Kim H. Veltman

Databanks in Education

The 12th E.C.O.O. and the 8th I.C.T.E. Joint Conference, Toronto, (May 1991), pp. 412-418.

Abstract

The author proposes that images in textbooks can be coded and linked with images in databanks produced by art galleries, museums and libraries and explores consequences that this will have for education.

1. Introduction

There are many who see the electronic revolution as a natural consequence of the industrial revolution, and view both in terms of replacing human labour with mechanical substitutes in the interests of efficiency and speed. In the factory this is obviously the case, and some assume that it should apply to all fronts: in stores, offices and even in the classroom. The reasons for this can readily be identified. The rise of television, video and interactive programmes have undermined the teaching of reading skills. The rise of spellcheck programmes have introduced the temptation of using machines as a substitute for teaching spelling and writing. The advent of pocket calculators has posed similar temptations with respect to teaching arithmetic. It is important to recognize that, no matter how fast machines become, the problem of teaching the three R's (reading, writing and arithmetic), will remain.

Indeed, there are many things that computers will probably never do. Computers cannot teach children to be polite, to have a sense of respect and decency, compassion and other basic human values. Even a personal computer cannot be personal or teach children about personality. Only humans can teach human values. Hence, the electronic revolution in classrooms must be different than the story of automation in factories, and cannot be seen in purely economic terms as a new

labour saving device. It is not a question of replacing teachers with more efficient machines, but rather a challenge of using the new media to make knowledge more accessible and thus expand the horizons of both teachers and students. This paper offers a practical vision of how this can be achieved in Ontario, thus making our province a model for new educational possibilities. By way of context the limitations of textbooks in education will be considered, and the fundamental advantages of databanks will be outlined. Practical examples will be given in a variety of subjects including geography, history, language, literature, religion, mathematics and science. Some of the deeper implications of this new approach for multiculturalism, active and interactive learning, and its potentials for new approaches to knowledge will then be explored.

2. Textbooks and Databanks

Education in the classroom has traditionally been focussed around textbooks. These have the advantage that they provide children with knowledge at a specific level. The disadvantage of a textbook is that children usually have little incentive to go beyond the textbook at hand. Moreover, textbooks give a fragmented view, which destroys awareness of the cumulative nature of knowledge. Hence each new treatment of a topic is presented as something new, rather than as a more detailed version of what was taught earlier. The history of the Vikings offers a useful case in point. The accounts in a grade six social studies text, a grade nine history book and a university textbook for a course in archaeology are so different that it is often difficult to recognize them as three versions of the same facts. In mathematics and the sciences these discrepancies are even more blatant, to the extent that teachers will often begin their classes by saying: "I know that when you were in grade x you were taught that....Now I want you to forget everything you've learned." And thus a new course begins which, from a child or student's point of view, is usually unhelpful because it undermines a sense of continuity which, in some cases, will make what came before seem a lie, remove a child's confidence in the value of their previous efforts and even destroy their desire to learn altogether.

Textbooks present facts in a linear fashion, as if this were the only way that the evidence could be organized. They usually present a one sided story which represents a dominant view at the time, without making readers aware of divergent and even conflicting interpretations through footnotes, as do some learned books. Tables of contents and indexes offer some alternative access points, but even so the access points of books, particularly textbooks, remain very restricted. Textbooks also follow different conventions in presentation. Hence the spelling of names will frequently vary enormously from one book to the other, to the extent that it is frequently difficult to recognize that the same individual is being discussed: for instance, that the greatest Arabic author on optics, Alhazen, Ibn al Haytham and Al Haitham are the same person; that the author of the first published treatise devoted specifically to perspective is alternately named Pélerin, Viator, and Gast.

Electronic media are fundamentally different. There is no set way in which the facts contained in a databank need to be accessed. We can make as many indexes as we choose and enter at whatever point we wish: alphabetically, chronologically, or a combination of these; through maker, author, editor, illustrator, publisher, seller; place where an object was made, or institution where an object is stored. Multiple access points are natural, and hence the same evidence can be rearranged in a series of ways. A variety of interpretations can also presented without undermining the structure of a databank. Nor do variant names pose a problem. These can simply be seen as additional access

points to a given name. Learning one fact does not require having to abandon earlier ones: it merely requires an adjustment in knowing where an item fits into a larger picture. In the case of amphitheatres such as the Colisseum in Rome this means being aware that there are at least two dozen other examples, ranging from Arles (France) in the North to El Djem (Tunisia) in the South to Pula (Jugoslavia) in the East. In the case of a Greek vase in the Royal Ontario Museum this means learning that there are thousands of other examples in other museums.

From the time of Gutenberg until about 1970 books were the prime means of access to knowledge. In the past two decades this has changed with the emergence of major databanks. The databanks in museums, art galleries and libraries are particularly important for our purposes and each of them will be considered briefly in turn. In the past, school children might go to their local museum or make a special trip to a major museum in the area. But most children, even most students, never had any idea of the enormous collections in other museums. In Canada, the Canadian Heritage Information Network (CHIN) has been creating a database, which will eventually include all the museums of the country. It is foreseen that it will contain not only bibliographic records but actual reproductons of objects in the collections. This databank of over 5,000,000 records represents a vast, untapped resource for the realm of education. A similar trend is evident in art galleries, which are producing videodiscs of their collections. Some of the major galleries are working closely on the CHIN model for museums. These videodiscs are another potential resource for education.

The library in a school traditionally consisted of a room with a few books donated by teachers and former pupils of the school. A child seeking more than this random collection was sent to the local library which was often not much better equipped. University libraries were larger but followed the same principle. One was limited to the books in one's local library. Inter-library loan was developed to overcome this problem, but tracking down copies of less known and rare books remained difficult. Databanks such as OCLC, RLIN, and UTLAS are eliminating these problems. Taken together these systems contain well over 50 million titles. And even this is modest compared with what is planned. A series of pilot projects are underway to enter not just titles but also the full texts into computers. In Paris, at the new Bibliothèque de France, it is planned that 300,000 books will be entered in computerized form by 1995. Meanwhile, the European Community has recently made a survey of all its major libraries, namely 75,000 institutions, which contain 1.4 European billion (i.e. million million) books, with a view to making these accessible directly at some future date. These new databanks in libraries represent a third resource of enormous potential value to education.

At present these databanks of collections in museums, art galleries and libraries are effectively like raw materials. The purpose of this paper is to suggest how these new resources can be used to complement earlier methods, extending the scope of textbooks rather than replacing them. Most textbooks give examples of objects in museums, art galleries and libraries. Each of these objects in a textbook could be coded. Hence, a child wishing to find more about the Viking sword mentioned in their social studies text, could call up an image of the sword as it now exists in the Royal Ontario Museum. In the classroom, teachers could use examples beyond those in the textbook. Children could then be encouraged to explore how many other swords are in other museums, and thus determine whether the example in their textbook is exceptional or simply a typical example. In so doing they would also discover how what they are learning in a given textbook belongs to a larger world of knowledge.

3. Practical Examples

The new combination of textbooks and databanks will change the teaching of every subject. Some practical examples from geography, history, language, literature, religion, mathematics and science will provide some idea of the enormous consequences of this approach.

Geography

Thirty years ago children relied on rough maps in their social studies textbooks, their school atlases, and sometimes maps in their classrooms. We learned where London, Paris, Athens and Rome were on a map, but we learned nothing about scale and hence nothing about relating these dots on a map to photographs of the same cities. Since then texts such as Blair and Simpson's *The Canadian Landscape. Map and Air Photo Interpretation* have introduced this dimension and the project of a *World Digital Atlas* is underway at Reidmore Books. If the maps which exist in libraries, archives and museums were systematically organized in terms of scale, teachers could explain even to children in the first grades of school how world maps, national, regional and local maps are related, and how these relate in turn to both aerial and topographical photographs. One would go from a satellite photograph to an aerial photograph, to city maps, street maps, plans and elevations of buildings along those streets, to plans and elevations of individual rooms in those buildings and to the objects, paintings, frescoes, sculptures etc. on the walls and elsewhere in those rooms. This would transform geography into a subject to which every child could relate. Thirty years ago we learned about the expansion of the Roman empire, and how Canada grew from a tiny settlement on the East coast to its present size. If historical maps are organized chronologically then children can use maps to retrace these developments, and connections between geography and history will come alive.

No individual school could ever afford the cost of such projects on their own. But given a central databank, a centralized effort could benefit all local schools. Popular subsets of this centralized databank could be distributed in the form of optical discs and video discs. Enterprising children wishing to go beyond the regular curriculum requirements could access the central database directly via a modem and download information that they wish to study.

History

The teaching of history will be equally affected. In the past we learned about the Parthenon in Athens, with little or no idea how this related to other Greek temples. Textbooks usually contained a poor black and white picture of the Parthenon. Now the pictures are frequently in colour. These pictures in textbooks could be coded for use with a light pen which librarians now employ in checking out books and clerks use in grocery stores. Children could then apply a light pen to a picture of the Parthenon in a book and software would take the code number of this illustration in the text to call up a corresponding colour photograph of the Parthenon on a computer screen. At first it is likely that such devices would be available only in the school's resource room. Eventually as children acquire a terminal at their own desk, this could become a regular part of classroom activity. Teachers would also be able to refer to other examples in class, and children could explore the differences between temples at Corinth, Segesta, Selinunte, Agrigento, Ephesus and Miletus on

their own. The stock examples in the textbooks would thus become a starting point for independent learning.

Rather than giving a child the false impression that a textbook contains all that can be learned, it would now become clear that textbooks are simply a tool to introduce us to the vast corpus of recorded knowledge. An enthusisastic child will soon learn that most Greek temples are not in Greece: that they are also found in Sicily, Italy, indeed that they range from the coast of Spain in the west to southern Turkey in the east. In addition to showing the Parthenon in its present state, teachers will be able to show various reconstructions, such that children can learn to relate present ruins to past architectural wonders. A chronological study of these reconstructions will reveal the extent to which interpretations have changed with time: how some generations have idealized the glories of Greece, while others have focussed strictly on the archaeological evidence. This same approach will apply to Rome and other great sites of civilization. It will become evident that history is much more than a list of events and objects of material culture. By using textbooks as access points into a centralized databank, children will learn that history is equally a record of changing interpretations of this evidence.

Language

One of the main reasons why Europeans in general have a greater mastery of language than North Americans is because they are exposed to television and films with subtitles in different languages. This principle might be adapted in teaching children initial reading skills. The beginners' texts with their stories of "See Jane run" could be supplemented using films with subtitles. If all the basic readings were available in at least two languages, English and French, this would provide an excellent means of learning a second language. Having learned the story in one language, children could then more readily master it in a second language. Variations on this approach could prove of enormous value in the teaching of English as a second language to immigrant children.

Religion

A centralized databank would have unexpected consequences for religious instruction. In the case of Catholics this will involve the lives of Saints such as Benedict, Francis, Dominic, Loyola and other founders of the great religious orders. With Catholics and Protestants alike, there is a concern in teaching the basic stories of the Bible. These stories could be made much more vivid by drawing on examples of great art. In the early grades individual pictures of Adam and Eve, the Flood, the *Annunciation* and the *Last Supper* could be chosen. Children could be shown how treatment of these themes changes over time and also from one country to the next: that the Birth of Christ in Florence has Tuscan valleys in the background, whereas in the Low Countries the same subject will have snow covered landscapes in the background. In the higher grades children can be introduced to the famous cycles ranging from the great series in the mosaics at Monreale or the frescoes at Padua and Assisi, to the much more selective cycles of Masaccio, Piero della Francesca and Ghirlandaio. In so doing they will become aware of historical shifts in emphasis: how one period focusses on the *Old Testament*, another on certain parallels between the *Old* and *New Testaments*, while a third period focusses on the *New Testament*. They will also become aware of regional and other shifts in expression: how Protestant renderings of the Last Supper differ from Catholic or Russian Orthodox ones. In being able to compare various treatments of a given theme,

children will have an excellent introduction to the problem of understanding and tolerating different versions of a common heritage.

This principle can be extended beyond the Christian tradition. It would be enormously helpful to make children aware of native Indian and Eskimo beliefs and legends; to make them aware of Greek, Roman, Jewish, Islamic, Hindu, Buddhist, Confucian and Taoist traditions; bringing to their attention both underlying similarities and differences. In an ever smaller world we need to learn about, tolerate and gain respect for different traditions.

Literature

Religious instruction using great works of art will have another advantage, because Biblical themes and Greco-Roman mythological themes are of central importance in Western literature. Learning classical and biblical stories will thus prepare students to read the classics of literature and poetry. It will also provoke children to reflect on the connections between religion, literature and art: that art and literature are much more than beautiful pictures and words. They convey basic values of a culture. They also illustrate how it is precisely the most familiar themes that are fundamental keys to the imagination. The greatest Renaissance artists did not choose unknown topics for their paintings. They chose the best known themes: the *Annunciation*, *Last Supper* and *Crucifixion*. Too often children assume that to be original they must be different; that different means finding entirely unfamiliar themes, and are then surprised to find how conventional are the results. Learning about the traditions of literature and art will thus make children aware of what it means to be original: that it requires taking a stand on a central issue rather than running away. A comparison of art and literature can also prompt them to reflect upon the differences between these modes of expression. Why are some scenes in classics such as the *Bible*, Dante, Shakespeare of enormous importance in art history, while many other noble and edifying scenes remain stories? Using Van de Waal's classification in connection with chronological lists of paintings, children could trace the history of themes which interest them, thus learning more about the continuity and cumulative dimensions of knowledge as they discover how much there is to be known.

The importance of these exercises lies partly in making children aware of the nature of the human imagination, which involves creating possible relations between ourselves, direct experience and collective experience in terms of historical records; that a greater expression of the imagination contains a larger range of potential associations, connections, interpretations and is thus a more profound expression of freedom than a text which seeks to remove all ambiguity.

Mathematics

The uses of such a databank in the teaching of mathematics are less obvious but nonetheless important. Many schools now have a few manipulatives: three dimensional models used to demonstrate fundamental mathematical principles. The databank would give children access to a wide variety of other models contained in science museums and other historical collections. They would discover that mathematics is not merely an abstract subject: that many of the great discoveries in mathematics involved practical problems in astronomy, mechanics and physics; that the logarithmic spiral and a number of other symmetries are found throughout nature, particularly in the realms of biology and botany. Art can also show children basic topological concepts such as

twisting and bending; introduce them to linear perspective, spherical perspective and other projection methods; thus making them aware of spatial relationships, using visualization to reveal the interplay of arithmetic and geometry (discrete and continuous quantity).

Science

Similarly the data bank will allow children to call up full colour versions of the examples in their textbooks and compare them with other specimens in other museums. In the case of classic experiments in the history of science, children will be able to call up images of models: originals and reconstructions. In some cases they may be prompted to use these as starting points for their own models. Using a chronological approach children will be able to trace how models have changed over the centuries, from rough and ready devices made by an amateur to complex apparatus requiring the skills of professionals. Enterprising children will explore changing interplays between practice and theory, between descriptive and predictive science and in so doing discover how the rise of instruments and technology is integrally connected with the rise of a scientific world -view.

4. Active and Interactive Knowledge

Textbooks have traditionally encouraged children to approach knowledge passively: from a child's viewpoint there is little sense of discovery. It is simply a question of absorbing what someone else has already mastered. Using databanks in the ways described above would help overcome this passivity. As a child goes beyond the minimum course requirements, the extent to which they learn will depend on their active efforts and will be an open challenge.

This sense of challenge can be increased if the textbooks and databanks are also linked with interactive teaching games such as those developed by Professor Martin Lamb. For instance, chemistry has traditionally been taught with a textbook, and simple experiments reproduced in a classroom lab. With the help of *Chemistryland*, children can simulate chemical combinations of the first 18 elements of the periodic table at three different levels of magnification: subatomic, molecular and "real world", and thus explore chemical properties beyond the scope of any classroom situation. If *Chemistryland* were developed to include the entire periodic table and linked with specimens of crystals and other compounds in museums, children could learn to relate chemistry to the natural world in new ways. Such interactive activities would greatly expand children's involvement in the learning process.

Implicit in such interactive games is a whole new approach to learning. A diagram in a textbook traditionally shows a result. The emphasis is on a finished product, usually with little or no hint of the dynamic process by means of which one got there. In rare cases diagrams or photographs may record some key steps, but even so the connection between these is often lost. Animations would focus attention on the process involved in any explanation and reveal in a new way how various interim steps relate to the end product. Explanatory diagrams in textbooks could again be coded such that if a child finds a particular result puzzling, they can call up a dynamic version which reproduces various steps in the process. This will save teachers a lot of time in unnecessary explanations. Instead of memorizing knowledge as a set of static conclusions, children will learn to understand knowledge in terms of dynamic processes.

5. Multiculturalism

Textbooks have traditionally presented subjects from one point of view. For instance, European and American history books usually refer to 1453 as the fall of Constantinople. From a Turkish viewpoint, 1453 marks the ascendancy and triumph of the Ottoman culture. Traditionally children have not been taught that every ally is someone else's enemy; that every military victory from one point of view is someone else's defeat and conversely. If we wish to avoid global wars, children need to learn to see events from different viewpoints. This much is simply a question of survival.

Persons are inevitably afraid of the unfamiliar. But if children have a chance to learn about the achievements of different cultures they will learn to view the world with more understanding, greater tolerance and a deeper sense of respect. A person who has learned about Dante, Leonardo and Michelangelo is not likely to dismiss Italians as Wops. The databank must make children aware of their Canadian heritage, so that they sense where they stand in the world, and also with the roots thereof in Britain, France, Italy, Poland, Germany, the Netherlands, China and the many other countries that have contributed in making Canada what it is. If the world is becoming a global village, then children must learn about the many traditions therein in order to see themselves, their neighbours and events from multiple viewpoints. Only then will multiculturalism go beyond being a buzz word and become a way of life

6. Knowledge as a Continuum

In the past textbooks have presented glimpses of knowledge in such fragmentary ways that children have sometimes seen learning as merely a set of pragmatic answers that needed to be learned and unlearned as one went through life. The proposed links between textbooks and a centralized databank will restore a sense of a cumulative body of knowledge which, though open to various interpretations, is based on the solid evidence of material culture, texts, and events. Children will be able to recognize a textbook for what it is: a tool which gives them access to a great corpus of knowledge, of which they see more with each progressive year in school. All children will benifit from this arrangement. Slow learners will have a chance to check as many times as they wish how a given conclusion was reached. Average students will have a clearer understanding of what they are learning and a deeper sense of what lies beyond their ken. Gifted students will finish the basic requirements more quickly and will no longer be faced with boredom.

They will have a chance to explore the enormity of the databanks to which their textbook has provided an introduction. As they do so they will recognize the cumulative dimensions of knowledge and see that what they are learning fits into a much larger picture. Very gifted children will find in the databanks incentives for new synthetic approaches to knowledge. Meanwhile the minds of all students will be the richer for recognizing that knowledge is a continuum, a cumulative experience, which is more fruitfully approached from different cultural, historical and methodological viewpoints. Knowledge, which is at present scattered in various libraries and other institutions, can gradually be collected together on optical discs to form knowledge packages. Such collections of everything known in a given field will be the logical extensions of the encyclopaedia concept in an electronic age and will open the way for further analysis and new synthesis.

7. Conclusions

In the 1950's computers evoked images of huge machines associated with science fiction and out of the way scientific problems. Most of the past four decades have been focussed on basic questions of hardware. Even a decade ago, questions of adequate memory, sufficient size, acceptable speed and compatibility still loomed as fundamental stumbling blocks. To some extent these problems still remain, but so vast a machinery is in place, that the necessary hardware solutions will almost certainly be found within this decade. The challenge of the next century will lie in finding wise applications for the extraordinary new horizons which the hardware is making possible: new software.

Canada is in a unique position to make a contribution in this context. Canada is a leading country in terms of technology. Unlike former colonial powers or the superpowers, which usually focus on a narrow nationalistic viewpoint, Canada's diverse population invites a multicultural approach. Canada already has a national databank of museums (CHIN) that is more organized than most countries. The province of Ontario in particular is at the leading edge with respect to use of computers in schools: in 1989 its budget was five times that of the State of California in this field. Hence the technological infrastructure and the raw material for a new type of educational databank are in place.

The vision described above requires some clear steps. A centralized clearing house is needed which contains copies of, or access to, the major databanks of museums (e.g. CHIN), art galleries (e.g. Marburg Archive) and libraries (e.g. RLIN, OCLC, UTLAS). Cooperation with industry is needed in order to have access to the latest hardware. Since the clearing house is effectively a showroom for the potentials of technology, it will provide excellent advertising for the contributing companies. Standardized indices will integrate materials from these databanks into a single system. Cooperation with educational publishers will assure that images in textbooks are identified and related to those in the databanks with the help of coding procedures. A small research team will be devoted specifically to creating new user interfaces between existing technologies: linking textbooks , databanks, interactive educational games, video, film and even interactive television in new ways.

Such a clearing house should be in a major centre such as Toronto in order to benifit from related projects. It should function as a research institute, enabling it to be free from the burdens of undergraduate teaching, yet maintain university connections. It would be appropriate if it became associated with the McLuhan Centre which has heralded new frontiers of technology in the past, and is now developing an interactive databank of perspective, spatial forms and representation methods in conjunction with Generation 5 Cartotechnical and Autodesk. Such a centre should receive public support from both the provincial and federal governments. Without such support there is a real danger that knowledge will be privatised, access will be purely in terms of financial ability and the enormous potentials of learning for gifted minds will be lost.

Everything is ready for a revolution in education. McLuhan will be honoured if it happens at his Centre. More importantly, our children will benefit from the new educational horizons that this brings. In their education lies the future and we owe it to them not to let this chance pass by.

Acknowledgments

I am grateful for a Canada Research Fellowship from the Social Sciences and Humanities Research Council of Canada* which has given me time to reflect on the problems raised in this paper. I am grateful to Miss Smythe, Principal and Mr. Seymour, Vice-Principal of Pope Paul II Elementary School and Brother Murphy, Principal of Edmund Rice Secondary school for allowing me to see present conditions in two local schools. I thank my colleagues Professor Syd Eisen, Dr R. W. Dawson and Mr. Eric Dobbs for reading the paper and offering advice.

* Canada Research Fellow,
Institute For the History and Philosophy of Science and Technology,
Victoria College, University of Toronto.