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TEACHING AND ASSESSING CAD USING ONLINE DEMONSTRATIONS

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ABSTRACT
A wide range of differences in student learning styles and computing abilities can make the teaching of Computer Aided Design (CAD) notoriously challenging. This study evaluates a novel approach to teaching and assessing CAD using video and Camtasia Studio 5 to capture working demonstrations of Rhinoceros 3.0 and Solidworks 2007 3D modelling. The approach also introduced a novel method of assessment of CAD knowledge, whereby students themselves generate an online demonstration, talking through their approaches and techniques to develop a CAD model of their own. The rationale was to present a clear means of assessing student understanding, to encourage the students to apply their skills to their own design work and to create a community of learning where students share ideas, tips, and experiences and can learn from each other. Students responded well to the relaxed nature of the tutor demonstrations, accepting reasonable mistakes and appreciating the ability to be creative in their own work. This helped to overcome the initial fear of a live recording. The communal learning approach also provided a means to improve students' attention to detail and their critical evaluation of different modelling approaches.

Keywords: Computer Aided Design (CAD), Camtasia, online, video, demonstrations, assessment

1 INTRODUCTION
CAD pedagogy can be challenging. Subject based, lecture led sessions can be slow and demotivating for adept and competent students. Student led sessions can equally be demotivating for less able students who struggle to get help from a tutor working his way slowly around a group. Traditional approaches to teaching and learning computer-aided design (CAD) have therefore tended to use a combination of techniques including live demonstrations, printed and online tutorial guides and textbook activities. Although effective in small classes with equal abilities, these methods still tend to be less effective in larger classes where students may not be able to follow demonstrations on their own and may become isolated or intimidated. CAD teaching can hence end up being prescriptive with little application in the context of the design process [1]. This in turn results in a superficial learning approach and poor ability to apply this knowledge to relevant design contexts. Students "want to obtain knowledge and skills that are most practical and useful to them when they become engineers" [1].

In a survey of industrial practitioners only 8% of participants think that current CAD education is adequate [1]. "Some colleges are still just teaching students simple 2D

drawing skills…even though some colleges have switched to 3D packages, the syllabus they present to students is not comprehensive and systematic" [1]. One of the real issues is ensuring that students receive an education in this area, rather than simply training. "Students came out of the class with the knowledge of what buttons to push, but not how to use the CAD software to enhance the design process, and with very little knowledge of how CAD works" [1]. Put simply, they want to learn in context. As a result of the survey, Ye et al (2004) summarises that the following are important in CAD education [1]:

- The ability to formulate the engineering problems
- The ability to use a computer in solving engineering problems
- A good understanding of the design process and PLM (product lifecycle management)
- Practice: the most important thing for CAD.

It has also been suggested that CAD training should include exercises in modular design, using CAD within a team environment, project management and on understanding important generic issues in CAD. "Training should provide more than the picks and clicks of specific software packages" [2].

2 RESEARCH CONTEXT

Developments in software and hardware, the growing trend in use of social networking and online streaming of video content, creates an opportunity to widen the scope of CAD teaching to accommodate a more diverse range of students and student learning styles [3] without a major shift in paradigm.

Software can capture lecture material, in the form of slideshows, as well as providing demonstrations using audio talk-throughs. Traditional teaching material can hence be turned into re-usable learning objects and interactive online learning material which can complement traditional teaching strategies at a relatively low time-cost to academics. In addition, students can use the software to then capture their own CAD efforts. Video recording software can augment this process, becoming a tool to assess the processes and techniques of students as they work. An example of this is asking students to generate online videos as they use the computers capture software as they develop CAD models or use particular features in the program. Capturing the student process as they work on the computer and as they work at the computer provides teachers with much more detail than a portfolio of finished models alone which may look polished and complete, but whose underlying rigor may be weak but time consuming to determine. Could it be created more efficiently? Was it even the work of that student? By having a step through demonstration of how models are generated, teachers receive a valuable insight into how students approach the problem and the depth and breadth of their knowledge in CAD techniques and the software used. An end model alone also allows little opportunity to give feedback on the technique, approach and range of features used. As a further benefit a database of student demonstrations encourages a community approach in learning CAD, where students can learn from the dead ends, tips, tricks and approaches of their peers.

However, although recent attention to re-usable learning objects (RLO's), online access to teaching material (such as Blackboard intranet software), shared networks (e.g. You-Tube) and readily available screen capture software has highlighted the complementary methods of teaching CAD, much attention is focussed on its value for students who

miss lectures or may miss detail in lectures, or who may require extra support with their learning, rather than the value of the learning experience in its own right.. Software companies that are trying to develop online demonstrations themselves show that such material is by no means comprehensive. Most of the material that is available through social network sites (e.g. You-Tube) and company websites is at best superficial and piecemeal. A new user to the software will gain little from these sites apart from an appreciation for the capacity for the software, with a limited coverage of instructional methods or critical awareness of the software and limitations.

It has been suggested that education driven research often leads to new insights, as well as to improved teaching [4, 5]. The aim of this study was therefore to add to the body of knowledge outlined by using Camtasia Studio 5 software by:

- Investigating the effectiveness of, and student responses to, a database of online demonstrations.
- Investigating the value of and student responses to a new form of assessment where students generate and share software demonstrations online.

3 ASSESSING STUDENTS WITH ONLINE DEMONSTRATIONS

The study was based on the first year module DP133 Communications 1, a compulsory year-long module for students within the product design portfolio at the University of Brighton. In the 2007-08 academic year there were 35 students in this module. Half of the module is not CAD, while the other is entirely CAD based and these halves are run in parallel throughout the year. A series of demonstrations were recorded at the beginning of the module to introduce the students to Rhinoceros 3.0 software. Examples of these include a recorded lecture introducing the package, creating a basic castle with general introduction, creating a flashlight using basic solid and surface features and calculating volume and surface area of a model.

In previous years the relevant CAD assessment involved two types of coursework: a group presentation/report and an individual portfolio of CAD work. In 2007-08 however, students were also required to produce an online demonstration of a Rhinoceros model and a Solidworks model. The criteria for this assessment included 1) clarity and coherence of voiceover, 2) clarity of presentation structure, and 3) level of detail in demonstration. These were chosen to ensure students paid attention to how they communicated themselves and their work and how they structured and prepared their presentation. It also placed an emphasis on their critical awareness of the package, in terms of options available, alternative approaches and limitations of various tools.

Students were shown how to use the software and were introduced to the online tutorials provided by the software developers. Students were required to submit their demonstrations using the university's online intranet. Guidelines were given (similar to the ones used by the teacher above) for preparing (planning, rehearsing), editing (mistakes are acceptable but no swearing) and producing (file type, size, resolution, frame rate) the videos. This facility allowed students to comment on each others work and staff were able to provide feedback and grade the work.

The following tutor observations were noted with respect to assessment:-

- After a slow response students engaged with the assessment well and produced some informative demonstrations.

- The demonstrations gave such an insight into the approaches, tools used and limitations to the students work that it was a more valuable feedback tool than had been envisaged.
- It was often the case that students were able to demonstrate a new feature that proved useful to them but hadn't been covered in class. They were pleased to be promoting the use of these to their peers, and this provided an obvious sense of satisfaction. They were then ultimately exposed to a variety of new techniques, tools and approaches and information on these could be accessed at any time.
- They could gauge where other students were at in their understanding of the package.

4 FEEDBACK FROM STUDENTS

A questionnaire was given in class after the assessment of student demonstrations where 27 students were present:-

1. 96% of students rated the online demonstrations by the tutor in the top 3 (of 4) most helpful for learning Rhinoceros, while 74% of students rated the online demonstrations by other students in the top 3 (of 4) most helpful for learning Rhinoceros. When prompted for an explanation, the following comments provide a cross section of responses:

- "Although the written tutorials are good, it's better to be talked through it"
- "Written tutorials are good to start but demonstrations are better later on"
- "Written tutorials were difficult to follow, unlike live demonstrations as you can ask questions"

2. When asked whether the online demonstrations (by the tutor) should complement or replace the written tutorials, students voted:

- Complement: 85%
- Replace: 15%.

3. When asked whether online demonstrations (by the tutor) should complement or supplement the live demonstrations (by the tutor), 100% of the respondents voted for complement.

4. When asked whether or not the shared online demonstrations promoted a community of learning, 85% of students agreed or strongly agreed with this statement. On this issue students made comments such as:

- "It allowed us to see what others have done and then use that information to enhance your work"
- "It's good to see something done from other people's perspectives and their methods"
- "There was a sense of trying to reach the same level as other students"

5. When asked *what do you feel you've learned by generating an online demonstration?* Students responded with:

- "How to help others in a structured, inventive, friendly process"
- "How to use Rhino more effectively and quickly"
- "A more efficient way of submitting work"
- "Presentation (public speaking) skills"

- "There is still so much to learn"

6. When asked if the online demonstrations by the tutor are necessary, 85% of students said that they were, while 15% said that they were not.
Explanations for this included:
- "Because some people don't get it during the lecture and they can go through the online lecture as much as they want until they do understand"
- "Because they help you to progress"
- "Not necessary, but helpful"

7. Finally, when asked what could be improved in the module, the majority of responses indicated that more online demonstrations would be helpful.

5 CONCLUSION

Online demonstrations were clearly a novelty for students and they responded well to work made available online by the teacher and other students. It was generally felt that these demonstrations added value to the traditional teaching methods of live demonstrations and written tutorials and possibly enhanced the students' learning experience since they were able to gauge their progress against that of others and could learn something in doing so. It is believed the teacher and peer demonstrations also allowed the students to progress faster and with more insight into approaches, techniques and tools available in these packages. One danger to beware of is the isolation of students who for one reason or another fail to progress at the same rate as others. This was highlighted by a number of comments which may have been flippant or intentional but they did highlight that students may feel more despondent as a result of this activity. Further work in this area includes the development of the database to include further demonstrations that are specific for features, tools, software limitations and troubleshooting. Interactive demonstrations with prompted questions and feedback are also planned for the CAD software. A formal peer assessment process is suggested rather than the informal method currently in use. This will allow students to provide more detailed feedback to their peers, rather than simply patting them on the back.

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