A New Framework for CAD Education with Workflow-based Document Management System

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This research presents a new CAD educational support framework using a document management system called ShareFast, an open source, client/server application based on workflow. The objectives of the framework are to help make it easy to maintain and improve learning materials, and establish a faster and more efficient (on time with correct design output) education for CAD software operation. This educational framework has been used for empirical studies with university students. The results shows that the framework can shorten the students' learning duration by means of learning materials improvement, and it helps the instructor to understand the student's problems in real time.
Key words: CAD, e-Learning, Document Management System, Workflow

1. Introduction

CAD systems have become central to process from the earliest design phase to final production in product design industry[1]. As a result, the educational field of CAD software has responded strongly. However, CAD education is not very simple. Students have to learn both design process and the use of CAD software. Moreover, teachers find it difficult to manage the class and learning material that involves many information technology aspects[2].

According to these difficulties, a framework for CAD education is necessarily developed to provide enhanced design assistance to students and aid them undertaking design coursework and using CAD software. This would provide a system to formalize and support the connectivity between various design activities of the coursework as well as provide links to electronic learning materials of design data and design methods. It is compatible with design software such as the modules of Tribon Initial Design.

2. CAD educational support framework using ShareFast

The CAD educational support framework using ShareFast is illustrated in Fig 1. The framework consists of five main components, student, teacher, ShareFast system, IT infrastructure and CAD software. Teachers use ShareFast to prepare for the class. Students learn how to use CAD software from learning materials and facilities provided by ShareFast. IT infrastructure plays a key role in supporting both ShareFast system and CAD software[3].
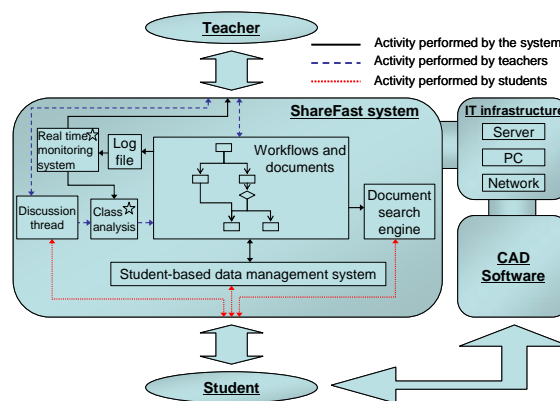

Fig. 1 Educational support framework

ShareFast is a client/server application for document management based on workflow using RDF metadata -- a model making

2/4

statements about resources in the form of subject-predicate-object expressions. The client program provides a workflow editor for users to create workflows and add any documents to each task node in the workflows. These documents can be displayed as instructions for the workflow processes.

In educational aspect, teachers can use the workflow editor tool to create workflow process of CAD design, and add learning materials to the related tasks in the workflow. Students can learn CAD design by following each task with related documents, as shown in Fig 2. Using discussion threads, student and teacher can add discussion messages to any workflow or task to discuss a particular subject. ShareFast also keeps track of student's actions after they log in to the system by writing to log file.
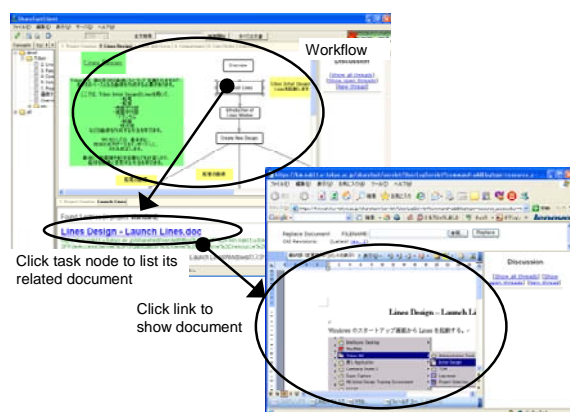
Fig. 2 Working with the system

The newly developed features for the educational framework, class analysis and improvement system, and real time operation monitoring system, will be explained in the next section.

3. New features for the framework

3.1 Class analysis and improvement system

From students' query messages in discussion threads and students' behavior captured by log file, the instructor can evaluate and analyze the class quality. The

instructor will know the task that students spend too much time on, frequently ask questions, or the task that students have to get back to read its document many times. The instructor can consequently check the task material and improve it for the next class.

Using this feature, it is expected that the students would be able to operate CAD software more smoothly, and have less questions and problems that will cause the quality of the class and the class delay.

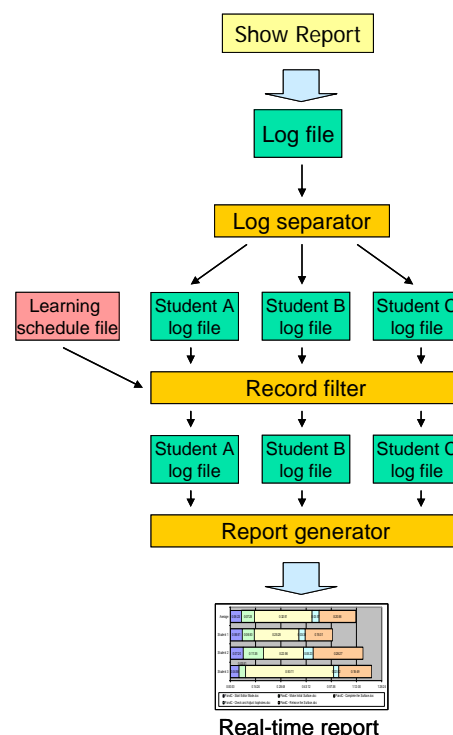### 3.2 Real time operation monitoring system

Fig. 3 From log file to operation report

This feature aims to help the instructor to monitor students' learning progress in real time in order to understand students' problem and control the class to be finished within the expected time. It is expected to help the framework to achieve establishing a faster and more efficient CAD education.

Fig 3 shows how the system transforms the log file, keeping student names, student actions and time stamps, to the report after instructors perform this function. The log separator component will read the log file and

3/4

generate an individual log file for each student. Then, the individual log files will be read and eliminated the duplicate or un-used records as well as reformed by the record filter component. Finally, the report generator will read all the reformed individual log files and generate the real time graphical report in HTML format, illustrated in Fig 4, and show to the user (instructor).
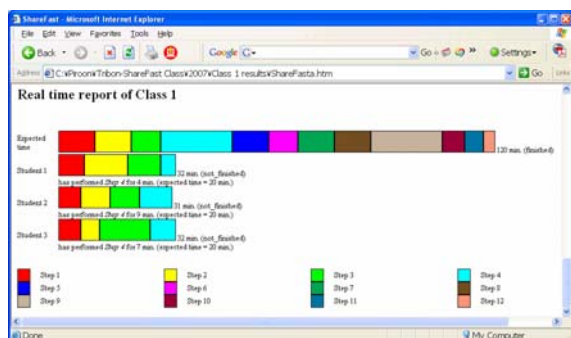

Fig. 4 Example of real time report

4. CAD software experimental classes

The experiment was to teach students how to work with a commercial CAD software package for ship design called Tribon M3 using ShareFast as e-learning system in the CAD educational framework. The two main features of the framework, to help instructors improve learning materials, and monitor students to control the class to be finished within the expected time, will be evaluated during the experiment. The experimental classes were conducted for two years, 2006 and 2007. Students will be asked to fill in a questionnaire after classes.

4.1 Experimental class 2006

The classes were conducted on two groups of three students. The instructor conducted class analysis after the group-one class, and improved the class content to use in the group-two class. The analysis was based on learning record from log file and messages posted by the students. The real time monitoring system was not used in this year experiment

Fig 5 shows the graph made from log file. From the graph, the instructor found that Student 3 spent very long time in Complete the Surface task. The instructor can later on investigate the problem. Fig 6 shows that Student 3 went back to do some tasks again as he hadn't finished them in the first time. Later on, the student was asked about this and he said that it was because he could not continue the next task as the previous tasks had not been finished yet. This kind of behavior can indicate that student was unclear about the learning material, and consequently, it should be simplified.

4.2 Experimental class 2007

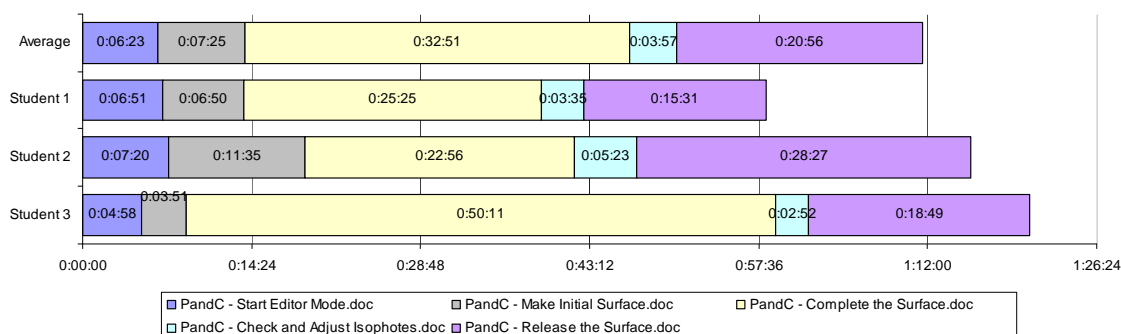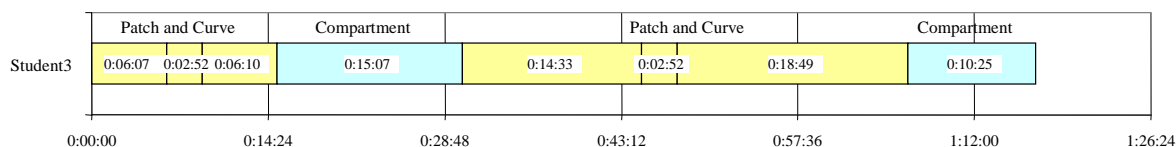The main objective of the experimental class 2007 was to evaluate the real time

Fig. 5 Individual learning record in Patch & Curve module made from log file

Fig. 6 Individual learning record of student 3 during "Patch and Curve" and "Compartment

operation monitoring system that it can help establish a faster and more efficient (on time with correct design output) education for CAD software operation.

There were three groups of students in class 2007. The numbers of students are 3, 3, and 6, respectively. The real time operation monitoring system was introduced in this year's experiment. Class analysis and improvement method was conducted after group one and group two classes, and the improved learning materials were used in group three class.
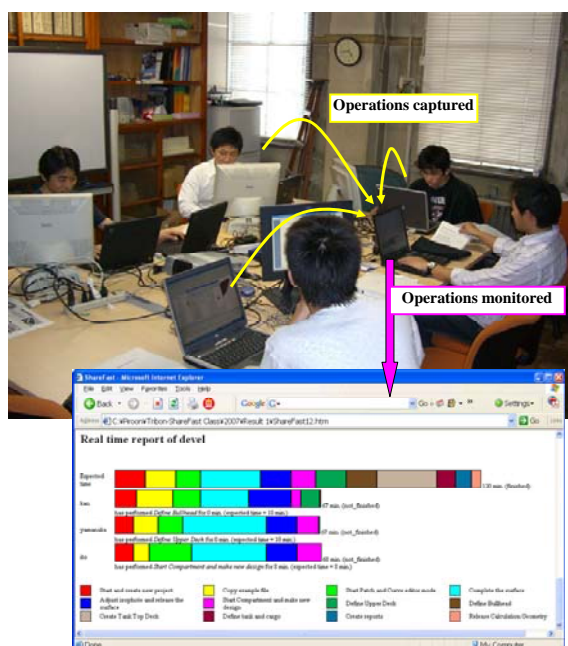

Fig. 7 CAD operation captured/monitored

Fig. 7 shows how the monitoring system works. During the class, the instructor will be able to see the students' progress of CAD operations captured by the system. It can tell what tasks the students are working on, and how long they have been in those tasks, in graphical image. The instructor will know from this graph if any students are spending too long time on any task. Consequently, the students can get helped before they spend time any longer, and the class duration as a whole can be effectively controlled.

5. Discussion

The 2006 experiment proved that log file paved the way to the class content improvement, consequently resulting in shortened class duration and trouble reduction. The real time monitoring system was verified in the 2007 experiment. With this function, the instructor could notice if any students are performing behind schedule and help those students not to be so late in the operation. Moreover, all of the students in class 2007 could complete every task of every module, and 11 out of 12 students could finish the class within the expected time.

6. Conclusion

A CAD educational support framework was proposed. The experiment results showed that the learning materials were able to improve as it could shorten learning duration and reduce number of students' questions asked. Moreover, the framework was able to establish a faster and more efficient CAD education as it helps the students understand design methods using the software, according to the questionnaire, and helps control the classes to be finished within the expected duration by means of the monitoring system.

References

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