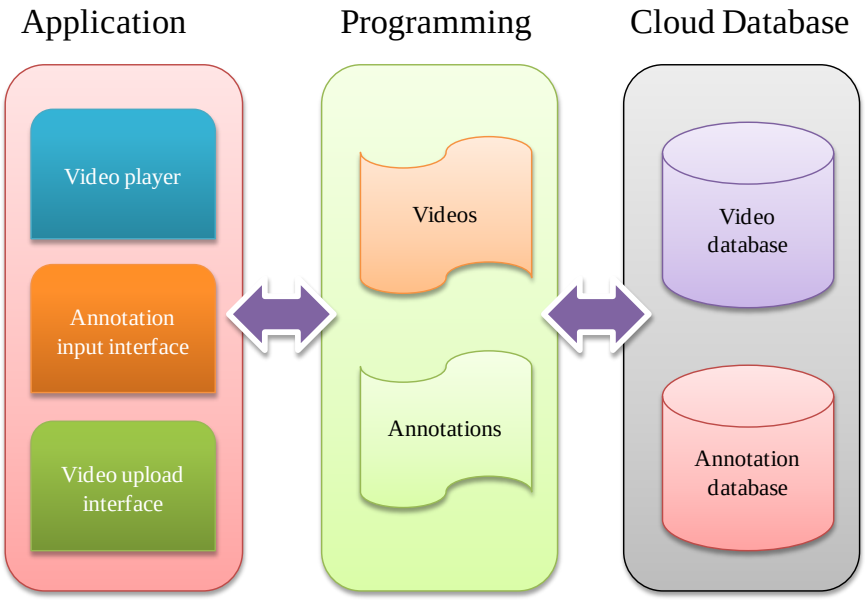

Fig.1. The structure of the video annotation learning system

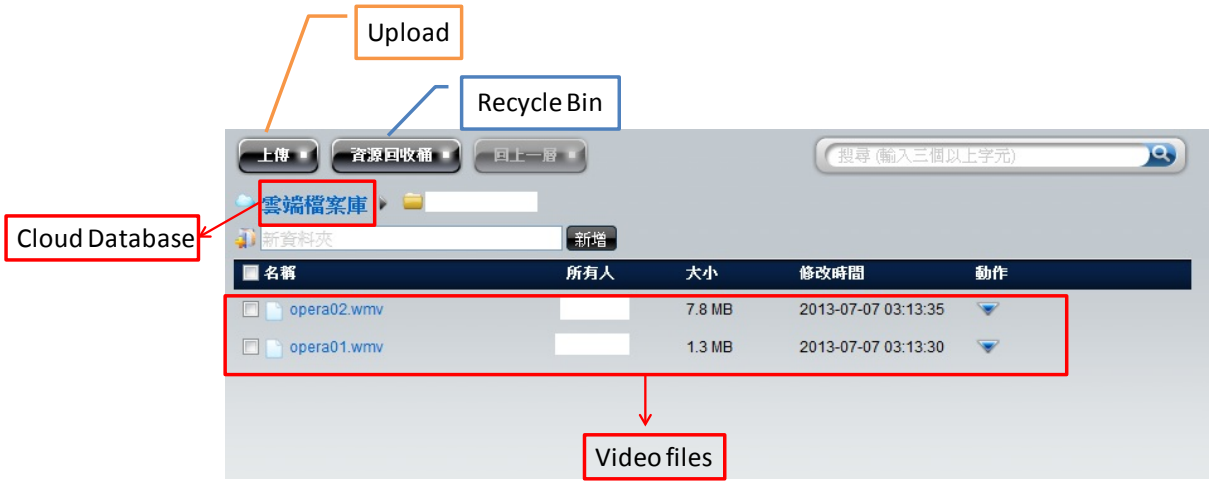

Fig. 2. The cloud database of the video annotation learning system

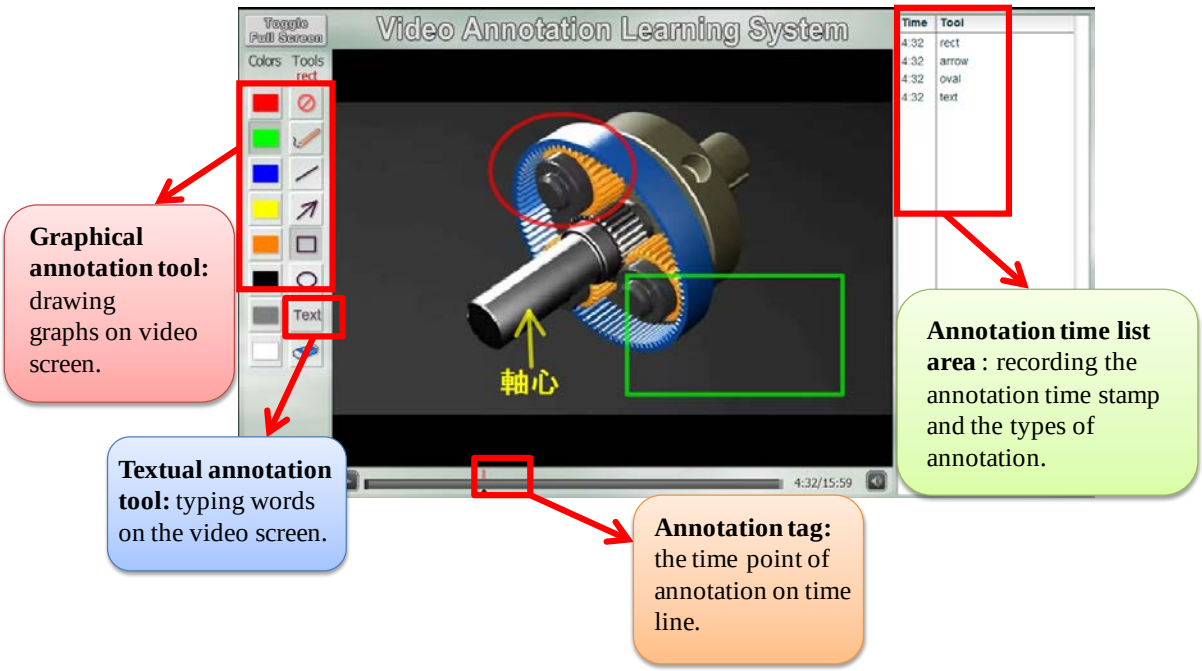

Fig.3. The interface of the video annotation learning system

In addition, annotation tool bar supports traditional annotation functions, such as circle, rectangle, textual tool, pencil, line and eraser. Learners can use annotation tool bar to annotate a variety of annotations on the video screen. The types of annotation tool and the annotation time stamp are recorded in the annotation time list area, and learners can view each annotation on this video effectively. After adding annotations on video, those designed annotations are shown in the video display area.

The functions of VALS are divided into five parts. Eraser tool provides learners use this tool to delete unnecessary annotations. Line and arrow tool supports learners use the line tool to draw straight line and arrow. Pencil tool provides learners draw freehand paths as if drawing with a pencil on papers. Textual tool supports learners can type words on the video. Rectangle and circle tool provides learners select an area to mark the key points of video. Additionally, learners can select different colors by using each tool to achieve their learning needs.

4 EXPERIMENT DESIGN

4.1 Experimental procedure

There are 30 students of Department of Engineering Science, National Cheng Kung University volunteering to participate in this experiment. The total experimental time is approximately one hour, and they took approximately 40 minutes to use the proposed VALS to learn the materials by using a computer in the classroom. At the end of the experiment, a questionnaire survey was given to the students to evaluate their learning satisfaction towards mechanical engineering course.

4.2 Measuring tools

In order to evaluate learning satisfaction of students for using VALS, a questionnaire was conducted by professional instructors. We used the SPSS software to analyze the reliability of the questionnaire. In addition, Cronbach's α is a measure of internal consistency for each dimension of this questionnaire [14], a Cronbach's α value is

higher than 0.7 indicates a highly reliability [15]. The analysis result indicated that the Cronbach's α value of the questionnaire is 0.76.

This questionnaire was divided into the three parts as follows: (1) learner's learning interest; (2) learner's learning satisfaction; (3) learner's technology acceptance. The purpose was to collect information about the students' learning interest for using the VALS in the first factor of this questionnaire. The second factor was to explore the students' learning satisfaction for utilizing the VALS. The third factor was to investigate the students' technology acceptance for using the VALS. We use a five-point Likert scale (strongly agree, agree, neutral, disagree, and strongly disagree) to evaluate each question.

5 RESULTS OF THE EXPERIMENT

5.1 Learning interest

Table 1. Analysis of the students' interest about the proposed VALS

Questions	Mean	SD
1. I like to learn Mechanisms knowledge through the proposed VALS.	4.13	0.71
2. This learning activity is very interesting for me.	4.14	0.81
3. I like to use proposed VALS to me understand the key points.	4.24	0.75
4. I like this proposed VALS can be used in other curriculums.	4.06	0.65
5. The proposed VALS is fascinating and amazing.	4.26	0.73
6. I also want to use this proposed VALS.	4.11	0.77

Moreover, the mean and standard deviation are shown for analysis of students' interest for using VALS in Table 1. The results reveal an average value of 4.15 and a standard deviation of 0.73. The fact shows that this VALS could enhance their learning interest and most of students stated that they liked to use annotation on the video material to learn knowledge. Students feel this learning activity is very interesting (mean = 4.14 and SD = 0.81), and they also want to use this video VALS (mean = 4.13 and SD = 0.77). In addition, most students stated that they consider the video with annotations is fascinating and amazing (mean = 4.26 and SD = 0.73). Hence, using VALS can promote the students' learning interest.

5.2 Learning satisfaction

Table 2. Analysis of the learning satisfaction of the proposed VALS

Questions	Mean	SD
1. I consider that the proposed VALS could help me understand Mechanisms course.	4.21	0.60
2. I consider that the proposed VALS could help me carry out right steps.	4.17	0.77
3. Are you satisfied for the proposed VALS in the Mechanisms course?	4.26	0.57
4. I believe the proposed VALS can help me demonstrate the	4.39	0.52

right Mechanisms course.		
5. I believe the proposed VALS can enhance the impression of Mechanisms course.	4.13	0.65
6. I recommend this proposed VALS can be used in other course.	4.26	0.61

The mean and standard deviation of learning satisfaction are shown in Table 2, and the results point out an average rating of 4.23 and a standard deviation of 0.62. Most students are satisfied for using this VALS, and they consider that the VALS could help them to understand knowledge in detail (mean = 4.39 and SD = 0.52). Moreover, most students stated that they think the VALS can enhance the impression of knowledge (mean = 4.13 and SD = 0.65), and they recommend this VALS can be used in other video materials (mean = 4.26 and SD = 0.61). Therefore, we conclude that the VALS can effectively promote the students' learning satisfaction in the activity.

5.3 Technology acceptance

Table 3. Analysis of the students' usefulness about the proposed VALS

Questions	Mean	SD
1. I think that the VALS for Mechanisms can elevate learning effects.	4.30	0.73
2. I think that VALS for Mechanisms can elevate learning ability.	4.25	0.85
3. I think that the VALS for Mechanisms is useful.	3.90	0.71
4. I think that the VALS for Mechanisms can elevate my efficiency.	3.45	0.82

Table 4. Analysis of the students' ease of use about the proposed VALS

Questions	Mean	SD
1. I think that the interface of VALS is clear.	4.05	0.75
2. I think that the VALS is easy to use.	3.95	0.94
3. I think that the VALS for Mechanisms is easy to use.	4.05	1.05
4. I think that the combination of VALS for Mechanisms can make learning activities easier.	4.10	1.21

The results of technology acceptance questionnaire are shown in Table 3 and 4. The average rating of the perceived usefulness is 3.97. Most students think that VALS for Mechanisms can elevate learning ability (mean = 4.25 and SD = 0.85), and they consider that the VALS for Mechanisms can elevate my efficiency (mean = 3.45 and SD = 0.82). This fact indicated that students almost agree with the efficacy of Mechanisms combined with the VALS. For the perceived ease of use, the total average value is 4.03. Students think that the combination of annotation tool for Mechanisms can make learning activities easier (mean = 4.10 and SD = 1.21), and

they think that the VALS is easy to use (mean = 3.95 and SD = 0.94). For these results, most students accept the interface of the VALS for Mechanisms.

6 DISCUSSION

To promote students to understand the dynamic process of mechanical operation, a video annotation learning system was proposed to provide learners can effectively learn the dynamic contents to understand the learning content. The experimental results indicated most students believe that it can elevate learning interest and promote learning achievements; this is the same as the opinion in the questionnaires. The context of using VALS to learn can inspire student learning motivation. Some students stated that this type of learning system can make natural Mechanisms more interesting and attractive. Students hoped that this type of operations can be applied to other courses, because it would make learning activities more fun. They suggested that the mechanical course is a boring one, but they found that learning methods that focus on playful experiences are good. Thus, they believed that the same effect will show up in other courses.

Based on related results, we consider integrate multimedia into mechanism curriculum, and it can promote students to understand the dynamic process of mechanical operation. This result is similar to Mu (2010) have attempted to use video, animation and computer simulation software to improve students' learning outcome [3]. In addition, novel learning materials have been used more widely in real learning environment, such as e-books, digital content, and multimedia content. More and more educators have applied multimedia learning materials to classroom activities and in learning environments, because they have the advantages of easy to share, easy to carry and easy to annotate more than textbooks. Besides, previous studies also explored that the effectiveness of using annotation tools on digital learning materials to promote students' learning performance [13], and the results of these previous studies show that using annotation tools can promote the learning performance of students in their learning environments. Therefore, the effects of annotations on video are similar to the previous studies.

7 CONCLUSION

In this study, a video annotation learning system was proposed to enhance the effects of video learning in the mechanical engineering course. In order to investigate the acceptance of the proposed system, this study develops a questionnaire which includes three factors are learner's learning satisfaction, learner's learning interest and technology acceptance. An experiment was conducted to understand students' learning satisfaction of the proposed system. The questionnaire results showed students think video annotation learning system for learning Mechanism is useful and ease to use, and they have high learning interest. At the same time, students have a better learning satisfaction for the video annotation learning system and as reference for future instructional experimental design.

ACKNOWLEDGMENTS

The authors would like to thank the National Science Council of the Republic of China for financially supporting this research under Contract No. NSC 102-2811-S-006-002, NSC 101-2511-S-041-001-MY3, NSC 100-2511-S-006-015-MY3, NSC 100-2511-S-006-014-MY3, and NSC 101-3113-P-006-023-. In addition, this study is conducted under the "Cloud computing systems and software development project (2/3)" of the Institute for Information Industry which is subsidized by the Ministry of Economy Affairs of the Republic of China.

REFERENCES

[1] Borgers, Tilman. (2008). An Introduction to the Theory of Mechanism Design. Retrieved May 10, 2013, from http://www.econ.yale.edu/~dirkb/teach/521b-08-09/reading/2008-mechanismdesign.pdf

[2] Mabie, H. H., & Reinholtz, C. F. (1987). Mechanisms and dynamics of machinery (4th ed.): Wiley.

[3] Mu, X. (2010). Towards effective video annotation: An approach to automatically link notes with video content. *Computers & Education*, Vol. 55, No. 4, pp. 1752-1763.

[4] Hegarty, M., Kriz, S., & Cate, C. (2003). The roles of mental animations and external animations in understanding mechanical systems. *Cognition and Instruction*, Vol. 21, No. 4, pp. 209-249.

[5] Mayer, R. E., & Moreno, R. (2003). Nine ways to reduce cognitive load in multimedia learning. Educational Psychologist, Vol. 38, No. 1, pp. 43-52.

[6] Tversky, B., Morrison, J. B., & Betrancourt, M. (2002). Animation: can it facilitate? *International Journal of Human-Computer Studies*, Vol. 57, No. 4, pp. 247-262.

[7] Kırkgöz, Y. (2010). Promoting students' note-taking skills through task-based learning. Procedia. *Social and Behavioral Sciences,* Vol. 2, No. 2, pp. 4346-4351.

[8] Brunken, R., Plass, J., & Leutner, D. (2003). Direct measurement of cognitive load in multimedia learning. *Educational Psychologist,* Vol. 38, No. 1, pp. 53-61.

[9] Chun, D. M. (2001). L2 reading on the web: strategies for accessing information in hypermedia. *Computer Assisted Language Learning,* Vol. 14, No. 5, pp. 367-403..

[10] Wentling, T. L., Park, J., & Peiper, C. (2007). Learning gains associated with annotation and communication software designed for large undergraduate classes. *Journal of Computer Assisted Learning,* Vol. 23, No. 1, pp. 36-46.

[11] Lai, Y. S., Tsai, H. H., & Yu, P. T. (2011). Integrating annotations into a Dual-slide PowerPoint presentation for classroom learning. *Educational Technology & Society,* Vol. 14, No. 2, pp. 43-57.

[12] Ball, E., Franks, H., Jenkins, J., McGrath, M., & Leigh, J. (2009). Annotation is a valuable tool to enhance learning and assessment in student essays. *Nurse Education Today,* Vol. 29, No. 3, pp. 284-291.

[13] Hoff, C., Wehling, U., & Rothkugel, S. (2009). From paper-and-pen annotations to artefact-based mobile learning. *Journal of Computer Assisted Learning,* Vol. 25, No. 3, pp. 219-237.

[14] Cronbach, L. (1951). Coefficient alpha and the internal structure of tests.

Psychometrika, Vol. 16, No. 3, pp. 297-334.

[15] Roberts, M. L., & Wortzel, L. H. (1979). New life-style determinants of women's food hopping behavior. *The Journal of Marketing,* Vol. 43, No. 3, pp. 28-39.