

## **The acceptance of using an annotation approach on Tablet PC-based e-book in a mechanical engineering course**

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## **1 INTRODUCTION**

With the development of mobile devices and 3G network rapidly, mobile learning has been a popular tendency in our daily life. Mobile learning devices have the characteristics of digital information and provide the mobility of learning. Several studies have explored the advantages of using mobile devices in mobile learning activity [1][2]. Mobile devices applied on learning activities can increase learning motivation and improve learning performance effectively. In addition, Tablet PCs have become a popular mobile learning device, which support a broader range of multimedia audiovisual functions and have larger screens than other mobile devices.

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Moreover, learners can use Tablet PCs to download the useful educational applications in the APP Stores to obtain the important knowledge. Tablet PCs offer a better operational and multimedia learning environment for learners.

In traditional teaching model of mechanical engineering education, an instructor usually uses textbooks or slides to introduce the knowledge of mechanical engineering in the classroom. For example, Mechanism is an important course to describe the basic concepts of the mechanical components in the field of mechanical engineering. Mechanism includes kinematics, mechanics, and mathematics to explain the law of motion of the machinery [3]. Due to learning the concepts of Mechanism is a basic condition to be a mechanical engineer, understanding the dynamic process of mechanical operation is the first step to learn Mechanism. However, static pictures of textbooks or slides in the traditional instructional approaches are difficult to present the dynamic process of mechanical operation.

In order to facilitate learners to understand the dynamic process of mechanical operation thoroughly, this study uses Tablet PC which supports the presentation of multimedia materials via video and animation to assist learners to understand the dynamic process of mechanical operation learn Mechanism. At the same time, learners can use Tablet PC to learn Mechanism anytime and anywhere. Moreover, this study proposed a multimedia annotation learning system which included traditional annotation tools assist learners can learn the contents of multimedia materials by annotation strategies to learning the principle and mode of mechanical operation.

To realize whether the annotations would attract learners' attention, the eye-tracking technology was utilized to investigate learning process of learners. The point of gaze and the movement of the eyes were recorded to trace learners' effectiveness of using the Tablet PC, and eye-tracking data would be additional evidence to explain learners' cognitive behaviors and mental thought for learning. In addition, a questionnaire was developed to evaluate learning satisfaction, learning interest, and technology acceptance to understand whether uses Tablet PC to learn Mechanism is effective for learners, and then provide suggestions for future studies.

## 2 RELATED WORK

Multimedia learning has developed rapidly, and its achievements have become a center of attraction. Multimedia materials are a combination of text, audio, image, animation, video, and interactivity content forms. The relative studies devoted to multimedia application has been present the practical importance in the field of instruction and learning. Multimedia had a positive impact on learning and teaching [4]. Moreover, with the development of mobile devices, many researches of multimedia learning investigated the learning effect about the combination of the different multimedia environments in mobile learning environment [5][6].

Annotation is a note by highlighting, underlining and writing text while reading information in a book to facilitate readers to understand the knowledge of reading content. Many studies have indicated that note-taking assists to promote learning performance [7][8]. Annotation has been used in computer-based multimedia learning, and gain the good learning outcome. Hwang et al. explained that the annotation tool enhanced their learning and the test results for those students [9].

With development of mobile devices, Tablet PCs have been used more widely in mobile learning environment, which can provide digital content and multimedia functions. In this study, a multimedia annotation tool is developed on the Tablet PC to assist students to annotate the important content of multimedia learning materials in mechanism curriculum.

### 3 THE PROPOSED ANNOTATION LEARNING SYSTEM

This study proposed an annotation learning system, namely ALS. A user-friendly interface of this ALS was conducted to support traditional annotation functions. In Figure 1, the interface was divided into three parts; media display area, annotation time list area, and annotation maker bar. 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.

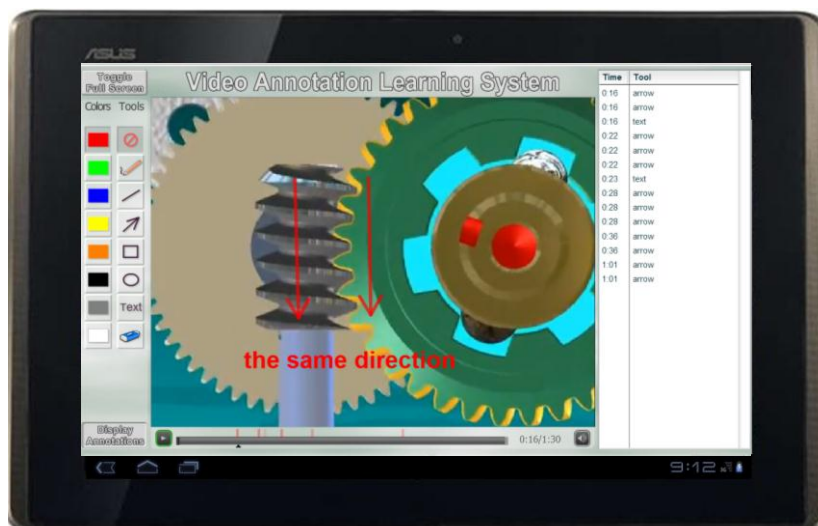


Fig. 1. The interface of the annotation learning system on the Tablet PC

## 4 EXPERIMENT DESIGN

### 4.1 Experimental procedure

There are 15 university students majored in Engineering Science to participate in this experiment. All of them completed eye-tracking experiment and did the questionnaire. During the experiment, participants used the proposed ALS to learn

the materials via a Tablet PC. After the experiment, the questionnaire survey was given students to evaluate their learning satisfaction, learning interest, and technology acceptance towards mechanical engineering course. At the end of questionnaire, students were interviewed to clarify some questions on their mental thought.

## 4.2 Measuring tools

In order to evaluate learning satisfaction for using ALS, a questionnaire was conducted by professional instructors. We used the SPSS software to analyse the reliability of the questionnaire. This questionnaire was designed based on learning interest, learning satisfaction and technology acceptance. The purpose was to collect information about the students' learning interest for using the ALS in the first factor of this questionnaire. The second factor was to explore the students' learning satisfaction for utilizing the ALS. The third factor was to investigate the students' technology acceptance for using the ALS. We use a five-point Likert scale (strongly agree, agree, neutral, disagree, and strongly disagree) to evaluate each question. In addition, the Cronbach's  $\alpha$  value of the questionnaire is 0.72.

## 4.3 Data collecting and analysis

This study mainly collected eye-tracking data and questionnaire survey. Eye-tracking data analysis display the whole process of learning material toward mechanical engineering course, that is, the scan path or distribution of attention of cognitive behaviors on the screen can distinguish some slight differences on learning process. Moreover, the questionnaire survey would show the effectiveness of learning satisfaction, learning interest, and technology acceptance by statistical measurement.

# 5 RESULTS OF THE EXPERIMENT

## 5.1 Questionnaire analysis

*Table 1.* Analysis of the questionnaire about the proposed ALS on the Tablet PC

Questions	Mean	SD
1. I like to use the Tablet PC learn Mechanisms knowledge.	4.18	0.83
2. Using the Tablet PC is very interesting for me.	4.31	0.70
3. I like to use the Tablet PC to me understand the key points.	4.12	0.61
4. I like this Tablet PC can be used in other curriculums.	4.37	0.80
5. I consider that the Tablet PC could help me understand Mechanism.	4.31	0.70
6. Are you satisfied for the Tablet PC in the Mechanisms course?	4.06	0.68
7. I believe the Tablet PC can enhance the impression of Mechanism.	4.31	0.70
8. I recommend this Tablet PC to my friends.	4.12	0.71
9. I think that the Tablet PC for Mechanisms is useful.	4.37	0.71

10. I think that the Tablet PC for Mechanisms can elevate my efficiency.	4.18	0.54
11. I think that the Tablet PC is easy to use.	4.43	0.62
12. I think that the interface of Tablet PC is clear.	4.31	0.70

The mean and standard deviation are shown for analysis of the questionnaire for using ALS on the Tablet PC in Table 1. The results reveal an average value of 4.26 and a standard deviation of 0.69. The fact shows that this Tablet PC could enhance their learning interest and most of students stated that they liked to use annotation on the video to learn knowledge. Students feel this Tablet PC is very interesting (mean = 4.31 and SD = 0.70), and they like this Tablet PC can be used in other curriculums (mean = 4.37 and SD = 0.80). Moreover, they consider that the Tablet PC could help them understand Mechanism (mean = 4.31 and SD = 0.70). Therefore, using Tablet PC can promote the students' learning satisfaction.

## 5.2 Eye tracking analysis

According to the eye tracking data analysis, this study found some slight differences about learners' cognitive process. First, the left one of Fig. 2 showed that students paid more time to the connection position of different gear wheels. This result revealed that they only thought about the relationship of motion on these separate gear wheels. However, the right one of Fig. 2 showed that other students pay attention to the whole components of this machine, including gear wheel, axle, and so on. This result revealed this type of students paid attention to the whole components of machinery. They thought about the relationship of motion by the systematic understanding on this machine. To sum up, the distribution of attention via eye-tracking data let us deeper distinguish different mental thought of different types of students.

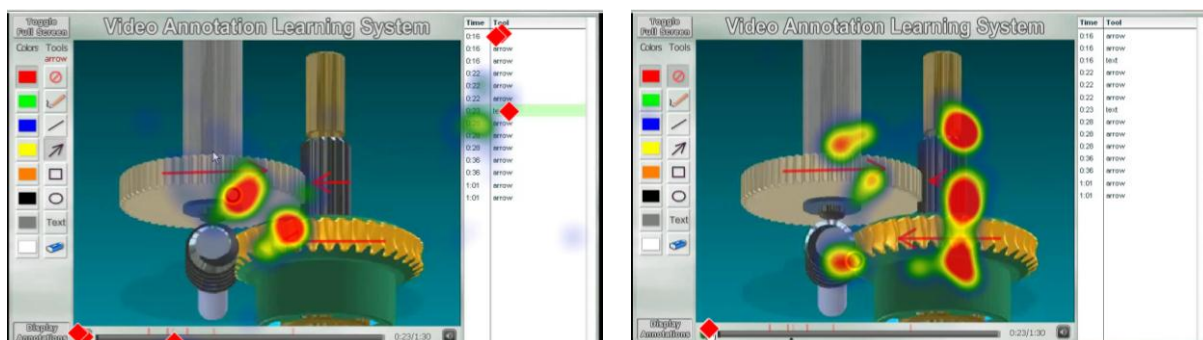


Fig. 2. Comparison on different viewing behaviours

In addition, Fig. 3 showed the scan path of someone's cognitive process. It displayed the whole process of learning and the duration on different component of learning material. Fig. 3 mainly revealed one student utilized ALS to review the important content of motion on different gear wheels. He quickly found the section of learning video via ALS and then repeated review the annotation and important content of digital material. In this way, this study inferred that the ALS really assist learners understand the motion of machinery effectively.

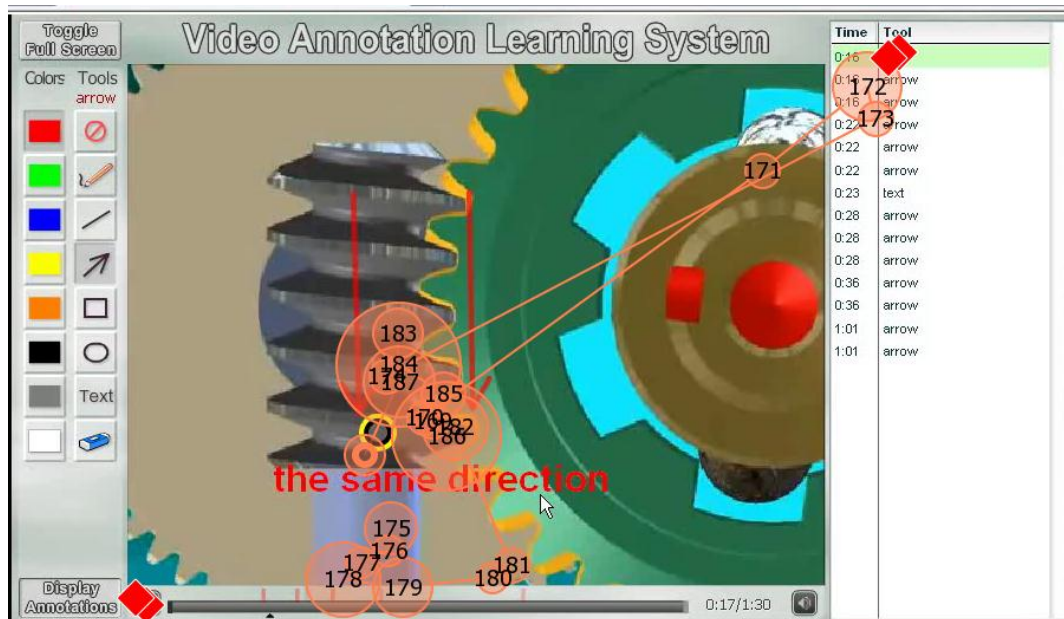


Fig. 3. Scan path of cognitive process

## 6 SUMMARY AND ACKNOWLEDGMENTS

In this study, VALS was proposed to provide learners effectively understand the dynamic contents about the motion of machinery. The results of questionnaire survey indicated VALS could elevate most students' learning interest and satisfaction. The relevant results showed the using of VALS could inspire students learning motivation so that to learn better. Based on eye-tracking related results, this study suggested the integration of multimedia into mechanical engineering course could effectively promote students to understand the dynamic process of mechanical operation. The scan paths of learning via e-Book exactly reflect the whole process of cognitive thinking. As the previous sample of scan path, it displayed learner gazed on one position in the screen and then shifting his attention to next position. According to the process of attentional shifting, the scan path can replay the cognitive process and clarify different pattern of learning. Moreover, the related studies also stated that digital learning materials have been applied in real learning environment widely, such as e-Book or digital video. This study also explored that the effectiveness of using annotation tools on digital learning materials could promote learners' performance of learning mechanical engineering course. To sum up, VALS was proposed to enhance the effectiveness of digital video learning in the mechanical engineering course. The exploration on learners' learning interest, learning satisfaction, and technology acceptance was conducted by questionnaire. The questionnaire results showed VALS is useful to make learner learn better. At the same time, eye-tracking results more let us clarify and understand deeper the whole learning process. So, the integration of VALS into multimedia video in a mechanical engineering course will make learner have better comprehension on the course of mechanical operation.

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