Frankincense or Frankenstein? Assessing the impact of CD-ROMs on school education

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CD-ROMs have been heralded as providing an opportunity for great advances in educational technology and learning. However, little attention has been given to date to the notion that, without an appropriate pedagogy, this new technology may fall short of its capabilities. It may, indeed, be more characteristic of a Frankenstein, a construct which is potentially dangerous, than Frankincense, a valuable gift. This paper explores a number of possible limitations in the use of CD-ROMs in school education, and suggests that teachers may need to re-think how some examples of CD-ROMs may be effectively implemented.

Recent articles in educational and other journals have discussed aspects of CD-ROMs. In many cases, writers, such as Desmarais (1986) stress the technical advantages of the medium, such as security of data, and speed of access. Other authors stress the money or time that can be saved through the use of CD-ROMs in school. One aspect of the debate that may be lacking, however, to date, is the notion that the disadvantages of many CD-ROMs for school education might actually outweigh the advantages. Instead of being the educational equivalent of a sweet smelling regal gift of Frankincense, CD-ROMs in schools may ultimately prove to be a construct as dangerous as the man-made creation devised by Mary Shelley in Frankenstein. CD-ROM is a generic term which covers a range of software items, but while some CD-ROMs might be considered to be useful for school education, others may cause concern. Sometimes, problems inherent in CD-ROMs may result in software which has greater disadvantages than conventional software. In other cases, teachers may attempt to apply inappropriate pedagogies.

In biblical times Frankincense was greatly valued. It is an aromatic gum which burns freely and gives off a sweet smelling perfume similar to incense. The Old Testament suggests that it was restricted to the most holy of uses (Exodus 31, 34-37), and in the New Testament, Frankincense was understood to be one of the greatest gifts which could be given (Matthew 2, 11). With the introduction of a new technology in education, there is a tendency for educational administrators, retailers, and other groups outside the mainstream of classroom teaching to promote its use in terms which suggest that immense good will result in its adoption. Yet, as Cuban (1986) has argued, classroom teachers have not always welcomed radio, film, television and computers. Early predictions of the potential for these technologies for classroom use have often been over-optimistic. Cuban's example of Edison's prediction that teachers would soon be replaced by images of films has not occurred.

A sober second look at some examples of CD-ROMs will reveal that there are potential problems which educators should be aware of. These concerns might include fears of growing illiteracy, doubts that CD-ROMs may be too entertaining, and apprehension about the values and content taught. In some cases the problems arise only if teachers use conventional teaching methods with this technology. Ultimately, there is a choice. When Shakespeare's Richard III announces that he is "determined to prove a villain", he speaks of destiny rather than his decision. Yet, unless technological determinism is to sweep teachers helplessly along with the tide of events, teachers do have the power to decide how CD-ROM technology is going to be implemented. Sometimes, in determining what leads to changes in students' learning we may have to consider teaching methods or other factors in addition to the characteristics of the technology. It is interesting to reflect that the Amish sect in the USA conduct their primary education in schools which many would regard as technologically primitive (Hostetler, 1975). Frequently, the simple school rooms used have no electricity, and devices such as radio, film projectors, television and computers are rare. Despite this, Hostetler reports that standardised tests indicated that Amish children were performing above the national norm in the USA in spelling, word usage and arithmetic. Not only is it important to note that modern technology is not required to teach some subjects effectively, other research, such as Clark (1983) suggests that no particular medium is really more effective than another.

Clark (1983) investigated the comparative benefits of employing different media for instruction. This research indicated that specific media do not influence learning under any conditions. Where there are learning benefits, explanations are vulnerable to rival hypotheses such as novelty

and instructional method. Although this research clearly predates recent developments in interactive multimedia and CD-ROMs, it is possible that CD-ROMs are finding their way into schools because retailers or educators have made excessive claims on their behalf, rather than demonstrated need.

With computers (an essential component of CD-ROM), it is common for extravagant claims to be made for their potential, and Beattie (1985) describes some of the more extreme assertions about what they can achieve for education. More recently, Gates (1993) has praised the educational value of multimedia and CD-ROM technology which his company is promoting:

> The ability of this technology [multimedia and CD-ROM] to bring information to life is unprecedented. It integrates digital sound, animation, and photographic quality images with text and graphics to create an intensely engaging learning experience ... Multimedia computing is a powerful tool tor educators to develop lessons and materials. It is especially useful for the subjects which are the hardest to teach and which are the hardest for students to learn ... the schools where the most learning occurs are the schools where learning is treated as a dynamic multisensory experience... (p.35-37)

These are optimistic claims. However, Beattie (1985) insists that there is room for a dissident voice on the effects of educational technology. She argues that computerisation has noxious side-effects. In some circumstances, computers, including CD-ROMs may have characteristics which echo Frankenstein's Monster in the way that they are misunderstood, or are potentially hazardous to their owner. Some of the hazards might include increasing illiteracy rather shall reducing it, contributing to student alienation, undermining the teacher's authority, and exposing younger students to material of doubtful value. It is sometimes in the interests of vendors, manufacturers, employers and economists to ignore concerns about educational outcomes of CD-ROMs and other computer-based innovations.

Some educators may be unconcerned with the hazards which may be posed by CD-ROMs because their own career can seem more important than possible dangers to students. Educators may introduce CD-ROMs because it makes teachers appear progressive in the eyes of their peers or parents. Others may believe in the inoculation theory, which in essence demands that students must be "at home" with technology early in their lives if that same technology is not to cause them distress as adults. This argument is however challenged by Stavely (1993) who suggests that the

technology is changing so rapidly that any vocational education based on particular computer technologies and software is likely to be irrelevant by the time the students are ready to use their skills in the workforce. The adoption of CD-ROM technology may also be due to what Bigum, Green, Fitzclarence and Kenway (1993) refer to as "technological determinism", where the existence of CD-ROMs will eventually coerce teachers into using them, in part because of the pressure from vendors and the needs of the industry. It has been suggested by some writers in Business Education that interactive technologies reduce learning time requirements by an average of 50%. (Foley, 1993). However, even if this reported research is accurate, it does not follow that the same results may inevitably be expected if CD-ROMs are used in schools, as the effective use of them may require skills which teachers do not always possess.

The effective use of CD-ROMs in schools requires appropriate teaching skills. The pedagogies which teachers implement may reflect a conservative teaching model. Computers and CD-ROMs may have great potential, but use of them is essentially a social act (Grint and Woolgar, 1992). In essence, the existence of a technological artefact with certain properties is no guarantee that it will be used to its full designed potential. Teachers and other educators will use CD-ROMs in the context of their own experience and the hierarchical structures of their school. Seymour Papert (1993) argues that computers have immense potential, but there have to be changes in the educational system, including extensive professional development, in order for this to happen. It is time for educators to think about how CD-ROMs can be used effectively. If there are limitations, they must be squarely faced.

One variety of software on CD-ROM which exemplifies such constraints for teachers is that of CD-ROM encyclopaedias. In many schools, the first and sometimes only CD-ROM will be found on a computer in the library. This could result in students returning with a neatly laser-printed project, little of which they understand. Certainly the problem of students copying slabs of information from encyclopaedias is a problem which teachers and librarians have grappled with for years. It is understandable that some students will continue the same learned behaviour, of copying material which makes little sense to them, and handing it in. Yet, strangely, such a situation may suit some economic rationalists and employers. Even if the students understand little, their knowledge of computer operations makes them potential "office fodder."

However, it is likely that CD-ROM encyclopaedias exacerbate this problem by making it easier to copy much larger amounts of information. This, in turn, results in a much greater amount of reading and correction

for the teacher, which by changing the teacher's task makes such student practises harder to detect. An astute student can easily change a few key words in a word processed file which results from the use of a CD-ROM encyclopaedia. Thus the student's work may appear to be different from the original on the CD-ROM, but it may still be poorly understood. Teachers need to be alert to these possibilities and implement appropriate teaching strategies.

A key concern relates to the notion that CD-ROMs can be so entertaining that literacy and other important issues will be affected. One characteristic of the CD-ROM medium that it is able to store considerable amounts of information. Thus it is possible to store the entire text of a book on CD-ROM. However, books on CD-ROM need not be limited to conventional text. CD-ROMs enable the use of animation, sound, and graphics. Examples such as *Arthur's Teacher Trouble, New Kid on the Block*, and *Just Grandma and Me*, are evidence that CD-ROM books can be very entertaining.

Electronic multimedia books now exist on CD-ROM. Known as "Living Books", the user purchases a print and electronic version of the story. If students prefer the electronic version of the story, it may affect their literacy (Anderson, 1992). Postman (1983) has argued that the entertainment value of television is actually a disadvantage, in that it engenders in students an expectation that all education should be entertaining. Multimedia is not the same as television, but it is possible for some programs on CD-ROMs to be little more than passive entertainment. Trotter (1991 and 1992) builds on Postman's ideas to argue that CD-ROMs can be more entertaining than educational. It may be intended that multimedia is designed to be interactive, but some students may simply choose what is the most entertaining from the offerings available on a CD-ROM. It appears that there is, increasingly, a convergence between education and entertainment. As a result, children may expect that more conventional modes of education will be as exciting. Often it isn't, and this makes the job of teachers who use conventional books more difficult. The problems of software becoming too entertaining may also be found in other educational software. However, the power of CD-ROM technology is such that CD-ROMs are often able to display more effective graphics, movies and sound. It is likely that they are more entertaining, and thus represent a potentially greater problem for teachers.

The possibility that CD-ROMs entertain rather than educate is a concern which cannot be easily dismissed. Colourful graphics, voices, movies and animation are combined with text with the avowed purpose of strengthening reading skills. It is, however, probably too early for any definitive indications from research to indicate whether such CD-ROMs

are having their intended effect. Although educators might expect CD-ROMs to be interactive, poor software design or inappropriate pedagogy can result in students passively watching movies. In some respects CD-ROMs can resemble television. An interesting parallel can be drawn here with Healy's (1990) criticism of the childrens' television program Sesame Street:

> Twenty years of throwing alphabet letters and dancing words at children have produced ... children who find reading "boring", who are satisfied with the superficial, who can't understand why meaning doesn't appear magically - like a visual effect - and who give up when it doesn't. The resulting failure and disenchantment are particularly tragic for the very children the program primarily was designed to serve (p. 25)

Students' preoccupation with entertaining movies on CD-ROM was also seen in research conducted by the writer in 1994. In this study, a coeducational group of Year 8 students who had not previously used CD-ROM encyclopaedias were asked to compare the CD-ROM encyclopaedias *Encarta, Compton's*, and *Grolier's*. An unanticipated outcome of this research was the students' high level of interest in the movies which some of these CD-ROMs contain. Students sometimes ignored instructions to locate information on the CD-ROMs and searched for the most entertaining movies. Soon an informal network sprang up, with information being passed rapidly from group to group, as students shared their experiences of which movies were the best. The following exchange was recorded at the time with a group of three boys using one of the CD-ROMs:

> Researcher: What did you think of the movies on this CD-ROM?
> Student 1: They were great! What did you think? (The student turns to one of his friends on the computer.)
> Student 2: Yes!
> (Student 1 looks inquiringly at the other student on the computer, who nods)
> Student 1: I think you can say that we're agreed on *that*.

One suspects that some students would be pleased if a large part of their curriculum contained movies rather than print-based materials. In an educational world where CD-ROMs are increasing, it may be inappropriate for teachers to teach as if print were the only important medium. Kuhn (1970) has suggested that there are a set of shared understandings or paradigms where normal practice provides models, from which spring coherent traditions. Sometimes we are unable to see beyond familiar data or perceive how the world might be understood differently, and this may apply to some teachers' conception of education as being largely a print based world. Beare, and Slaughter, (1993) who have applied Kuhn's ideas to educational futures and technology, suggest

that technology is overhyped, and that we may need to think about the role of technology in different ways in the future. Teachers' insistence that completed work should be in traditional print form may be one example of this problem.

The pressures of traditional teacher culture and the expectations of a wider educational community help to determine assessment practices, including the marking of student work on paper. Yet this may be a mismatch of technology and pedagogy, and students who have used multimedia may find themselves limited by conventional methods of expression. An educational innovation such as CD-ROM, which promised revolutionary change in education, yet managed to increase problems might indeed be viewed in the same light as Frankenstein's Monster. When Mary Shelley wrote Frankenstein, or the Modern Prometheus, in 1818, she told of a scientist, Frankenstein, who constructs a Monster. One of the characteristics of the Monster created by Victor Frankenstein is not that the Monster is by nature evil, but is forced into murderous acts by the actions of Frankenstein and other people. "I had feelings of affection, and they were requited by detestation and scorn", the Monster tells Frankenstein. In essence, the way in which this man-made construct is used determines whether the consequences will be good or bad. Similarly, the question of the educational worth of another technological artefact, the CD-ROM, may also depend on its method of use.

Clinging to a dominant print paradigm may be unwise in a world of CD-ROMs, but it may be difficult for teachers to abandon a traditional set of understandings of their world. Greist (1992) suggests that people profess allegiance to written composition, when textual literacy is becoming hard to separate from visual, computer and other literacies. However, there are many literacies (Lankshear, 1993) and some students may be more at home with electronic images than conventional print. In recent times, students have had to cope with literacy involving print and graphics, and visual, computer and other media literacies (Greist, 1992). Just as postmodernists may now refer to a "text" as a book, a television program or the contents of a computer monitor's screen, teachers need to consider that students' reading and comprehension abilities may differ with the type of literacy. Words and images on a computer screen are not necessarily just electronic versions of a print-based book. On the other hand, they may be identical. Teachers will increasingly need to be able to differentiate between different types of reading-related materials available on CD-ROM, and implement appropriate teaching strategies.

To understand the role of CD-ROMs in education we may also have to consider that they are still evolving, and that the current versions of

software on CD-ROMs, in some cases, may be less satisfactory than a conventional print-based alternative. The "electronic text" may still have some transformation to undergo before it reaches its final form, if, indeed it ever does. Bolter (1991), argues that the printed book may be moving to the margins of our culture, as electronic texts replace paper ones. We may be in the late age of print. Yet, paradoxically, but understandably, some writers report that they would rather curl up on their couch with a book than read it on a screen. We may be expecting too much of some software which appears on CD-ROM. Ten years ago, Gould and Grischowsky (1984) reported that participants who read the same material from paper and computer monitors read the paper-based material 20% to 30% faster. More recently, Mackenzie (1992) noted that 33% of a group of Hypertext users, using computers, complained that it was not as convenient as text. This is not to suggest that all CD-ROMs will be disregarded by students in favour of conventional texts, but rather that not all CD-ROMs are likely to be of educational value. However, a small number of CD-ROMs can cause real concern, not only because some may be less effective than text, but because of the materials which they contain.

It is difficult, writes Rosen (1990) to understand the consequences of technology where the effects are of a subtle sociological or psychological variety. The classroom teacher will need to ask how the software on CD-ROMs might affect students' relationships with others, or their mental stability. If the teacher is mistaken in the estimation of the effect of CD-ROM software on group dynamics, the result may be disruptive behaviour in class. However, the focus for defining the success or failure of the system is sometimes seen as how effective it is from a technical point of view. Advertising stresses the amount of material which a CD-ROM can hold. A CD-ROM can hold an animated story for children, or pictures and stories of great violence and cruelty. While this is also true of other media, the vast quantity of information available on a CD-ROM makes it difficult for the teacher to monitor what students are experiencing. It may therefore be unwise to allow students to use CD-ROMs unsupervised. Arguably, it is also unwise to allow unsupervised students in a library full of conventional books, but a crucial difference may be that the experience of interacting with a CD-ROM may be more emotional, presented more quickly, and the psychological effects may be more long-lasting.

As an illustration, one might consider a comparison of a photo of the execution of a Viet Cong prisoner in a library book with a movie clip of the same event on a CD-ROM. While such a scenario may not yet have taken place, there is no reason why it should not in the near future. It could be argued that students are already desensitised to violence through the

medium of television. Again, television, which one teacher described to Cuban (1986) as "video valium" may have already been responsible for a loss of innocence in students, by exposing them to adult concepts at an early age. This is an argument which Postman (1983 and 1986) would be sympathetic to. Yet such an argument appears to be a deterministic surrender to technology, and a denial of the teacher's right to attempt to educate children with commonly agreed values. For teachers to allow students to use CD-ROMs which they have not themselves previewed appears to be irresponsible. Wholeben (1987) suggests that the rights of human subjects (the students) are violated each time an untested courseware package is used for instruction in the classroom. When teachers are ignorant of the contents of CD-ROMs, they delegate their authority. The de facto authority becomes either the computer, or the unseen authors of the CD-ROM. Split between the responsibilities of vetting many hours of material on a CD-ROM, obtaining sufficient access to use the computers, and using CD-ROM technology effectively, the teacher is placed in a difficult position.

One of the biggest problems which students have is being cast adrift on a sea of information. They may end up as lost as Coleridge's *Ancient Mariner*. Although there may be a high level of learner control, students may spend a lot of their time just trying to find their way around (Marchionini, 1988). Wright (1990) reports research which indicates that the brain can only absorb 50 bits per second of information, a situation which is unlikely to be changed by technology. Deluged with information, some students may simply "tune out." As Amthor (1991) argues, large numbers of students travel to school every day, but they cannot always say which way the school bus has gone. With a conventional book, the learner is more able to control the speed at which information is presented to the senses and the resulting processing by the brain. Student feelings of being overcome with the deluge of information, and being lost without guidance may be inherent in CD-ROM technology, or at least more likely than in conventional print-based media.

Students need to be able to relate pieces of this sea of information to each other, and this in turn presupposes that students have specific questions to answer, and an entry level of understanding in the subject to be investigated. Angle (1992) claims that CD-ROMs can contain the equivalent of 200,000 pages of text, or 1000 books. Although in practice the use of animated sections and graphics would rapidly use up much of this storage space, the amount of information on a CD-ROM is still more than enough to be confusing to students. What students may need is not so much the ability to access information, but the ability to exclude it. In the information age, there is a danger that students will be swamped with

data which they will be unable to evaluate. It is true that conventional books in libraries also contain a large amount of data, and it would be unusual to argue that the number of books in a library ought to be limited because students might become lost in the amount of information available. However, search techniques for finding information in CD-ROMs, as opposed to books appear to be different in nature, and the novelty and distinctive nature of the medium may place additional stresses on students who want to use them, and librarians who would like to help them. An additional stress on teachers is that process is not always valued as much as a product, and teaching students how to find information on a CD-ROM may not always be rewarded by the school system.

Learning outcomes tend to be valued more than learning processes by those who want to see evidence of student progress. Outcomes are more easily measured, and superficially provide the answers which parents and employers want. However, the processes of metacognition actually allow students to tackle new tasks, solve new problems and learn new skills. (Rowe, 1988). With CD-ROMs learning processes become more important, as students may spend a great deal of time working out search processes, or viewing material which is not central to their task. If students become increasingly aware of how they go about their tasks, they become aware of their own process of thinking, and they are likely to become more effective learners. Nevertheless, it is very difficult for teachers to measure these processes.

If the teacher sets a project on the causes of war, parents and the school system are likely to want to know how well the students were able to complete the task. A student may have learned little of the required task, but may have learned other things of great value from CD-ROMs. It is often in the teacher's interest to keep the students on task, so that the teacher has enough information for the mark book. Sometimes we assess those things which are the easiest to assess, but this does not mean that they are always the most valuable things which students do. Evaluation of students' thinking processes using a CD-ROM, and assessment of the unexpected [earnings which result from their CD-ROM sessions may be possible, using individualised teacher instruction, think aloud protocols and interviews. However, CD-ROMs also require a computer. The combined cost of software and hardware suggests that it is more likely that there will be only one or two machines available, at least in the early stages of this technology. The teacher may well have to manage a whole class simultaneously while these one or two CD-ROMs are being used by students, whether they are in the classroom or the library. Consequently available teaching methods may be inappropriate for this approach. It is not unusual for teachers using computer technology to feel that the existing curriculum is no longer adequate. An example of this was the

Queensland Sunrise Centre. This was a four-year investigation of a technology rich environment in which students and staff had the use of laptop computers and access to CD-ROMs. Finger, Grimmett, Betts, Hallett, MacFarlane, Mitchell and McGuren, (1992) in their program evaluation of this initiative, reported the feelings of one primary school teacher who reported:

> The curriculum that we've got needs to be adapted. I've found it difficult to match the syllabus with the technology. I think the curriculum needs to be modified to give us more leeway to accommodate the more advanced things (p. 209)

Another problem which the teacher may face is that in some cases novels may be available on CD-ROM. But if film rather than print becomes the dominant literary form, the endings and the whole tone of the story may be changed (Trotter, 1992). It is likely that our impressions are shaped by the character and structure of the technologies that we use. If, as Norton (1992) suggests in his interpretation of McLuhan's ideas, the computer structures messages differently from print, students may find that the message itself is likely to appear different in a computer based form, compared to print. Although teachers are most likely already aware that, for example, a film version of Emily Bronte's *Wuthering Heights* is likely to be different from the traditional print version, it is not clear in what ways a CD-ROM version may differ again. It is likely that the nature of the discourse is modified by the technology, but it is less certain that teachers will understand what pedagogies are appropriate for a CD-ROM based novel.

In this case the whole experience of literature on a CD-ROM based system would imply a change for students. Indeed, it is possible that students themselves have already changed. Green and Bigum (1993) argue that schools are now dealing with a student who is quite different to students of previous eras. In part this may be because of new information technologies. If this hypothesis is correct, our assumptions about what constitutes an appropriate curriculum for students may be obsolete. It follows then that by simply declining to use CD-ROM technology because it may be too entertaining is an inappropriate response. Taylor (1989) provides evidence that CD-ROMs are expensive, but students like CD-ROM searches very much. The alternatives to conventional education may seem more appealing to students than traditional methods. If students are more aware of the alternatives they may be more likely to find time-honoured pedagogies boring and alienating. By their use of CD-ROM technology, teachers may in fact be creating stresses on traditional instructional patterns when no alternative can be easily implemented. It is unlikely, in the short term, that the school will be able to provide enough CD-ROMs for the majority of students.

Humanity has often been reluctant to examine the implications of new technology. Often it is only when we are overtaken by events that we are forced to consider what actions we should have taken to prevent unfortunate consequences. More than sixty years ago, the novelist H. G Wells (1932) used the introduction of the automobile as an example of a lack of foresight:

> All these new ...inventions ... come crowding along; every one is fraught with consequences, and yet it is only after something has hit us hard that we set about dealing with it. See how unprepared the world was for the motor-car. The motor car ought to have been anticipated at the beginning of the century... In the case of the motor-car we have let consequence after consequence take us by surprise. Then we have tried our remedies - belatedly (p 3-4)

Such comments could equally apply to the use of technology in education. It is likely that this is an opportune time to plan for the effective use of CD-ROMs in school education. An unthinking implementation could lead to a scenario where teachers' control of the educational process is diminished, and, at times, the technology itself may seem to be the authority. Mary Shelley's Frankenstein contains the words "You are my creator, but I am your master" which the Monster utters to his creator, Victor Frankenstein. Teachers and other educators need to remember that CD-ROMs are social constructs. The way that they are used is not predetermined by the existence of the technology. The choices which teachers make are critical. Ultimately, it is the teachers' use of CD-ROM technology which will determine whether, in educational terms, CD-ROMs are likely to be seen in the future as a precious gift, such as Frankincense, or a monstrous construct such as Frankenstein.

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