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Using "live" demos and tests for CAD/CAM technology training

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Abstract

The author use 'live' instructions and tests extensively for training mechanical engineering students in CAD/CAM technologies. Creating such training and testing materials requires no special computer skills from the instructor. It is recommended this training technology to all instructors whose discipline involves computer programs. The author use 'live' instructions and tests extensively for training mechanical engineering students in CAD/CAM technologies. The students have noted their effectiveness, and many of them prefer 'live' instructions to conventional text ones. The tuition technology can be used both on the spot and for online learning courses.

Keywords:

student	CAD/CAM
training	flash
AdobeCaptivate	interactive instruction

1 Introduction

The Ukrainian Engineering-Pedagogy Academy has been training engineers-instructors for power engineering, the printing industry, the light industry, machine building, transport, civil engineering, etc. A modern engineer works with software; hence, the skill of using industry-specific CAD/CAM/CAE is one of the key competences to be instilled in a graduate. For example, Academy graduates majoring in machine building, besides being skilled in Office software, become proficient users of the following software packages: SolidWorks, SolidWorks Simulation, Kompas, Delcam for SolidWorks, and TekhnoPro. They also get familiarised with AutoCAD, MathCAD and PowerMill.

An effective technology of CAD/CAM/CAE software training differs significantly from that used in humanities and sciences, and mathematical and engineering disciplines. At the initial training stage, the technology is focused to memorising the software interface elements and the sequence of actions for executing specific tasks. In turn, tasks include typical problems, which are executed stepwise, and the instructions are built around the principle "Do as I do".

For this kind of training, the conventional approach is to use text instructions with illustrations for the stepwise algorithm. However, they have a significant drawback, viz. when mentioning the names of buttons and interface elements, the student cannot find them at once. Besides, detailed instructions on navigating the software menu are very verbose.

2 Literature Review

A "live" instruction, which not in words but visually demonstrates work procedures, is much more effective. Earlier, only one technology of creating such instructions existed, and this was video. Creating videos, in the first place, was a challenging task because it was necessary to record videos for separate stages of the task,

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then clip required video segments there from, arrange them in the required sequence on the timeline, add transition effects, and overdub. Only a handful of instructors were able to do this.

Secondly, the size of the video films was big (hundreds of megabytes for a 10-minute video clip), making this difficult to use such materials in online learning. Compressing with video codecs made the image blurred. The student also remained a passive observer of the video (Kovalenko, Kupriyanov, & Zelenin, 2012). Creating flash videos manually is still more challenging.

The emergence of Captivate reversed the situation. Adobe Captivate allows making compact and interactive multimedia tutorial materials using the flash technology. The final demo comprises a frame sequence, with mouse movements and keyboard manipulations also recorded. What matters is that the student is not a passive viewer because he/she can be aroused by being asked to answer questions and choose interface elements. The final demo is also appended with audio instructions.

Adobe Captivate help for creating eLearning scenarios (Duvall, 2014) for online education. Materials developed by Captivate can be successfully applied in on-line and off-line training.

Based on examples of using the studied software, interactive scenarios can help students solve problems, make decisions and learn the real interface of programs. One of the most difficult tasks is to plan and storyboard the training scenario itself (Stewart & Brown, 2008).

Interactive scenarios implemented in Captivate are widely used to study mechanical engineering and machining. Study (Yılmaz & Tuncalp, 2011) aims to investigate the effect of a Web-based mixed learning approach model on mechatronics education. Captivate integrates various methods of perception, such as reading, listening, speaking and practice, developed in accordance with the professional experience of engineers in this field.

Recent developments in e-learning authoring software, such as Adobe Captivate, have greatly simplified the task of developing engaging and pedagogically effective interactive learning modules (Jaksa, 2012). It provides several advantages over traditional forms of learning, such as increasing student engagement and improving their experience, providing an appropriate learning context and an active learning environment.

The interactive approach implemented in the training material allows students to immerse themselves in an active learning environment that allows them to achieve higher learning outcomes, while having a support structure that provides basic information in an attractive and effective way. Surveys show that 85% of students believe that a hybrid approach is more conducive to learning than more traditional learning formats (Maier, 2014).

3 Features of creating interactive multimedia materials for CAD/CAM instruction in Captivate

The sequence of creating ‘live’ demonstrations in Captivate is as follows:

1. Select an application window to be recorded. The record mode (StoryboardView) is activated.
2. The instructor executes the design taskin the computer program, and instructor’s actions are automatically recorded as a sequence of slides.
3. Transition to the edit mode (EditView). No longer needed slides are deleted.
4. The sequence of mouse actions is verified to achieve the result.
5. Hints for the student are added or redefined. Screen areas are backlit.
6. Elements of obligatory responses of the student are configured.
7. Test slides are added and customised.
8. Transition to the navigation mode (BranchingView). A navigation slide is createdand the nonlinear structure of transition between slides is adjusted.
9. Audio instructions are recorded.

The navigation slide (Fig. 1) is important for the student to understand the scope of work as a whole. Returning to this slide after having covered separate sections makes it possible to continue studies from a certain stage. This helps the student understand, which part of the work has been done.

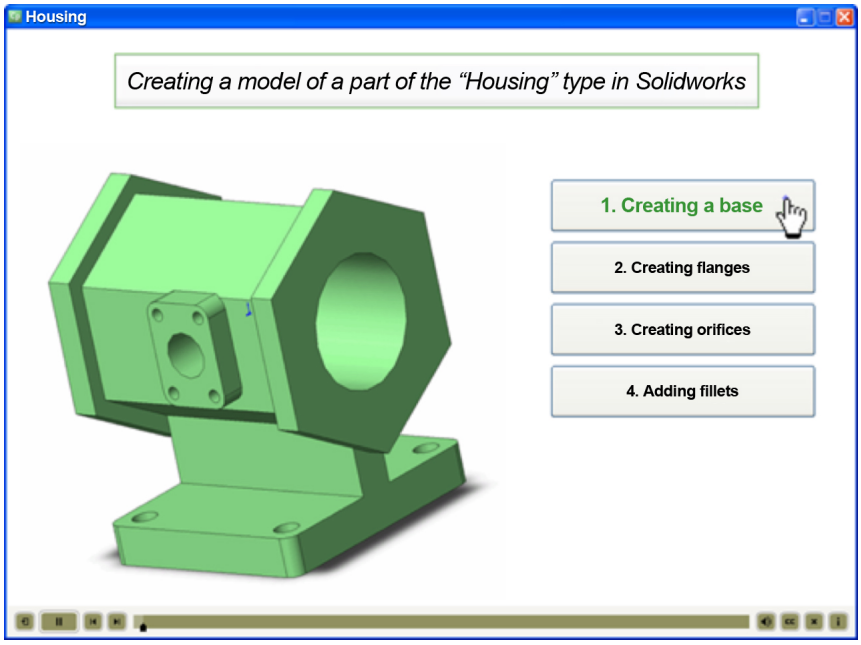

Fig. 1: Navigation slide of a "live" demonstration

Interactivity in Captivate is implemented by setting screen areas on the slide, which have to be selected to continue the video. The demonstration will not continue (Fig. 2) unless the student clicks the mouse on this area. This element significantly enhances the memorising of key elements of the workflow because teachings converted from the level of simple perception to that of reproducing.

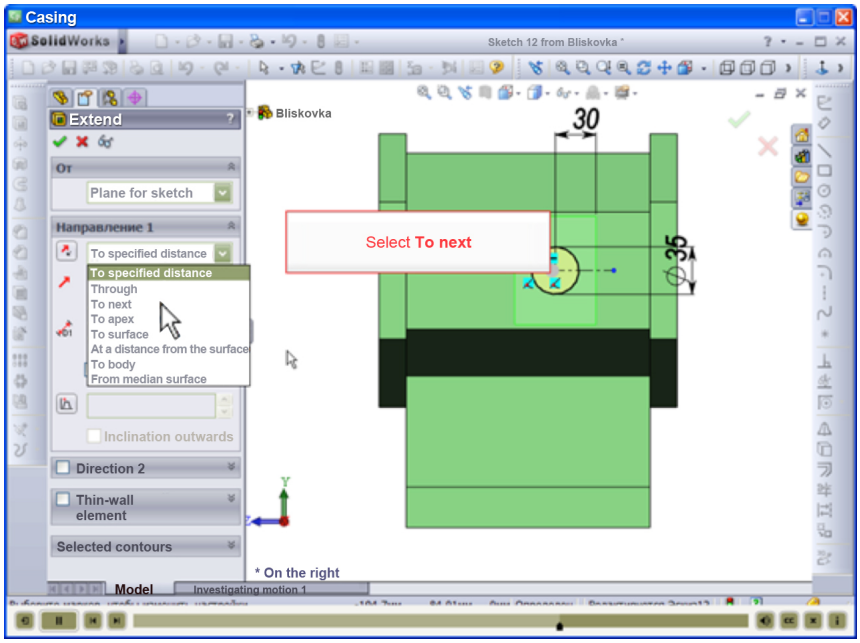

Fig. 2: The hint to perform the key element of the work appears when a wrong action has been executed

The majority of students use "live" demonstrations simultaneously with executing the obligatory practical task: they review a "portion of the material", and then proceed with execution. Hence, another advantage of such "stop points" is that they help in splitting the entire demonstration into separate "portions". The student reviews a separate portion, and when the demonstration comes to feedback, the student switches to the application window and executes a "portion" of the work. An important point here is that the "portions" should not be very big, making it possible to memorise them in the short-term memory.

Classical testing with generalisation of results (Fig. 3) can also be organised in Captivate. Testing can be done both with a training purpose, when correct answers are displayed at once, and with a control one.

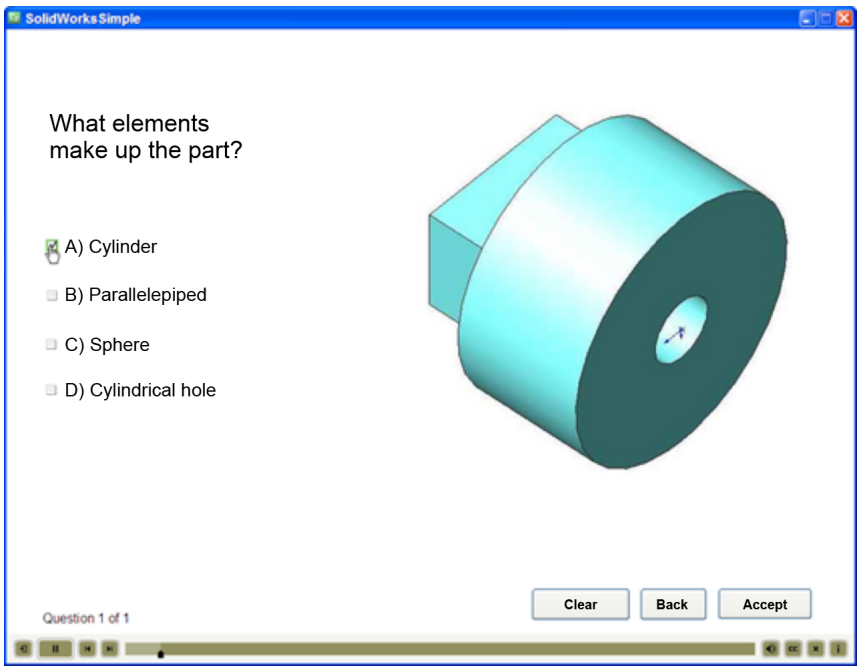

Fig. 3: Example of a test task

It is worth mentioning that, thoughthe possibilities of organising Captivate testing deserve attention, they do not exceed the performance of other testing programs.

After a "live" demonstration has been created and customised, it is published in a format practical for applying without Captivate. The program provides for many result formats, with two of them being used primarily in practice:

- Flash (SWF) format for use in online learning in web browsers.
- Media (EXE) format for starting an individual file.

When creating live demonstrationsand tests, an important issue is proper selection of the resolution of the resulting video because flash materials cannot be scaled. Here one has to look to the smallest screen size in the target group of users. The authors recommend creating 'live' demonstrations with a resolution of 1024x768 pixels.

The size of the interactive presentations obtained is tens of megabytes. When used for online courses, splitting them into smaller parts would be practical.

4 Advantages and usage of "Live" testing

Apart from training, the instructor has to test students' skills. Classical closed-form tests are ineffective when testing CAD/CAM software user skills because the set of offered answers a priori simplifies finding the right answer.

"Live" testing implemented, for instance, when passing Microsoft Office Specialist exams, is built on practical testing of skills. The student being tested solves practical tasks, and the software environment evaluates the correctness of the student's actions to achieve a result. Hence, skills are tested not through test questions, but directly. Such testing of skills is most adequate; however, its implementation is accessible only for software developers and is overwhelming for instructors.

Captivate makes it possible for ordinary instructors to simulate "live" testing. The student being tested is shown an image of the program interface and offered to do actions leading to the proper result. User clicks are tracked. Such a test can work both with tuition in view when the student being tested is told whether the

action has been correct and as a test one without any messages to the student. An example of a test is shown in Fig. 4.

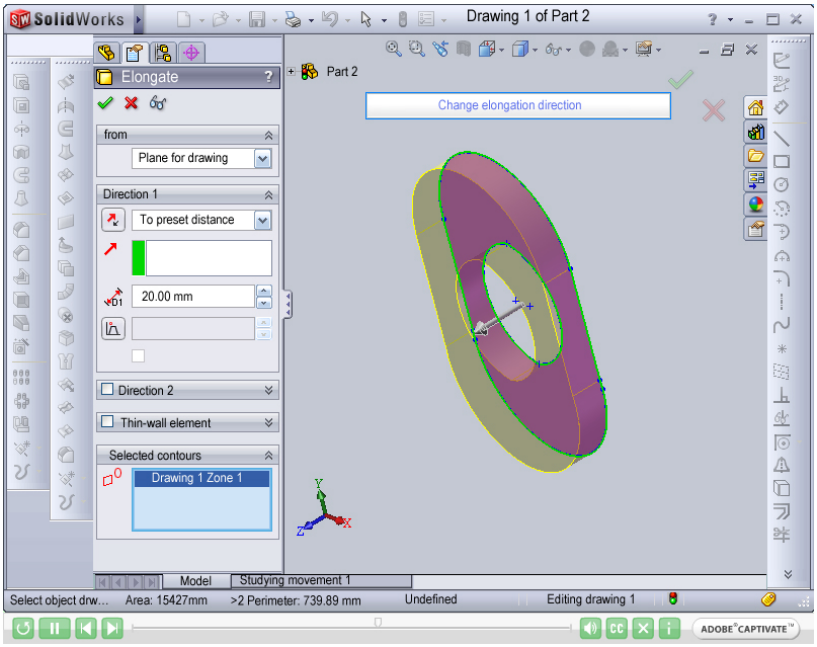

Fig. 4: Example of a "live" test task

"Live" testing in Captivate is very effective, though it has some deficiencies. The deficiencies of the technology of simulation tests in Captivate are as follows:

- Only one method of executing a given task can be checked, though at the same time there can be many of them.
- No tools are available to generalise user's actions with the purpose of converting them to an evaluation summary.

5 Conclusions

The author use "live" instructions and tests extensively for training mechanical engineering students in CAD/CAM technologies. The students have noted their effectiveness, and many of them prefer "live" instructions to conventional text ones.

Creating such training and testing materials requires no special computer skills from the instructor in video editing and/or flash technologies. The training materials are created interactively, with the proper sequence of instructor's actions being recorded in the background.

"Live" simulation of performance created in Captivate, besides demonstrating a sequence of actions, enhances the memorising of key points. In the course of simulation, the student is offered to select interface elements with the mouse. This is done using the Captivate function. The user is required to click the mouse in a predefined area of the image. Each simulation can be divided into sections, allowing to continue training from the middle.

The author have developed a set of interactive training materials for laboratory exercises in the software products SolidWorks, CAMWorks and TekhnoPro. The language of the materials is Russian.

The author recommend this training technology to all instructors whose discipline involves computer programs. The tuition technology can be used both on the spot and for online learning courses.

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