EVALUATING COURSEWARE:

A NEED FOR MORE CONTEXT BOUND EVALUATIONS?

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This paper reviews what different commentators have written about the evaluation of educational courseware, especially the recent suggestion that more 'context-bound' evaluations are needed. We draw on our experience of such an evaluation and hypothesise on the reasons for the lack of such evaluations. Examples of context-bound evaluations include an evaluation of the Climate courseware, developed by the Education Department of Western Australia some years ago, to illustrate the approach. This is contrasted by a desktop evaluation of courseware of the same name Climate, developed in the UK with a similar kind of context-bound evaluation of Where in the World is Carmen Sandiago? Reviews of the courseware From Alice to Ocean, The Gold Adventure, of context-bound evaluations are provided for illustrative the value of context-bound evaluations.

The case is made for using context-bound evaluations as a complementary and valuable addition to traditional forms of evaluation of educational courseware, such as checklists. Evaluating the quality of the instructional design remains an important consideration in evaluating courseware. Ongoing comment and dissent is invited from teachers and academics on the value of context-bound evaluations of educational courseware. In doing so, we hope to re-invigorate the debate over appropriate ways of evaluating educational courseware that will provide useful information for classroom teachers. Implications for web-based evaluations of courseware are considered. Principles similar for the evaluating courseware may be applied to evaluation of different mediums, such as CD-ROM, DVD and on-line learning material.

INTRODUCTION

The evaluation of educational courseware is considered a crucial activity in the use of information technology for educational purposes. Unfortunately, there is not enough agreement about what evaluation involves and who should carry out such evaluations. In this paper we consider the stage of development of the literature in this crucial area.

A useful beginning is the set of categories for evaluating courseware proposed by Hawkridge (1990): descriptions, analyses, critiques and evaluations. A similar set of categories, as suggested by the OECD/CERI, was given by Cheung (1994): courseware description (a description of the main features of the courseware), courseware review (one individual's judgment about the courseware) and courseware evaluation (which must include actual use by the intended audience). This last procedure has been labelled 'the acid test' in the courseware evaluation process (Schibeci,

1985; Hawkridge, 1990) because it is often considered to be a crucial test of the worth of educational courseware.

Analyses and reviews of computer courseware are commonly found in computer magazines. A new computer game, application, or utility will be described, analysed or critiqued by someone on the magazine's staff and we may use this information to help us decide whether to buy our own copy. Similarly, educational courseware may be described, or analysed, or critiqued but using different criteria. Is educational courseware evaluated? Much less often, it seems.

THE PROMISE OF EDUCATIONAL TECHNOLOGY

In a provocative article to educators, Ely (1997) posed: 'Technology is the answer! But what is the question?' He wrote that we should ask of technology (hardware and courseware): How is it being used? By whom? For what purpose? How often and with what result? Additionally, he asked:

- How can we create the conditions for learners to become increasingly responsible for their own learning?
- How can we help learners to use the tools that are required for survival in a technological society?
- How can we 'humanise' technology in the service of all people?
- How can we help learners to ask the right question?

These questions are perennial, regardless of the technology concerned. As we conduct courseware evaluations, we may ask ourselves similar questions. Indeed, it is crucial that we do this to ensure high-quality educational material is selected for use by students. Despite the large investment in information technology by educational institutions, there is still scant evidence to establish the proposition that the new technologies have led to significant learning gains among students. *This may be due to a number of reasons; including lack of funding to support such research and a reticence of courseware 'evangelists' to subject their work to the rigours of academic scrutiny, or because there are no demonstrable educational gains, just different kinds of learning experiences (Ely, 1997; Oppenheimer, 1997; Boyd-Barrett & Scanlon, 1990).*

Perhaps this response is indicative of the unrealistic expectations that are often held by proponents for any new technology by some educators and those in the information technology industry. Also, it may be that the expectation that technology above all will lead to significant changes in learning is naive. It may be that economic exigencies unrelated to student learning, such as affordability of courseware, will outweigh educational considerations. Rowley and Slack (1997) claimed that the "literature on CD-ROM interface evaluation and design is surprisingly sparse" (p. 11). In their view, this is a result of the disproportionate effort devoted to "product development and the launch of new products to the market place" (p. 11). Alternatively, this may be a result of the relatively short time CD-ROM courseware has been available. While an increasing number of reviews of CD-ROMs are being published, few are focused on the educational worth of the courseware. Rather, these reviews tend to concentrate on technical issues, such as quality of graphics and speed of operation.

Evaluation of educational courseware whether delivered by using storage, such as CD-ROM and DVD technologies or on-line via the Internet remains as an important activity. The need for effective evaluation is as necessary today, as it was when computers were first used in education. On-line learning via the Internet is of particular interest because of the ubiquity of the technology and the flexibility inherent in this medium of delivery, provided students have access to the requisite computer hardware and software and communications capabilities. The Internet has potentially profound implications for promotion, delivery and administration of international education and is analysed next.

IMPLICATIONS FOR 'ON-LINE LEARNING'

What is learnt when evaluating the various forms of courseware may translate into useful approaches to evaluating on-line learning material. Technologically Mediated Learning (Hosie, 1993) potentially offers cost effective interactive learning for students over long distances while maintaining high quality outcomes (Lundin, 1993). While this may constrict potential student volume participating in face-to-face education, for the astute, technologically nimble courseware developers, this scenario also presents opportunities. There are substantial opportunities for institutions prepared to adopt a mixed mode of delivering education based on models of open learning (Hamer, 1993). Technologies which can be used to deliver education have suddenly become cheap, ubiquitous and pervasive (Lundin, 1993). As a consequence, the potential to deliver education locally, and at a distance, is poised to expand exponentially.

Of all the various permutations of Technologically Mediated Learning, the Internet has the greatest capacity to integrate the existing technologies and emerging technologies. The Internet has captured the imagination of the community and educators alike as the fastest growing form of information exchange within our society because it allows emerging multimedia technologies to be available worldwide.

The Internet is effectively a set of linked computers characterised by protocols that allow the Internet to be used across a wide-range of platforms. This means that the same information is accessible from any location, regardless of the type of computer operating system being used mostly driven by browsers. This offers an improvement on many existing computer-based multimedia technologies that are platform specific and allows for the presentation of multimedia information. Multimedia offers educators a means of overcoming some of the difficulties normally associated with traditional learning that it cannot be achieved using more typical teaching methods, such as the capacity to access and search large amounts of information and conduct simulations.

CONSIDER THESE TECHNOLOGICAL DEVELOPMENTS

The impact of the Internet on education continues to be debated. Increasingly critics argue

that the educational merits of classroom computers are dubious, while the cost of the technology is too high (Ely, 1997; Oppenheimer, 1997).

A mix of technologies is likely to prevail until it is possible to efficaciously transmit full-motion video images over the Internet. Digital Video Disc (DVD) format is likely to predominate storage medium for course delivery in small groups requiring full-motion video. Advances in graphics file compression technologies have already overcome impediments to using dense graphical information on the Internet. Similar progress has occurred in 'streaming technologies' that will permit the transmission of full-motion video via the Internet.

Whatever the educational merits of the Internet it is accessible in around 150 countries. It provides the hardware support for many technologies including: e-mail, the World Wide Web, file transfers and remote systems access, which can be used for entertainment, business, social and educational applications. While it is not possible to state, with any great accuracy, the number of world-wide users who access the Internet, estimates place it between 30 and 50 million people with the expectation that *these numbers will double every six months* (refer to: http://www.browserwatch.com for the latest updates).

Regardless of the precision of these guestimates, a colossal number of people have access to the Internet worldwide and this is growing exponentially, as is the demand for higher education using the Internet (Hooker, 1997; Bromley; 1998). A new 'megatrend' has emerged (Naisbitt, 2000). An alternative prognosis for where education and global learning is heading is worth considering (Logan & Pritchard, 1996). There is every indication that the impact of information exchange on the Internet will rapidly translate into a viable international distance education service. Scores of institutions are planning to, or already offer, education via the Internet.

Students at all levels of tertiary education already make extensive use of the Internet to improve learning (Hooker, 1997; Bromley; 1998). This trend seems likely to become more widespread amongst primary and secondary school students.

A REALITY CHECK ON EDUCATIONAL TECHNOLOGY

Considerable expectation, hope (and hype) have also surrounded this latest manifestation of educational technology. What is the reality? Some clues come from reviews, such as Scanlon's (1997) review of on-line learning in science, in which she highlighted the issue of priorities: some teachers might prefer basic resources (books, adequate hygiene) to Internet connections. Nevertheless, she raised a number of issues for those evaluating on-line learning to consider. Among these were the following:

- reliability of the network;
- scalability: small groups of learners, or larger group?
- bandwidth;
- integration, technology and curricular;
- pedagogy; and
- evaluation.

Scanlon noted that few studies she reviewed did "more than describe new and innovative uses of technology" (p. 84), and argued for "more critical accounts" of such endeavours.

Given the large investment in educational technology in schools and universities, we need to consider seriously whether, as Oppenheimer (1997) claimed, we have deluded ourselves and that computers, and information technology generally, do not significantly improve learning. Clearly, we need evidence rather than hype, despite the claims of Roblyer, Edwards and Havrilvk (1997) that: "Courseware quality is less troublesome now that it is in the early days of microcomputers when technical soundness frequently caused problems" (p. 116). This may well be true in a technical sense, but is educational courseware contributing to learning in a more significant way than earlier methods? If so, how is this occurring?

EVALUATION

Many educational technology texts assume that teachers should conduct their own reviews and provide checklists to help them conduct such courseware reviews, either on the net or using CD-ROMS or DVDs (to use the OECD/CERI term, Cheung, 1994). For example, Sharp (1996, p. 156) provided a checklist with the headings: courseware type, hardware, courseware contents, instructional design, courseware appearance, ease of use, consumer value and support. Rowley and Slack (1997) and Reeves and Reeves (1997) have reviewed checklist approaches to evaluation and developed an integrated list from the information gathered. Checklists and frameworks are two common approaches to predictive evaluation which have been criticised. Predictive evaluation has been defined by Squires and McDougall (1996, p. 147) as "the assessment of the quality and potential of a software application before it is used with students'.

Reeves, Harmon and Stephen (1994) have devised systems for evaluating educational software and Websites that makes effective use of scales such as: as ease of use, navigation, cognitive load, mapping, screen design, knowledge space compatibility, information presentation, aesthetics, and overall functionality. These are essentially based on the approach originally developed by Reeves (1994). This schema assists in the evaluation of pedagogical issues in multi-media learning systems, is useful in planning and developing learning experiences of students as well as in formative evaluation of its progressive development. Fourteen pedagogical dimensions of general principle of what constitutes good multi-media design have been identified by Reeves and Harmon (1994).

Reeves argued that before assessing the effectiveness of Web-based instruction, it is essential to define the "dimensions of interactive learning" which can be enabled through World Wide Web technology. An understanding of these dimensions, Reeves and Reeves argued should precede an interactive learning program development, implementation and evaluation" (1997, p. 59).

Ten dimensions of interactive learning within a Web-based environment which they consider essential are:

1) pedagogical philosophy

2) learning theory

3) goal orientation

4) task orientation

5) source of motivation

6) teacher role

7) metacognitive support

8) collaborative learning

9) cultural sensitivity

10) structural flexibility

McDougall and Squires (1995) reviewed checklists for courseware evaluation and concluded that there is a role for checklist, such as the one given by Rowley and Slack, in the formative evaluation of courseware but not in its selection. McDougall and Squires (1995) also noted a confusion between *evaluation* and *selection.* These two types of reviews serve two very different but equally important purposes. Tergan (1998) has also critically reviewed checklists and suggested ways in which they can be used.

Checklists may be seen as an extension of the positivist evaluations of courseware. Scriven (1983) argued that one of the worst aspects of logical positivism is its attempt to construct a value-free science that purports to exclude values from the scientific process. A checklist used to evaluate educational software is neither value-free, nor scientific but is an instrument that when used appropriately by a reviewer may provide useful information for educators.

A number of authors have suggested procedures for teachers to follow as they decide what courseware to purchase. For example, Roblyer, Edwards and Havrilvk (1997) recommend that teachers adopt the following sequence in selecting courseware: identify a need; locate titles; conduct 'hands-on' reviews; and collect students reviews', that is, field test the courseware. However, it must be recognised that the teacher's intent and approach are also critical. Teachers' perceptions are a highly variable aspect of the context of evaluating courseware.

Certainly, it is crucial to involve teachers in courseware evaluations. Cheung (1994) suggested that teachers conduct a five-stage process for evaluating courseware. While these suggestions may be ideal, it is debatable if many teachers have the time for such a laborious procedure. Cheung also suggested that teachers "should be given the time and opportunity to prepare themselves to carry out the evaluation" (p. 195).

What does 'evaluation' entail? Levine (1996) suggested that there are four aspects of evaluation, which apply also to 'courseware' evaluation: "(a) courseware design; (b) the effects on courseware selection; (c) courseware implementation; and (d) the formation of a theoretical base for courseware use, including its effects on cognitive, social, and instructional process" (p. 261). He also noted the following about courseware evaluation as a field of study: "Although a vast amount of literature exists on this subject, a basis of agreed criteria is still lacking" (p. 261). Among the approaches to courseware evaluation listed are: "a checklist, an analytical (open-ended) review, a panel evaluation, an interview, automated measures, observations and, experimentation" (p. 264).

Levine suggested that "Observation of courseware in use can provide the basis for valid and effective evaluation for either formative or summative purposes" (p. 265). Regarding experimentation, he wrote that it is 'controversial' in courseware evaluation, but it is debatable that "the only methodology that checks the origin of the effects rather than the effects themselves" (p. 265). Finally, Levine concluded his review of courseware, as indicated earlier, evaluation that:

> Effective evaluation produces judgments that are context-related; regardless of the methodology used, it takes into account the pedagogical nature of courseware, the classroom milieu the desired goals and the type of usage. Such evaluation is driven by educational needs, as reflected in the curricular, and by learning theories, rather than by technology (1966, pp. 266-7).

Squires and McDougall (1996) noted recent acceptance by many educators of a 'situated' view of learning, in which what is learned and how it is learned are not separated. They believed this view has important consequences for educational courseware evaluation. Importantly, they distinguish between predictive and interpretative evaluations:

> Predictive evaluation of software is the assessment of the quality and potential of a software application before it is used with students. Interpretative evaluation is concerned with assessing the observed use of an application by students. By definition, interpretative evaluation is conducted in context (p. 147).

Squires and McDougall (1996) offer an approach they label the 'Perspectives Interactions Paradigm':

> a comprehensive framework for thinking about educational software and moves ... toward more educational uses such as learning processes, classroom activities, teacher roles curriculum issues, and student responsibility for learning (p. 155).

Their approach considers interaction between pairs of three elements: perspectives among teachers, student(s) and designs. They illustrate the approach, which they claim can offer an effective predictive evaluation tool, with an evaluation of the CD-ROM *From Alice to Ocean.* Readers, presumably, are to use this example in applying the approach to other courseware.

Russell (1994) questioned the use of context-free procedures, and argued that "educational courseware criteria should derive from the experiences of students and teachers who are to use the courseware in schools" (p. 159). This approach is illustrated in the evaluation of *The Gold Adventure* game, an evaluation that included an investigation of students working through the courseware.

COMPARING MODES OF DELIVERY

Perhaps the strongest potential criticism of the courseware revolves around whether the tasks performed by the computer could be done as well by

traditional methods. These issues have been explored extensively by Clarke (1983). This was a common, and sometimes valid, criticism of educational courseware. Critics suggest that trivial tasks suddenly become important when performed on a computer.

Clarke asserted that it was pointless to compare delivery methods, a position vigorously opposed by Scriven (1988). Reeves (1994) is highly critical of media comparison as a method, proposing instead a dimensional approach as a viable alternative. A dimensional approach permits an individual piece of courseware to be systematically, and quantitatively, measured and described. Ideally, this approach would allow evaluators to assess two pieces of instructional media to see how compatible they are, before comparing outcomes of their use. As Reeves (1994) stated:

> A major weakness in traditional empirical approaches to evaluation is that the treatments being compared …are often assumed to be cohesive, holistic entities with meaningful differences. (p.221)

Courseware evaluation seems to be in transition from traditional experimental evaluation towards a more ethnographic approach, or using a combination of approaches. As Reeves (1991) noted that "... the phenomena involved in learning are so complex and so difficult to measure that multifaceted evaluation methods are required to obtain meaningful information" (Reeves, p.108). Mixed methods approaches (evaluations that combine two or more evaluation methodologies) rarely appears in the literature. Mixed methods approaches are also more likely to be used when there a number of distinct evaluation goals. As Marchionini and Crane (1994) and Boyle *et al* (1994) note, mixed methods approach are likely to become an increasingly popular methodology for courseware evaluation. With mixed methods courseware may be expertly reviewed, with checklists completed by students and teachers that are complimented by observation and interviews.

We will now illustrate the typical, published evaluation and the potential value of 'context-bound evaluations' with two examples, one of which we were involved in some time ago.

CONTEXT-BOUND EVALUATIONS

Two examples of context-bound evaluations will be used to contrast with the previous examples, *From Alice to Ocean, The Gold Adventure,* of context-bound evaluations are provided for illustrative purposes.

Example 1: Climate

In the spirit of understanding courseware in context, we have summarised our experiences with the Climate courseware *(Word Climate and Western Australian Climate),* developed in the mid-1980s. Our experience with this evaluation leads us to value this approach (Hosie & Schibeci, 1997). This small-scale interpretive investigation led us to draw some tentative conclusions. While *Word Climate* and *Western Australian Climate* courseware was developed in the mid-1980s, the principles of sound and creative instructional design transcend some aspects of the time of development as the design exhibited a number of the aspects of constructivism. As such, the *Word Climate* and *Western Australian Climate* courseware was arguably well ahead of its contemporaries, as an example of constructivist instructional design. Some of these findings remain relevant to the design and subsequent evaluation other mediums of delivery (eg. CD-ROM, DVD and the Internet). This is an account of an exploratory evaluation of the courseware *Climate.*

The *Climate* courseware (Education Department of Western Australia, 1984) was written to integrate closely with the state curriculum, unlike commercially produced courseware, and comprised the following elements:

1. *World Climate* introduced some of the concepts of world climate for students in the Western Australian upper primary school. It consisted of a series of simulations which presents the major factors affecting the average temperatures and rainfall for an imaginary landmass.
2. *Western Australian Climate* was a set of courseware used to investigate general principles about climate in Western Australia. Climatic information was stored for approximately 120 centres throughout Western Australia. Each of these centres had the following information recorded; latitude, longitude, average yearly maximum, average yearly minimum, yearly rainfall, rainy days, wet season.
3. *Western Australian Climate* was designed in the period 1983-5 to help primary school children (a target group of 5-12 years of age) to understand the concepts of world climate, and to be able to relate these concepts to the Western Australian context. The computer discs containing the *Climate* courseware was accompanied by a booklet which gave a brief summary of how both program operated and other relevant information. The children's activity sheets were clearly laid out, on A4 sheets with bold headings, to allow photocopying. Extra activities were suggested, and when necessary, short explanations with diagrams, provided additional information not available in textbooks.

Methodology

A naturalistic research framework was used (Hosie, 1986) in the evaluation of *Word Climate* and *Western Australian Climate* courseware which aimed to document how learners were using the courseware. Interviews with the designer of the courseware, by one of the authors of this article, and a small sample of student and teachers provided the major data source for this evaluation. In addition, participant observation was used to balance self-reports with classroom practice. The data collected concentrated on the areas of teacher adoption strategies, courseware, documentation, perceived learning outcomes, the mechanics of operating the program and comparison with other methods. These can be summarised by the following propositions: computers should promote discussion and interaction among students; computers can give students experience they could not get any other way; and, computers can be used effectively by whole classes and groups of students. These well-known precept of instructional design of educational courseware is infrequently evident in contemporary designs.

Naturalistic research techniques were used to conduct a small-scale

evaluation of the computer courseware *Climate* and *World Climate*. Information was collected and analysed from the designer, teacher and students perspectives in an attempt to gauge how well the aims of the courseware were attained. Parameters, which were examined, include: design background, documentation, ease-of-use, suitability of subject matter and unintended outcomes in an attempt to 'bound' the evaluation to ensure that is was manageable. In addition, the educational rationale for developing the courseware was examined.

Participants

Two teachers and their two classes (a mixed Years 6/7 class and Year 7 class) from a State Primary School, a large metropolitan primary school (with an enrolment of approximately 600 students), situated in a middle to upper SES suburb of Perth, Western Australia in mid-1985, formed one data source. A teacher from an State Academic Extension Unit and a group of eight children from a lower to middle SES area were also interviewed. Students from the school had limited experience with courseware produced by the Education Department of Western Australia, but many had access to computers at home, even in 1984. Naturally, the extensive market penetration of computers has resulted far more access to computers at homes for students.

In the spirit of understanding courseware in context, we have summarised our experiences with the *Climate* courseware. This small-scale interpretive investigation led us to draw some tentative conclusions. This is an account of an exploratory evaluation of the courseware *Climate*.

Selected Findings

The rationale for developing the courseware seemed well-based, because:

- The courseware was simple-to-operate, with clear graphic representation. The subject matter was appropriate for the curriculum it was designed to complement, and level of the students it was intended for;
- Teacher assistance was required if children were to maximise learning gains;
- Successful independent learning was possible for students but teacher direction was needed to ensure holistic understanding of the concepts embedded in the courseware;
- Problem solving seemed to be encouraged and other unintentional gains were evident, such as the refinement and development of skills of prediction;

Certain factors contributed to the appeal of the courseware. Children were able to relate to the information contained in the WA Climate database, by taking particular delight in examining the statistics of various towns. Children enjoyed competing against computer courseware. Attempting to match the report and target facsimiles of *World Climate* was singled out by the teachers and students as particularly motivating. Games and competitions using the WA *Climate* database as a stimulus, developed by the children, were also reported. This joy in competing against the computer led to what was isolated as an important unintentional learning outcomes of *World Climate.* This is important in a contextual evaluation were the courseware may be used for purpose other than what it was initially designed for.

This courseware also satisfied another acid test of justification; that is, it could it perform tasks not possible using more typical teaching methods. Problem-solving was considered by many as a highly beneficial learning activity. One difficulty of using this approach was the need to get children to formulate and organise questions likely to lead to meaningful learning. The WA Climate database was an ideal medium for developing interrogation skills. However, teachers need to assist children to structure worthwhile questions in order to get the most from problem solving exercises using the database.

Children found the courseware engaging. Overall, the courseware appears favourably received by teachers and students. Based on comprehensive data about how children and teachers use the courseware, the most useful finding of this investigation related to how the courseware was used in classroom situations.

Consistent with other curriculum dissemination practices, teachers took and modified the courseware for use in a number of ways to suit their circumstances and teaching style, as they would with any other resource. If this method of adoption was accounted for in the design of courseware it might lead to greater classroom use. It might be profitable for courseware designers to allow for this possibility by producing more flexible material. For example, WA Climate could be used for other applications it was not originally intended for, such as a statistics database for mathematics.

This limited study was not a definitive evaluation of the Climate courseware. We offer these findings as an approach that may be useful in guiding the methodology for future researchers contemplating adopting this methodology, by way of illustration. We hope subsequent researchers will gain some insight into the advantages and inherent limitations of this approach. In some way this may assist to refine interpretative evaluations of educational courseware. This may serve to progress the debate about the utility of context-based evaluations for educational courseware.

INSTRUCTIONAL DESIGN

The instructional designer developed a TV series, in conjunction with one of the authors, titled *Computers in Primary Schools*, with the Education Department of Western Australia. These videos used the same title as the courseware. The videos *World Climate* (15 mins), *Western Australian Climate* (10 mins), were developed to assist teachers' to integrate the use of education courseware into the classroom. Details of how the programs are operated, the philosophy behind the design and teaching strategies for implementing their use are given by the designer in the videos. These videos were designed to be used as a guide in conjunction with the *Climate* manual, which was supplied with the courseware.

The idea for *World Climate* was generated by the designer, working virtually in isolation. When teaching primary school social studies, he found it hard to find meaningful activities about the topic, *Climate.* There was a great deal of material available for teaching about micro

climates but dearth of quality material about macro climates. One of the reasons for designing *World Climate* was the traditional method of teaching the concepts in schools; latitude, longitude and temperature, are normally subject of a 'talk and chalk' description followed by location searches in an atlas. Teaching about rainfall and factors influencing rainfall has a descriptive phase, which was usually followed by the use of charts, diagrams and possible experiments. Student experience of this mode of instruction was mainly teacher directed and relatively passive. As stated earlier, one the authors of this article used information from interviews and while developing the TV series Computers in Primary Schools to inform this context-bound evaluation.

The aim of developing the courseware was to encourage more active student learning than could be provided by drill and practice, the most common program type available at the time. What the student could investigate was, of course, bounded by the available data. Nevertheless the courseware provided scope for exploration. One important feature of the program was that actual data about Western Australian towns that were to be interrogated. This gave students a sense of reality and purpose to the exercises they were completing, which contrasted the use of artificial data characteristic educational learning materials at the time. The designer was also keen to allow students a large measure of control over their learning. Allowing children to conduct simple computer-based searches for information could complement concepts covered in *World Climate.*

The designer asserted that there were about the concepts of climate than was possible through traditional teaching methods. He considered design encouraged children to use the computer either individually or in small groups independent of the teacher. There was a deliberate attempt to permit students to use the computer without constant teacher assistance. The courseware was not meant to replace the teacher but to complement the normal classroom program. Children can use the program unaided, which was a motivational aspect in itself. More active involvement encouraged by was considered by the courseware instructional designer to assist long-term retention and understanding of the subject matter.

Additionally, the instructional designer considered that the program allowed children to manipulate data independently of a teacher will make for more engaging learning, which will conversely result in deeper understanding of the concepts and subsequent long-term retention. Coburn *et al* (1982, p. 43) noted some time ago, imaginative educators are beginning to devise ways of adopting the data processing capabilities of computers to enhance student learning.

Example 2: Climate (UK-Climate)

A desktop comparison of UK version of *Climate (UK-Climate)* evaluation and *WA Climate* and *World Climate* was instructive to the reviewers. Self (1985) has critically evaluated the *UK-Climate,* which was designed and developed courseware on the same subject matter. The courseware presented data for mean monthly temperature and rainfall using multiple choice questions to assist the user to conclude what type of climate was under consideration.

In contrast to *WA Climate* and *World Climate,* Self noted that the designers of *UK Climate* did not state the assumptions about the knowledge supposedly incorporated into the design of the courseware. Inevitably this leads to confusion about the expected learning outcomes. Even with the artificial data from theoretical weather stations, *UK Climate* provides insufficient data to generalise conclusions about the climates under consideration.

According to Self, *UK Climate* failed to satisfy the criteria to be considered a valid teaching/learning activity because the program made no significant contribution to the instructional process and did not engage the learner in activities a competent teacher would involve students. *Climate* and *World Climate* tackled the areas suggested in Self's evaluation. The *World Climate* simulations were potentially more effective for teaching concepts about climate than an approach based on books and models. Children were able to manipulate variables, such as wind direction, to get a graphic representation of the effects on an overall environment.

Many of the tasks performed by WA Climate, such as information searches, could be done manually, using an atlas, but the program allowed these searches to be performed in a fraction of the time normally required. Also, the information was more readily interrogated than in book form. Children could see the information collected developed into a graphic representation (on a map) which had an important reinforcing effect. Again, this task could be performed manually, for example by getting children to colour in maps, a laborious practice of dubious educational value. However, the short gap between putting in search parameters and getting a result allows for a more effective use of learning time. This resulted in a dramatic increase in the number of searches possible in a given space of time. Perhaps more importantly this allowed children far greater freedom to explore the data and propose hypotheses and see patterns of distribution information develop.

Example 3: Where in the World is Carmen Sandiago?

A similar kind of 'context-bound' evaluation has been published by Grundy (1991), who investigated the use of the courseware, with a group of Year 3/4 and a Year 6 group in two small, rural schools in Australia. In this study, "The students were recorded as they worked through the game in naturalistic classroom situations" (p. 44). She noted that there were many benefits to students' use of this game; for example, the game provided "a successful and enjoyable learning experience as well as opportunities for the development of problem-solving strategies" (p. 53). However, she also added that:

> While this investigation highlighted ways in which the computer can enrich the learning experiences of children, it has not demonstrated that such learning was more worthwhile than traditional print-based experiences. *(p. 54)*

This is a useful issue to consider. Examples of actual use of the courseware that was unhelpful included the fact that teachers did not use the database

"...MORE EFFORT COULD BE PRODUCTIVELY DEVOTED TO CONTEXT BOUND EVALUATIONS. SELECTING COURSEWARE FROM A CHECKLIST IS ANALOGOUS TO PURCHASING A CAR"

function, and that students could avoid reading the text provided. This context-bound evaluation provides information, which would be useful to teachers contemplating the use of this courseware in their classrooms.

THE IMPORTANCE OF INSTRUCTIONAL DESIGN

Without doubt, the quality of the instructional design of courseware is critical to the learning function. A significant consideration, which is given scant attention by the literature, is that many learners prefer some form of human interaction in learning tasks, while others do not. Clearly, individual learner preferences will be an important factor in any design and subsequent evaluation considerations for multimedia. Vadas (1989) also notes a significant percentage of students also prefer solitary learning circumstances. Accommodating these individual preferences is possible with learning involving multimedia and needs to be considered by instructional designers as well as those seeking to incorporate multimedia into learning programs. These need to be designed to accommodate individual learning styles.

Traditional use of multimedia has emphasised images and video although speech recognition is already well established within the technology. According to Schank (1994) the future challenge for multimedia design lies in developing programs that actively engage the user, as has always been the case regardless of the medium of delivery. New courseware designs, which do not rigidly structure learner responses, need to be explored to complement this medium of instruction. Successful adoption of multimedia depends on developing quality courseware, which takes into account the unique attributes of the technology. Multimedia designs are only just beginning to exploit the capacity of the technology.

Also it is necessary to ensure that non-courseware-based courses involve learning by doing. Multimedia information system design is still a new field and there is no agreed model of how to proceed (Grosky, 1994).

CONCLUSION

A number of issues emerge from this brief review. First, there are the limitations to using the checklists to evaluate courseware. McDougall and Squires (1995) have discussed the problems and limitations of the checklist approach to courseware selection, especially because this approach emphasised these technical attributes of packages at the expense of consideration of broader classroom environments and activities, learning processes and other educational issues; that is context was not addressed. Context-bound evaluations of courseware have the capacity to augment information gathered by checklist evaluations to illustrate the potential educational value of courseware for students.

Another interesting issue is how acceptable are context-bound evaluations to journal editors? Clearly, they will be longer than description, analyses or critiques. Will such evaluations be welcomed for publication, given pressures on journal space?

A 'checklist' approach to evaluation can provide useful, if incomplete, information about educational courseware. In our view, however, classroom teachers require additional evaluation data that are not provided by checklist evaluation. We argue that more effort could be productively devoted to context-bound evaluations. Selecting courseware from a checklist is analogous to purchasing a car.

The potential buyer of a car is likely to have a mental checklist of what they want (such as; good fuel economy, price range, air-conditioning, power steering, automatic gears and the like) in a car of their choice. A car being considered for purchase may have all the features required in the buyers' checklist but the final decision is likely to rest on how the car how performs in relation to the purchasers' expectations. Prospective buyers are unlikely to make the final decision to purchase the car until they have actually test driven the vehicle. As with motoring magazines, subjective reviews by experts may also sway a prospective educational courseware purchaser. Once the checklist of essential elements (subject matter, level, cost) of courseware is found, a context-bound evaluation may provide the visceral 'driving' experience a potential courseware purchaser seeks.

Lessons garnered from evaluating various forms of courseware may be used when evaluating on-line learning material. The conceptual development and application of courseware evaluation has lagged behind marketing initiatives. Courseware evaluation needs to improve considerably to ensure the health of educational computing (Hardin & Patrick, 1998). By health we mean the ongoing development of quality authentic learning experiences for students by creative instructional design informed by practice and the literature. Hawkridge (1990) points out that courseware was "only one element in a complex teaching and learning process" and that teachers and reviewers "need to understand the context in which it was used" (p. 106). We hope that others will contribute to the sparse literature reporting context-bound evaluations of educational courseware, for as, Hawkridge asserts, "you only understand the potential of courseware when you use it with learners" (p. 106).

REFERENCES

Bieler, D. & Stevenson, I. (1998). OVUM REPORT: Internet market forecasts: Global internet growth 1998 – 2005 December (http://www.gsmdata.com/repovum2.htm#Key findings)

Bromley, H. (1998). Education/Technology/Power: Educational computing as a social practice. SUNY.

Cheung, W.S. (1994). A new role for teachers: Software evaluation. In J. Wright and D. Benzie (Eds), Exploring a new partnership: Children, teachers and teaching (pp. 191-199). Elsevier.

Education Department of Western Australia (1984). Climate. WESOFT Educational Software.

Ely, D.P. (1997). Technology is the answer! But what is the question? In R. M. Branch and B. B. Minor (Eds), Educational media and technology yearbook (Vol. 22). Englewood, Colorado: Libraries Unlimited.

Felix, U. (1997). Integrating multimedia into the curriculum: A case study evaluation, On-Call, 11(1), 2-11.

Grundy, S. (1991). A computer adventure game as a worthwhile educational experience. Interchange, 22(4), 41-55.

Hamer, G.A. (1993). The use of technology to deliver higher education in the workplace, Department of Employment, Education and Training, Higher Education Division, Occasional

Hardin, L. & Patrick T. B. (1998). Content review of medical educational software assessments. Medical Teacher, 20(3) 207-211.

Hawkridge, D. (1990). Software for schools: British reviews in the late 1980s. In O. Boyd-Barrett and E. Scanlon (Eds.), Computers and learning (pp. 88-108). Wokingham: Addison-Wesley.

Hosie, P. (1986). Some theoretical and methodological issues to consider when using interviews for naturalistic research, Australian Journal of Education, 30(2), 202-14.

Hosie, P. & Schibeci, R.A. (1997). A context-bound evaluation of the Climate software. Unpublished manuscript, Murdoch University.

Hooker, M. (1997). The transformation of higher education. In Diane Oblinger and Sean C. Rush (Eds.) (1997). The Learning Revolution. Bolton, MA: Anker Publishing Company, Inc.

Levine, T. (1996). Courseware evaluation. In T. Plomp and D. Ely (Eds), International encyclopedia of educational technology (2nd ed.). Pergamon.

Lundin, R. (1993). Overseas experience in non-traditional modes of delivery in higher education using state-of-the-art technologies, DEET Higher Education Division Occasional Paper, AGPS, Canberra.

McDougall, A. & Squires, D. (1995). A critical examination of the checklist approach in software selection. Journal of Educational Computing Research, 12(3), 263-274.

Naisbitt, J. (2000). High Tech/high Touch: Technology and our search for meaning, Nicholas Brealey United Kingdom.

Oppenheimer, T. (1997). The computer delusion. The Atlantic Monthly, 45-62.

Roblyer, M D. Edwards, J. & Havriluk, M.A. (1997). Using software tutors and tools: Principles and strategies, Integrating educational technology into teaching (pp. 116-126). N.J: Prentice Hall.

Reeves, T.C. & Reeves, P.M. (1997). Effective dimensions of interactive learning on the world wide Web. In B.H. Kahn (Ed.), Web-based instruction, (pp. 59-65). Englewood Cliffs, NJ: Educational Technology Publications.

Reeves, T.C. (1991). Ten commandments for the evaluation of interactive multimedia in higher education, Journal of Computing in Higher Education. 2, 84-113.

Reeves, T.C. (1994). Evaluating what really matters in computer-based education in Wild, M. & Kirkpatrick, D. Computer Education: New Perspectives. MASTEC, Edith Cowan University Press, Perth, Australia. 219-246.

Reeves, T.C., & Harmon, S. W. (1994). Systematic evaluation procedures for interactive multimedia for education and training. In S. Reisman (Ed.), Multimedia computing: Preparing for the 21st century (pp. 472-505). Harrisburg, PA: Idea Group

Reeves, T.C. (1994). Multimedia evaluations of instructive learning systems. Proceedings of Association for Educational Communications and Technology (AECT) Nashville,

TN Rowley, J. & Slack, F. (1997). The evaluation of interface design on CD-ROMS. Online and CD-ROM Review, 21(1), 3-14.

Russell, G. (1994). Implications of context-based software development for education. Australian Journal of Education, 38(2), 157-173.

Scanlon, E. (1997). Learning science on-line, Studies in Science Education, 30, 57-92.

Schank, R.C. (1994). "Active Learning Through Multimedia", IEEE MultiMedia, Spring, 69-78.

Schibeci, R.A. (1985). Educational software: Good, bad and indifferent, Australian Science Teachers Journal, 32(3), 23-27.

Scriven, M. with Adams, K. (1988). "The educational potentialities of videodisc: An evaluation of the videodisc "Ask the workers ..." in the West Australian Schools" (with Kerry Adams); in Ask the Workers, James Steele, (ed) Australian Caption Centre, Surrey Hills NSW, 51–97.

Sharp, V. (1993). Computer education for teachers (2nd ed). Madison, Wisconsin: Brown and Benchman.

Squires, D. & McDougall, A. (1996). Software evaluation: A situated approach, Journal of Computer Assisted Learning, 12, 146-161.

Tergan, S. O. (1998). Checklists for the evaluation of educational software: Critical review and prospects, Innovations in Education and Training International, 35(1), 9-20.