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# Effective CAL:

## theory and practice

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*This paper looks at the creation of CAL material in theory and practice through the perspective of a CAL development unit, the Hypertext Support Unit at the University of Kent. With similar units now in place in other institutions, the production of CAL is taking place at a rapid pace, often with the evaluation of the applications disproportionately lagging behind. This inevitably raises questions of whether what we are producing is effective CAL, and what approaches should be taken to use the potential of multimedia in a learning environment.*

### **Introduction**

Modern-day authoring systems have made the production of CAL applications so easy that people with little computer literacy are able quite quickly to create elaborate multimedia applications. The point, however, is that while so many of us have become authors in the past few years, the objective of our creations has been somewhat missed. It is all too easy to see visually impressive multimedia CAL, and to convince ourselves that they represent good CAL material. An application may be quickly sanctioned, produced and implemented at universities, then attention is focused on to the next project. While evaluation is normally costed into a project, various constraints, such as shifting personnel or additional demands on funds, limit the evaluation of the application to ascertain whether the investment of producing it was worthwhile. The Hypertext Support Unit (HSU) at the University of Kent was set up in 1992 to promote the pervasive use of hypertext across the campus. In its role as a support unit, it facilitates the development of CAL material in all disciplines in close collaboration with the content specialists, i.e. the lecturers. The HSU, along with many other units or departments, produce many CAL applications paying attention to the aesthetics of interface design, but largely glossing over the learning instructions so vital to good CAL applications in harnessing the potential of multimedia in an educational environment. Too many people put a linear book on-line,

give it some bookmarks, and call it hypertext; worse yet, they add a few scanned-in photographs and a soundtrack and call it multimedia (Fisher, 1994).

## Effective CAL

The view that multimedia would add a new dimension to teaching and learning and enhance the learning process, has not yet been realized. This may be in part untrue, due to the lack of documentation and research into the evaluation of current CAL systems and their impact on learning, but developers have certainly still not tapped into the true potential that multimedia has to offer in the scope of knowledge construction. Nelson and Palumbo (1992) state that 'simply allowing learners to quickly access a body of information, even in the learner-controlled, non-linear manner supported by hypermedia systems, does not ensure learning any more than a library does'. There is a case for arguing that even a very flat, predominantly text-based publication, when put on-line over a network, can greatly increase access to the information. It is not to be confused, however, with an application that is to be used to augment learning. Such systems need to use the cognitive processes of the brain by incorporating learning instruction. These systems cannot merely concern themselves with the elaborate presentation of information making use of sound, graphics, video or animation, but rather must facilitate the assimilation of the information into a knowledge base of content from which inferences as to the principles or concepts that are to be learned, may be articulated. Nelson and Palumbo (1992) go on to say that 'merely developing knowledge bases for presentation to learners in a hypermedia environment will not be particularly effective unless instructional activities are supported by the hypermedia system'.

## Learning theory in CAL

Most popular authoring systems support at least four inherent cognitive features. These can be classified as: browsing, searching, integrating chunks of information, and angling, as mentioned by Duchastel (1990), a process that describes the navigation to the same chunk of information via a number of different pathways. Angling can be used to good effect in CAL applications to allow a topic to be perused in different ways, each one bringing a new perspective to the learner. All of these processes allow the incorporation of some sort of learning instruction in CAL to aid knowledge representation, construction and assimilation. Lindsay & Norman (in Dufresne *et al.*, 1990) describe the definition of concepts as being central to comprehension; through the use of careful organization of information into defined categories with further subdivisions of related information, authors can build up a linked knowledge base that can be explored by learners and assist in the articulation of concepts. The four processes described above are central to authoring principles, and their use ultimately determines the accessibility and flexibility to be found in the CAL application (Khan *et al.*, 1994).

Authoring systems are coming in for much criticism for making the incorporation of learning instruction difficult. However, it is probably more a case of a lack of understanding about the learning theory and the under-use of the true hypertext features

of authoring systems. Learning tools that may be constructed in CAL applications are advanced organizers (Ausubel, 1960). These can serve to revise information and concepts that should have been learnt, and also introduce the new information that is to follow. Advance organizers may be extended to offer suggested pathways (Hammond, 1989) that guide learners through the information. At the outset of the application, a concept map or navigational web can be used to present the learner with an outline of the information available, and to highlight alternate navigational pathways which may be based on different levels of comprehension. Concept maps provide learners with a top-level look at the mesh of hypertext information. Halasz *et al.* (1987) have gone as far as saying that no system can be described as a true hypertext system unless it has something akin to a concept map. For the purpose of development, however, where current systems do not support this feature it is normally possible to exploit the interactivity of the authoring system with other applications. These learning tools provide mechanisms for theme highlighting, restatement, introduction, summary pages and the use of analogies, all of which promote the understanding of information (Kintsch & Van Dijk, 1978).

Another useful learning skill is knowledge construction, the building of new nodes and links between information that is pertinent to a particular individual: open hypermedia systems such as Microcosm (Hill & Hall, 1994) allow the construction of a personal library linkbase of information in a distributed environment. Even World Wide Web, through the manipulation of the hotlist feature, allows users to create their own information base.

### **The future of CAL development**

Authors of CAL must possess a variety of skills, some of which include computing, art and graphic design, audio and visual manipulation skills, and some knowledge of learning theory. It is in this capacity that CAL development differs from traditional software development. It is important to grasp the fact that authors of multimedia CAL applications cannot ignore the use of these skills during development. An author possessing even some of these skills is a vital commodity, yet realistically it is not always fair to expect lecturers who have become developers to turn their ideas into effective CAL applications. Development of CAL involves an investment of time, money and resources, and another factor that is so easily forgotten: the subsequent maintenance of the applications. Poorly designed applications are so often required to be completely redeveloped when the content has become dated. As I have mentioned, development of CAL is increasingly being shifted from isolated departments to centralized development units, which serve as a focal point and repository of development, support and maintenance activities. Yet while it is probable that such entities will possess more of the skills required for effective CAL development, additional specific expertise will still be required. There is no one solution to this problem, but there are several options. Institutions can deliberately try to recruit multi-skilled personnel for development units, though it is improbable that any one person will possess the right mix of skills. Another possible approach is to train recruited personnel by allowing them to spend time in

various departments whose expertise would be useful to CAL development. The most idealistic approach is the collaboration of development units with relevant departments, though this may be more or less difficult from university to university depending on the individual culture of the institution.

## Conclusion

Learning is a highly individual process, and cannot be standardized. Multimedia allows information to be constructed so that it may be adapted to various cognitive styles. Current systems need to be evaluated to assess the benefits of investments involved in their production and maintenance. Central to the process of development of effective CAL is the need for a variety of skills. These skills are often available within a single institution and should be tapped. The University of Kent has a campus where there exists a climate of receptiveness to learning technology, and the Hypertext Support Unit has been able to use the campus-wide co-operation (Khan *et al.*, 1994) in striving to develop effective CAL material. But each institution has a particular culture, and where collaboration is not practicable, other ways of accessing the skills required for CAL development must be sought.

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