INTERACTIVE MULTIMEDIA DEVELOPMENT AND COGNITIVE TOOLS

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Introduction

Learning is a complex process and one that has a variety of theoretical views to explain and predict the outcomes. Cognitive scientists seek to develop these theoretical views so that instructional processes can be enhanced and fully understood. This is a relatively new field of study and there is a great deal of argument about the fine details of many of the theoretical views. However, there is a consensus on the general lessons learnt and there is now a large body of knowledge about learning, with constant research helping to refine and clarify that knowledge. The research has shown us that children's natural learning processes are very much in the realm of experimentation and reflection, not instructionalist modes so prevalent in classrooms and yet the schooling process is very much based on an economic imperative rather than an educational imperative. Pilot studies of a great variety of instructional modes and forms have proved them to be highly successful, and yet they have not been introduced into the broader schooling system. Much of the evidence about the lack of success of such programs in large scale schooling not only relates to economics, but also to teacher attitudes and beliefs about education and learning and to teachers perceived workload and opportunities, i.e. the type of individual learning support that cognitive scientists are telling us can improve the learning process is beyond the physical capability of most classroom teachers, at least for sustained periods of time.

Introduction of information and telecommunication technology, and specifically computers, into the educative process has been heralded as a panacea for the woes of education. The technology offers teachers the opportunity to individualise instruction, place children in open ended student centred investigations, and to shift from their traditional instructor role to mentor and co-learner. The panacea however, like past revolutions in education, will go the way of previous technologies unless changes to our schools and the tools provided with computers occur, such as a shift in teachers' pedagogical approaches and software that supports the modes of instruction that cognitive scientists are telling us are appropriate

Bork(1995) has argued these points strongly in his critical review of the failure of computers in schools and universities and also supports the development of an extensive research base of empirical evidence to support the changes that we instigate in learning environments.

One of the most extensive longitudinal studies on the effect of the introduction of information technology in classrooms has been carried out under the Apple Classroom of Tomorrow (ACOT) program (Dwyer, 1995). The ten year research and development collaborative program focused on how teaching and learning change when teachers and students have routine access to technologies. One of the key elements of this program was a belief that technology should be used as a tool for learning and a medium for thinking, collaborating, and communicating. The outcomes of the program have been summarised by Dwyer (1995)

> .... technology plays a catalytic role in opening the minds of teachers to new ideas about children, learning, and their own role in the education process.

Dwyer also claims that without this form of reflection and subsequent changes in professional practice, the promise of technology will never be realised. This premise supports the criticisms of Bork (1995) and Schank and Cleary (1995) of our current modes of education.

The Potential of Interactive Multimedia

Current interactive multimedia technologies can represent ideas in almost any mediated form, and provided we can generate a comprehensible metaphor for organising our functional options and the underlying knowledge structures, the student can roam through the resources, creating their own meanings and understandings of the phenomena they encounter, ie creating their own form of the learning environment rather than one generated by their teacher or by the package designer. When raising the idea Florin (1990, p30) saw

> information landscapes, ...as virtual towns, or intellectual amusement parks. The analogy is quite intriguing and helps us to visualise many abstract concepts within a single metaphor.

This form of representation of information supports students' learning processes advocated by researchers like Schank and Cleary (1995) who have argued strongly for the use of such technology to support students in following their own interests or questions. This rich context has the potential to allow the novice to work with authentic problems and practice.

However, within this context, designers of multimedia learning environments have tended to be narrow in their view of how users will interact with the rich array of multimedia resources once a challenge, in the form of a problem to solve, has been posed. Once the material has been presented to user(s) and they have interacted in the ways envisaged by the instructional designer (and often in new ways not considered by the designer) the user is left to ponder and present their conclusions using more routine presentation technologies, such as pen and paper. Increasingly, users have access to the same multimedia technology but have lacked access to the rich digital media resources embedded in the learning environment. Additionally cognitive tools to support the user have been shown by Jonnasen and others to enhance the learning process and to support the users' investigations. If students are to truly create their own meanings and understandings of the phenomena they encounter, designers need to not only incorporate user tools which will enable them to present their findings using the full array of resources contained in the packages, but also support their investigations with powerful cognitive tools.

The lack of intriguing learning environments embedded in much of the commercial interactive multimedia products currently available cannot be entirely attributed to the lack of understanding of the results of cognitive science research by developers. The challenge for researchers is to not only conceptualise new types of learning environments, but also demonstrate that process so that developers of educational software produce products that support learning in the most effective ways.

Interactive Multimedia and Cognitive Tools

There is some evidence now that cognitive scientists are attempting to narrow the gap between the learning environments portrayed in many commercial interactive multimedia packages and the sorts of learning environments that will truly enhance learning. Schank and Cleary (1995) have described a set of innovative interactive multimedia packages based on their conceptualisation of realistic learning situations and what they describe as learning architectures. These packages illustrate the general lessons of cognitive science research through the design models adopted.

The innovative use of cognitive tools in interactive multimedia learning environments has also been reported by Lajoie and Greer (1995). The package Bio-World (Lajoie, 1993) is an interactive learning environment designed to support the acquisition of scientific reasoning skills in high school students and integrates a variety of cognitive tools to assist in scaffolding scientific reasoning activity. Users of this package are engaged in explicitly justifying hypotheses with evidence; organising, categorising, and rating evidence; and constructing a final summary argument on the topic of bacterial and viral infections. One of the proposed developments for this package incorporates an authoring mode for students to generate new scenarios for their peers to investigate. This enhancement will support the powerful augmentation framework design of the package.

EXPLORING THE NARDOO AND STUDENT DRIVEN INVESTIGATIONS

With an understanding of the shortcomings of much of the commercially generated learning packages, we sought to combine the ideas of situated learning and problem based learning from information landscapes to form the basis for effective design. Within this context we also sought to incorporate a range of cognitive tools which would support the learner. The detail of this design process and the theoretical position has been reported in Hedberg et. al. (1994). The resulting package, *Exploring the Nardoo*, provides an information landscape of resources based on ecology. The information landscape uses a geographic metaphor which contains a Water Research Centre and a navigable river environment.

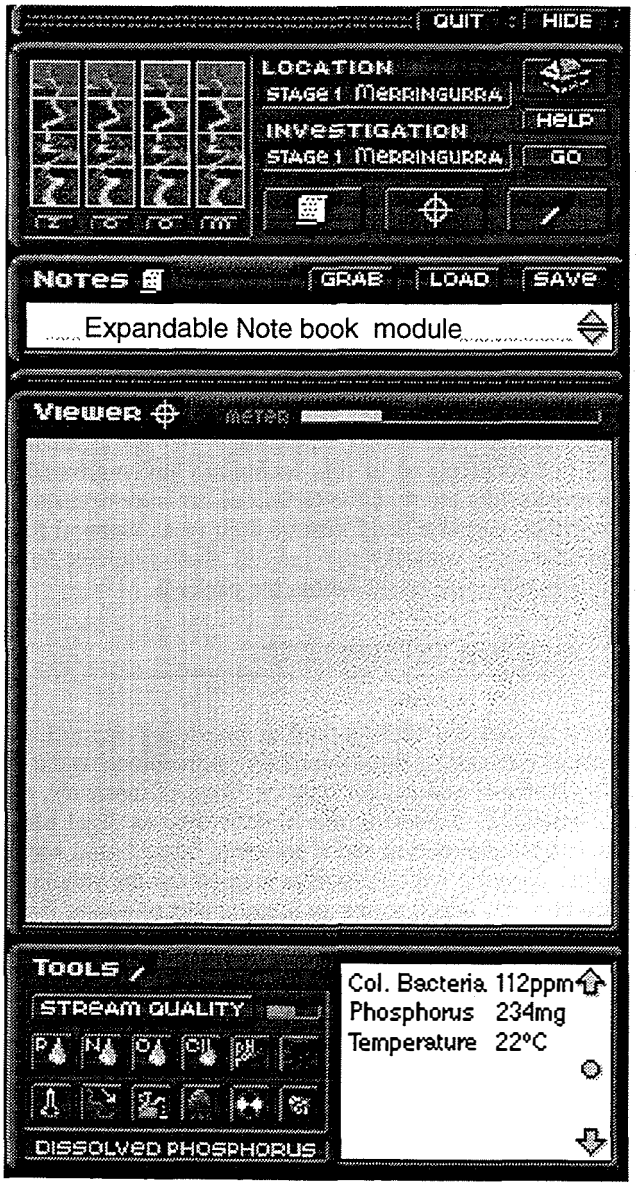

Figure 1: The Personal Digital Assistant Notebook

It incorporates problems that challenge students to become active participants in the learning process and simulators that allow the user to ask questions and investigate possible answers to those questions. By providing a metaphor relating to the real world, students are encouraged to apply scientific concepts and techniques in new and relevant situations in this ecology-based application. In so doing, the learner is likely to become more interested in developing questions, ideas and hypotheses about the learning experiences encountered. *Exploring*

the Nardoo provides the student with a flexible set of tools made available through a personal digital assistant (PDA), Figure 1, to assist in the investigation process.

The process of using source material within the package in support of an investigation has facilitated by allowing the student to:

- Decide precisely on the quantity and selection of text to be copied into their notes. This is either through making a selection and then 'grabbing' it into the PDA or by using a 'drag and drop' technique where the target text is selected or highlighted and 'dragged' into the notes module of the PDA .
- Use marker buttons as pointers to video, audio or picture information which can be displayed within the PDA's viewer along with any linked information.
- Gather video material, place 'in' and 'out' point markers within it and display it within the PDA thus increasing the student's ability to be more selective in what they choose to use in response to an investigation.
- Manipulate marker buttons and text within the notes areas, via 'drag and drop', to facilitate the re-ordering of ideas in the process of building an investigative response in the form of a report, explanation, procedure etc.
- Use text style tools, within editable text notes, providing the opportunity to use font colour, style and size as organising criteria within the notes.

The package also provides the ability to record thoughts and impressions 'on-the-fly' whilst examining media stories. This provides the potential for students to reorganise or revise their thoughts to better 'make sense' of what they see and hear. Students are able to document their emerging ideas in support of an investigation or problem solving exercise whilst viewing different media. This provides support in the formulation of new schemata in the process of accommodating the new information.

The multimedia collection, editing and presentation facilities offered within *Exploring the Nardoo* are extensive and present a great potential for students to become manipulators of multiple media. New avenues are opened for expression for those who choose to use the facilities within the package. We are aware however, as Schroeder and Kenny (1994) point out "learner's not accustomed to this technique and multimedia facilities will require instruction in its use" before they become proficient with the technique but once accustomed to it the student has a powerful process at their disposal to gather, organise and illustrate their ideas. Support for teachers and students in the use of these features will be modelled using walk-through movies made available through the help system and also detailed in support notes available in reference books within the package.

SPECIALISED SUPPORTIVE TOOLS FOR EXPLORATION

Exploring the Nardoo contains two specialised tools aimed at providing support at a deeper level for the exploration process, namely, a simulator (containing three interactive simulations) and a presentation guide which, together with support for note taking methods and suggestions on filing of materials, contains a series of genre templates. The three simulations available in *Exploring the Nardoo* are, an algal bloom simulation, a whole catchment level water demand management simulation and a personal, home based water use simulator. Each of these simulations is a powerful exploratory tool, which provides support for the solution to one of the embedded problems by mimicking a 'real world process' which forms an integral part of one of the problems encountered in the Nardoo River Catchment. They greatly enrich the 'quality' of the problem solving process for students by providing the student with unhindered access to act and become immersed in a 'real' situated process, manipulating the various causal parameters and testing hypotheses without a 'real' consequence or risk and in a time frame which is convenient to them. (Figure 2). They promote the adoption by the student of the active learner mode and in so doing support the active construction of knowledge by the student during the process of solving a problem.

The simulations complement the problems embedded in a complex information landscape by providing links with the 'real world' experience and by creating an environment in which the user may practise skills.

More able students are provided with the facility to solve problems at a deeper level through the testing of their own "what if" scenarios. This can, during the course of solving problems, facilitate more detailed exploration and learning by:

•allowing the user to take readings at a sight and study the changes as the simulation runs,

•allowing the monitoring of all parameters while the simulation is running, with the aim of exploring the relationships between them (Corderoy, et.al. 1993, p 126)

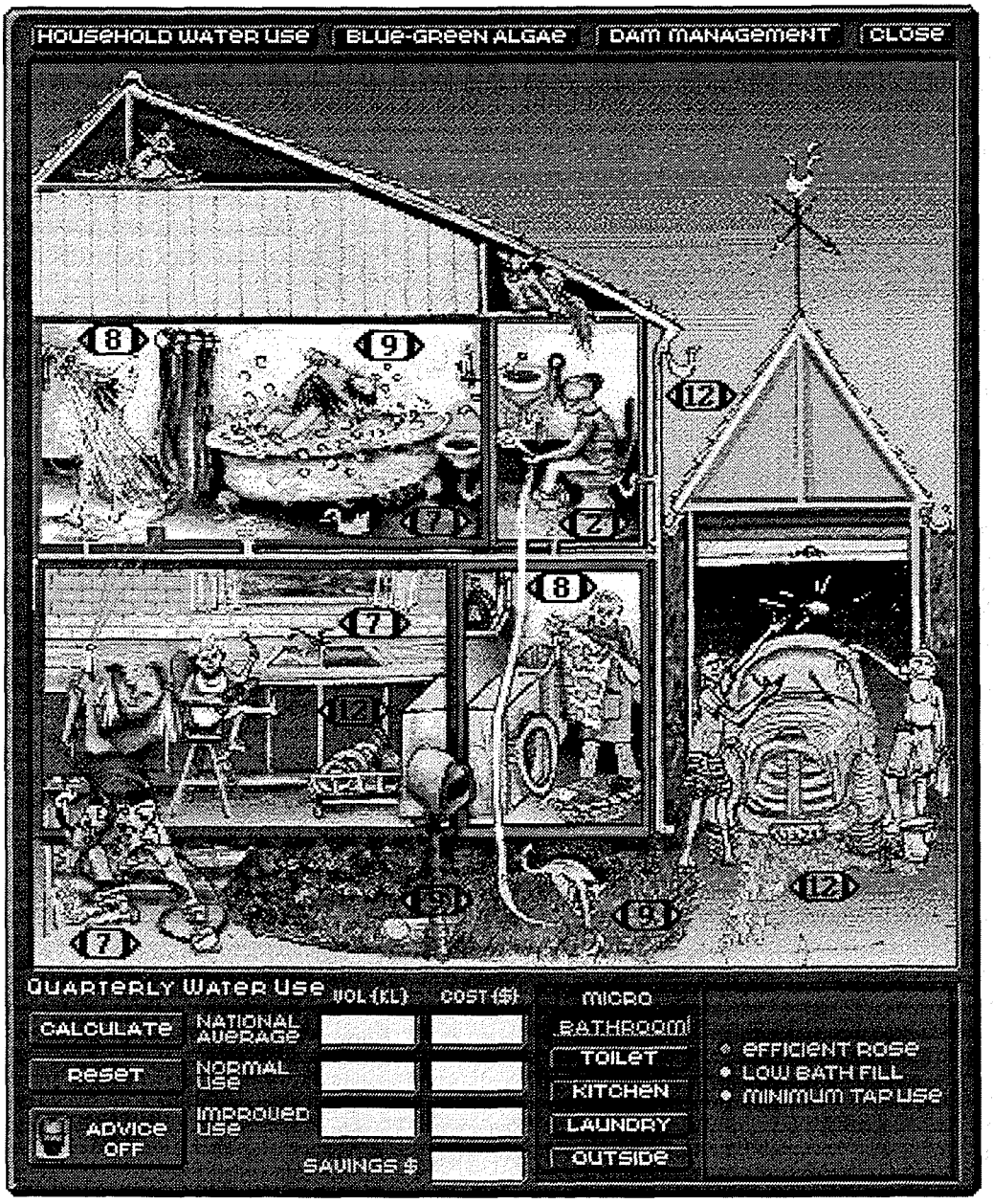

Figure 2 A personal water use simulator

A necessary skill in problem solving is the ability to collect and manipulate and analyse many different forms of data and then present them in a meaningful and useful way to any of the many different discourse communities.

The genre template tool in the presentation guide provides a suitable mechanism for the support and development of this skill.

The student support for the collection of this data in the form of note taking and the resulting solutions to problems needs to include modelling of the various styles of discourse used in different communities.

The use of the notebook metaphor can be carried through to the creation of multimedia presentations. The notebook can be used as an organiser for drafting the presentation and should make the transition to a finished multimedia product seamless. Templates such as the genre templates within a notebook can be used as advanced

organisers for the learner, especially those with little prior knowledge. The templates also provide a framework for gathering information and stimulating recall of prior knowledge.

By making such templates available and encouraging their use, we are assisting students through a modelled form of outlining. Identifying concepts within their notes that bear some relationship to part of a template structure requires high order thinking skills which

> "a) causes focusing on important points, b) helps students gain familiarity with text structure, c) aids retention, d) generates useful alternative texts to supplement materials read, and e) causes active participation in learning " (Bianco and McCormick, 1989 in Schroeder & Kenny, 1994, p966)

The value of this modelling process is not faculty, learning style, level of school, or type of writing dependent.

CONCLUSION

The development of innovative interactive multimedia packages that support student driven exploration and investigation has not been a priority for the multimedia industry. Design models and examples of such products are now being presented by researchers to not only support the research endeavour in this field, but also to support more commercial design of educational products. *Exploring the Nardoo* is an example of a product which provides a range of cognitive tools in an information landscape to support student investigation. Simulations and support tools which allow multimedia reporting are embedded in the package and are supported by several metacognitive tools for the writing process. These tools not only include details about genre but also scaffolding templates to support the learners. The extent to which problem solving and student centred learning goals are achieved will be investigated and reported upon when the product is released to schools.

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