THE SUPPORT OF STUDENT ARTICULATION OF REASONING, STUDENT REFLECTION AND TUTOR FEEDBACK

Stuart Garner
Edith Cowan University,Joondalup, Western Australia
s.garner@ecu.edu.au

ABSTRACT

Learning theory suggests that student learning can be improved if students are required to articulate and reflect about work that they have done. This process helps students think more clearly about their work and such articulation also enables tutors to better assess student knowledge and mental models.

There are various electronic tools available to help and promote such student articulation, including Cam Studio, Castalia Studio and Windows Media Encoder. These tools can also be used by tutors in order to provide a richer form of feedback to students. They belong to a category of software known as Screen casting.
This paper discusses some of these screen casting tools together with some of the issues that arise in practice. It particularly looks at the use of screen casting within a software development unit that runs at Edith Cowan University in Perth, Western Australia. Movies were made by students to explain and reflect on their assignment work and by the tutor to provide feedback to students. The feedback movies have formed the basis of a vicarious student resource for subsequent semesters.

BACKGROUND

In subject areas that require students to solve problems, such as computer programming, tutors often require students to give demonstrations of their problem solutions in a computer laboratory. Due to time constraints, such demonstrations have to be short and yet the process of students explaining solutions and reflecting on them is both valuable to students and tutors.

Students gain value from demonstrating their solutions as they have to undertake a planning process and consciously think about why they solved problems in particular ways, thereby going through a process of reflection. Tutors gain value from demonstrations as they are able to determine what students have learnt and gain insight into the mental models of the students.

Various writers support the value of articulation and reflection in student learning. Guzdial *et al.,* (1996) believe that a hard problem, addressed with support for successfully solving the problem and for reflecting on the problem, will lead to deep, transferable knowledge and skills. Herrington and Oliver (1997) discuss a learning environment that would be applicable to situated learning. They suggest that two of the characteristics should be the promotion of reflection to enable abstractions to be formed and the promotion of articulation to enable tacit knowledge to be made explicit.

Electronic tools are now available that can help promote this articulation/reflection process. They are of obvious value to students who are studying within a flexible learning environment as such students may well be studying at a distance and not be able to attend the educational institution in order to give a live demonstration of their problem solutions. However, such tools can also be of value to campus based students forcing them to spend time creating such demonstrations thereby making them think more carefully about why they made certain decisions and adopted particular strategies in their solution processes. Some of the electronic tools can also be used by tutors to provide a richer form of feedback to students.

Types of Tool To Support Articulation And Tutor Feedback

There are now tools available that can support student articulation and tutor feedback by recording computer screen activity and also allowing text annotations and/or voice-over narratives to be made. There are two categories: tools that are specific to a computer application and tools that are generic and can be used with any computer application. The emphasis of this paper is on the latter. These tools support screencasting, a screencast being a digital recording of computer screen output, often containing audio narration (Wikipedia, 2007).

Tools That Are Specific To An Application

There are several applications available that have in-built facilities enabling some form of screen capturing to take place together with the ability to annotate the screen captures with either text or an audio commentary. Some applications allow a series of screen snapshots to be taken and then played back; others dynamically record all screen activity during a computer session. One example is the Internet Software Visualization Laboratory (Domingue & Mulholland, 1998). This helps students learn Prolog programming in a graphical environment, supports individual exploration, and also supports both synchronous and asynchronous communication. A second tool example is the ASCENT CASE tool, which is an educational computer assisted software engineering (CASE) tool. This includes a facility to allow students and tutors to record presentations of graphical models that they have produced (Griffiths & Oates, 2003).

Tools That Are Generic

There are several dynamic screen capturing tools currently available that allow the capture of all screen activity, including mouse movements, plus a voice-over narrative. They are useful in creating "show and tell" type movies or WYSYWYD (what you see is what you do). Royalty-free players are available for such movies to be played back. Three of these tools that are available for Windows' hardware are: CamStudio (2007), Camtasia Studio (TechSmith, 2007) and Windows Media Encoder (Microsoft, 2007).
Up until recently, Lotus ScreenCam (Lotus, 2004) was the best known of this category of tool and it has been extensively used in both Education and Industry. An example of its use in education is in the creation of movies for the CD-ROM multimedia course in software development (Garner, 1997). Camtasia Studio can be thought of as the "Rolls Royce" of the screen recording software. It allows the production of such e-movies in the common "AVI" format and also has a facility to convert them into Flash, CD-ROM and streaming video formats. The main disadvantage of Camtasia Studio for educational institutions is the cost which is US$299 per licensed copy. Windows Media Encoder is not as flexible and versatile as Camtasia Studio, however it does have the major advantage of being free. It only allows movies to be produced in "WMV" format. CamStudio is able to create industry-standard AVI video files and Streaming Flash videos (SWFs) files. It has the added advantage that it is a free open source program.

Articulation Of Reasoning In A Software Development Course

During one semester of a software development unit within the Business Faculty at Edith Cowan University, we had a requirement that, for each assignment, students should make an electronic movie using Lotus ScreenCam in order to explain how they solved their programming problems, giving reasons for the decisions that they made. In the movies, students were expected to discuss and reflect on the programming code that they produced and also run their programs with a variety of test data. We found that the requirement to produce such movies had the effect of making students think and reflect more carefully about their solutions. It also had the effect of making students test their programs more thoroughly.

Several issues arose during the students' movie making. The first was that file sizes are inevitably large. We had to ensure that students knew how to change screen resolutions and set the number of colours to 256 thereby keeping file sizes to a minimum. At the time of the experiment, the computer laboratory did not have CD writers and students had to save and hand in their files on zip disks.

A second issue was that microphones were needed in the laboratories. We found that only a few were needed as students made their recordings at different times. Obtaining good sound quality was a problem and we had to enable student access to the mixer controls of the computer sound card. In some cases, recordings had to be made at a higher sound quality, for example 16 bit, 22Kz, resulting in even larger files.

Third, students found difficulty in being succinct. Some would record movies of around fifteen minutes and then express surprise that they were longer than say five minutes. This led to us imposing time limits on the length of the movies. A number of students were also uncomfortable about recording movies when other students were present in the computer laboratory.

Students were also encouraged to make movies when they encountered difficulties with a programming problem and then to email them to their tutor. In order to keep file sizes such that they were suitable for emailing, these movies had no voice recording but were annotated with text captions, an example being shown in Figure 1.

Again, students indicated that the making of such movies helped clarify in their own minds the problems that they were having and the movies certainly helped the tutor better understand the student problems so that replies could be formulated.

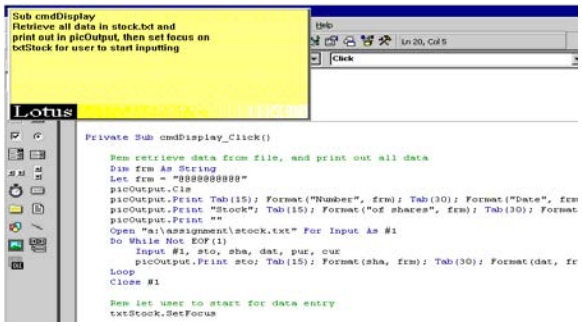

Figure 1: Example of Student Movie

Provision Of Rich Feedback To Learners

The above electronic tools can also be used by tutors to record movies in order to give a richer quality of feedback to students. Simple “low-tech” audio tapes have been used in student feedback (Anson, 1997 and Neville, 1995) and it is suggested that such feedback adds a social dimension to the commentaries with the tutor being able to talk personally to each student, whereas written comments lacked context and sounded impersonal. Probably the main concern for tutors with respect to such a software tool being used in the provision of student feedback is the length of time needed to provide that feedback. Any such tool needs to be easy to use and, if anything, reduce the amount of time required to provide feedback.

A set of such movies were produced for a small group of campus-based students that were involved in a summer school software development course. Each week the students attempted a small programming problem and handed in the relevant programming code together with a small text-captioned movie explaining their program. The tutor then made a feedback movie for each student. Each feedback movie had audio commentaries to keep the production time to a minimum.

The tutor was able to go through the programming code on the screen, highlighting areas of interest with the cursor whilst making comments. In addition, (s)he was able to run the student programs with a variety of data whilst passing comments about both the good and the bad points of the programs. A major advantage is that the feedback is personal from the tutor to the student. It is no longer necessary for the student to have to attempt to read the tutor's handwriting and decipher possible obscure acronyms.

The sets of movies that the students handed in, together with those that the tutor produced, have now become a vicarious learning resource for use by students in subsequent semesters. Vicarious learning is defined as (Cox, McKendree & Mayes, 1999):

The Potential Benefit To Learners Of Being Able To Observe Or 'Listen In' On Experts Or Their Peers As They Discuss A New Topic.

Use is made of this learning resource as follows. Each week, students are given a small programming problem to attempt. They can then use the movies from the resource in order to view the student-tutor interactions for a similar programming problem. The exercises shown are those done by previous students. The files that the previous students handed in, which are possibly incorrect, together with the feedback movies that the tutor made, are made available.

Students have commented on how useful they have found these resources with online feedback eliciting a variety of supportive comments which include:

- I found it helpful and interesting in giving clear visual instructions or explanations.
- All the other students' solutions were very helpful. And they were informative.
- Only used the movies once, but they do provide a good resource for students experiencing difficulty.
- Pick up other students' mistakes.

Such feedback does not have to be limited to subjects such as software development. For example, essays or reports could be handed in by students in both hard and soft copy form. A tutor could then walk through the essay or report on the screen in an electronic movie, highlighting sections whilst making comments.

CONCLUSION

Articulation and reflection are important aspects of student learning. This paper has discussed a variety of tools that might be used to promote articulation of reasoning and reflection by students in their learning processes and such tools can also be used by tutors to provide richer feedback for students. The feedback can be used as a vicarious resource for other students. Until recently, the use of such movies with students has been problematic, however recent developments have made it practical to increase the utilisation of the techniques that have been described in this paper. These developments include: cheaper hard disk storage; ever increasing network bandwidth; USB thumb drive storage and the availability of CD writers. One major issue has been the cost of the movie producing software which was such that it precluded its use by distance learning students. This problem has now been addressed by the use of Microsoft's freely available Windows Media Encoder and by the use of CamStudio..

Specific situations where such electronic movies can be useful in education include:

- Students explaining their solutions to tasks, particularly in problem solving domains of knowledge such as mathematics, science and engineering.
- Student-tutor dialogues using movies as email attachments. Such movies can be used so that both students and tutors can articulate difficult concepts.
- General feedback by tutors on student assignments.

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