Digital Video Analysis of a Multimedia Product

Ken Knibb, Jan Herrington, Judy Denham

k.knibb@cowan.edu.au

Edith Cowan University

Abstract

This paper begins by describing VideoSearch, a recently developed multimedia software product designed as a research tool to allow researchers to digitise and analyse video on a computer. Codes and labels can be linked to any segment of a digitised video. Identified segments of the video can be recalled at any time. Because the program stores video in a digital format on a hard disk, access and playback of any video segment is almost instantaneous. Simple summary statistics are also available.

Next the paper reports on how this product has been used to precisely categorise how students use a multimedia product. The allocation of time to different student activities in formal university settings, has been a subject of interest to researchers in recent years. For example, in a study of the distribution of time devoted to a variety of learning activities, Laurillard found that 'attending' was by far the most common activity. By contrast, anyone who has observed a child playing on a video arcade or Sega/Nintendo game will have noticed that the child has a very active role. However, there is very little time for the child to think in responding to the various challenges presented by the life-and-death situations. Children react rather than consider. For many of these programs, the educational value for the player is inversely proportional to the reaction time required . Both of these situations point to possible shortcomings in learning environments: the first in denying students an active role, the second, in denying a reflective role.

The Cognition and Technology Group at Vanderbilt make the point that the learning environments they produce are meant to be explored and discussed at length rather than simply read or watched. In this vein, a program on assessment in mathematics was produced according to principles of situated learning *or* situated cognition . *The program was designed to minimise students' keyboard responses, and maximise thoughtful, active reflection and discussion between the users.*

As part of an interpretive study into how students use interactive multimedia, small groups of students were videotaped using the assessment resource. VideoSearch was used to facilitate the analysis by coding excerpts of videotaped material into user-defined categories.

The findings of the study suggest that an interactive multimedia program based on a situated learning model is conducive to promoting student activities other than attending behaviour. Unlike the traditional university courses mentioned by Laurillard and McNaught , with their emphasis on the transmission mode, the students using the assessment program were able to reflect and discuss their learning for a substantial portion of the available time.

VideoSearch

Using VideoSearch usually involves three main processes, (a) digitising the video, (b) coding and labelling the digital video, and (c) analysing and interpreting the coded and labelled segments. Most of the development work to this point has focussed on sections (a) and (b).

Storing video as digital movies:

The source for the videos can be a VCR, video camera or standard television broadcast signal. The software can be used to capture video signals from any of these sources and store them on computer hard disk as QuickTime™ movies. Power Macintosh computers with a video capture card installed are required to digitise the movies.

As much as ten hours of video can be stored on a nine Gb hard drive but the duration depends on the quality and size of the digital video required. For most classroom research situations, an hour of video requires about one Gb of hard disk space. For videoing and analysing sporting situations, an hour of video requires about six Gb.

The user initiates the digitising process by clicking the Record button shown in Figure 1.

Figure 2: Movie window linked to code window shown in Figure 3.

Figure 1: Digitising window

Digitising is done in real time. The digitising process can be stopped by clicking a stop button. At this point, the software produces a movie window containing the digitised video (Figure 2) and a code window (Figure 3).

Coding digital movies

VideoSearch can be used to code and label instances of events in time. An almost unlimited number of instances of events can be linked with any

segment of the digitised video. Line one in Figure 3 shows two instances of the category 'teacher question'. The time bar in Figure 3 shows the range of times that can be viewed. The time line represents the time currently displayed in the source movie window.

New instances can be inserted by holding down the command key, and then clicking and dragging in the time bar. Fine control can be achieved by 'zooming in' on a time segment.

Analysing and interpreting codes and labels

Instances of events can be played back by double clicking on the representation of the instance in the code window. A movie of the instance appears in a separate window. By clicking on the '**MAKE MOVIE**' button, all instances of a selected category are placed together in a separate movie and played. For example, if this was done for the first row in Figure 3, all instances of '**teacher question**' would be played back. The process of creating a movie from separate coded instances takes less than 0.5 of a second. Summary statistics, indicating the number of instances in a category and total time that a coded event is represented are also available. About 5000 words can be attached to any instance. This text can subsequently be searched to recall and play labelled video segments.

Codes from different categories can be combined and used to produce new movies. For example, a movie could be created of all disruptive behaviours during a lesson AND times that the teacher was not facing the class. New movies created can be saved in a format that can be played on Windows or Macintosh computers.

Using VideoSearch

Example of application: Multimedia and use of time

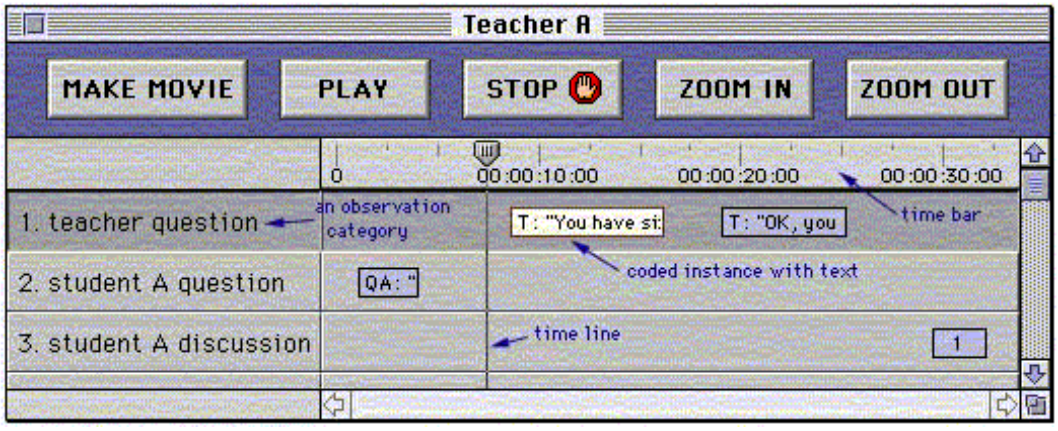

Figure 3: Code window linked to the movie window shown in Figure 2.

VideoSearch was used in a study which investigated students' activities as they used an interactive multimedia program on assessment in mathematics for preservice teachers: *Investigating assessment strategies in mathematics classrooms* . The program had been specifically designed to incorporate a number of characteristics consistent with situated learning . For example, the program incorporated an authentic context and an authentic and complex activity; it provided multiple perspectives of the issue of assessment; it promoted reflection and opportunities for students to articulate their learning; and it required students to work in small collaborative groups. Students were videotaped using the interactive multimedia, and a segment of one tape was analysed using *VideoSearch* to corroborate observation of the nature of their activities as they used the program, and the allocation of time devoted to each activity.

The allocation of time to different student activities in formal university settings, has been investigated by Laurillard . In a study of the distribution of time devoted to a variety of learning activities, Laurillard found that 'attending' was by far the most common activity. As an example, she gives the distribution of activities of a student in an engineering course in a 40 hour study week (Table 1).

While these figures appear to allow for enormous latitude-for example, they assume that no discussion occurs in lectures, that no attending occurs in assignments, that no discussion occurs in audio-visual-they indicate that traditional methods of teaching at university emphasise the transmission of knowledge rather than active participation by students in the learning process.

By contrast, anyone who has observed a child playing on a video arcade or Sega/Nintendo game will have noticed that the child has a very active role. However, there is very little time for the child to think in responding to the various challenges presented by the life-and-death situations.

Children react rather than consider. For many of these programs, the educational value for the player is inversely proportional to the reaction time required .

Both of these situations point to possible shortcomings in learning environments: the first in denying students an active role, the second, in denying a reflective role. The Cognition and Technology Group at Vanderbilt make the point that the learning environments they produce are meant to be explored and discussed at length rather than simply read or watched. Similarly, the interactive multimedia program on assessment was designed to minimise keyboard responses, and maximise thoughtful, active reflection and discussion between the users. In the videotaped sessions, it was noticed that students use of the keyboard was relatively infrequent. Most of the time appeared to be spent thinking and discussing. In order to substantiate this observation on the amount of time spent on various activities, one group of students was monitored using the *VideoSearch* program for a period of exactly 30 minutes, starting approximately 30 minutes into the students' second work session. This was done to allow a short settling in period in order to gauge a more typical pattern of use. The students' actions were timed according to the following four categories:

	Attending	**Practising**	**Discussing**	**Articulating**
Lectures	15			
Audio-visual	1			
Tutorials	3		1	
Practice		10		
Reading	2			
Assignments				8
TOTAL	21	10	1	8
	52%	25%	3%	20%

Table 1: Distribution of student activities in a 40-hour study week

- *Attending*: Selecting, watching or reading the media elements of the assessment program such as the video clips or the expert comments
- *Discussing*: Discussion between partners or reflective thinking (silence)
- *Typing and composing*: Typing reflections and responses in the notebook and formulating what to type
- *Off task*: Off-task behaviours.

These categories most closely resembled the observable types of behaviour that were of interest, and were more salient than the categories chosen by Laurillard . Laurillard's distinction between discussion and articulation was particularly problematic given the theoretical framework used in the study.

The data was analysed using the beta version of *VideoSearch*. The software was particularly appropriate because it allowed analysis of qualitative data by coding excerpts of videotaped material into user-defined categories. Figure 3 shows the coding tool with the four defined categories of activities on the left hand side. The video movie on the left is the digitised video source of 30 minutes of students' use of the multimedia program on assessment. The video clip on the right is the selected video clip, the eleventh occurrence of *Discussing*.

The *VideoSearch* software enabled a very precise categorisation of student activity. On occasions, the students engaged in two activities at the same time, for instance, discussing, and typing, where while one student typed the other's talk was on general issues rather than the composition of what to type. On these occasions, the instances of both were recorded, such as excerpt No. 11 of *Discussing* and excerpt No. 10 of *Typing* in Figure 3. This meant that while 30 minutes was monitored, the total time amounted to 34 minutes and 3 seconds. Percentage times were calculated from the total of combined activities. The times recorded on each of the four nominated categories are provided in Table 2.

The figures suggest that the interactive multimedia program on assessment is conducive to promoting student activities other than attending behaviour. Unlike the traditional university courses mentioned by Laurillard and McNaught , with their emphasis on the transmission mode, the students using the assessment program were able to reflect upon and discuss their learning for a substantial portion of the available time. Their experience was not comparable to the student attending in a formal lecture, nor the child reacting spontaneously to a video game. The students attended to the video and text elements provided by the program, and consolidated this information with thoughtful discussion and creativity in the preparation of a written response.

	Attending, selecting, watching reading	Discussing, reflecting	Composing and typing in notebook	Off task
Total time	11 mins 7 secs	15 mins 41 secs	6 mins 51 secs	24 sec
Percentage	33%	46%	20%	1%

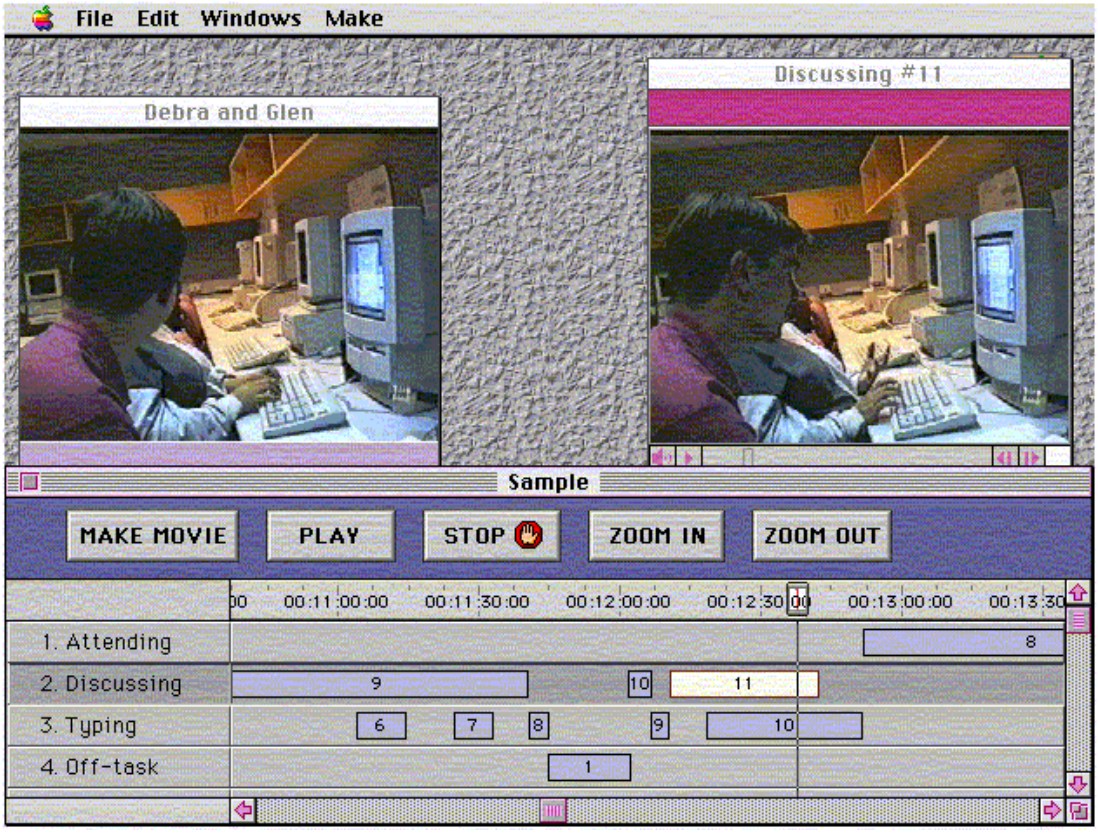

Figure 4: The VideoSearch interface showing the data as coded (bottom), the digitised video source (top left) and a categorised excerpt (top right)

Further research is needed to establish precisely the design elements of interactive multimedia which enable reflection and articulation to occur as a paramount consideration rather than a chance event. The advent of *VideoSearch*, a powerful analysis tool for video data, will enable further research opportunities in the investigation of the way students learn from multimedia.

References

ASCILITE (1995, December). Games forum. Paper presented at the Twelfth Annual Conference of the Australian Society for Computers in Learning in Tertiary Education. Melbourne, Victoria.

Brown, J.S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. Educational Researcher, 18(1), 32-42.

Cognition and Technology Group at Vanderbilt (1992). An anchored instruction approach to cognitive skills acquisition and intelligent tutoring. In J.W. Regian & V.J. Shute (Eds.), Cognitive approaches to automated instruction (pp. 135-170). Hillsdale, NJ: Lawrence Erlbaum Associates.

Collins, A., Brown, J.S., & Newman, S.E. (1989). Cognitive apprenticeship: Teaching the crafts of reading, writing, and mathematics. In L.B. Resnick (Ed.), Knowing, learning and instruction: Essays in honor of Robert Glaser (pp. 453-494). Hillsdale, NJ: LEA.

Herrington, A.J., Sparrow, R.L., Herrington, J., & Oliver, R.G. (1997). Investigating assessment strategies in mathematics classrooms [Book and CD-ROM]. Perth: MASTEC, Edith Cowan University.

Laurillard, D. (1996). The changing university. [On-line]. Available: ITFORUM@UGA.CC.UGA.EDU.

McNaught, C. (1996, June). The nature of information technology and its implications for practices and policy in higher education. Paper presented at The Role of Information Technology in Education Development in the Asia Pacific Region: ASAIHL Conference. Melbourne, Australia.