Kim H. Veltman

Content Ordering or Ordered Content? Active versus Passive Knowledge

Toronto 1996. Unpublished

---

1. Introduction

There are some curious parallels between our approaches to computers and approaches to teaching and learning. In the world of computers there are two contending paradigms for how they should be organized. A first approach, which derives from the original arrangement of a centralized mainframe connected with a series of dumb terminals, extends that idea on a global scale such that there are centralized servers from which individual clients gather the software and contents which they need. A second approach is decentralized, sees each machine as a "personal" computer, an island unto itself, with its own supposedly unique configuration of "standard" software which allows each individual to enter their own unique contents. Between these two extremes is a third model whereby a series of networked machines work together in a local area network, sharing resources for the common good of the group.

In teaching and learning there are also two contending views. One, centralized, assumes that the teacher and the textbook will impose order unto the mind of the individual student. According to this view, the teacher is the server, the student is the client. The teacher is the intelligent hub, the student is the dumb terminal. The teacher is the active master, the student is the passive slave. A second approach is decentralized. It assumes that each individual is a personal learner, the emphasis is on learning not teaching. The teacher is a facilitator. The intelligence is in the individual student and the central aim is in organizing, structuring, constructing one's personal world view which, the rhetoric goes, is more important than any external world view. Between these two extremes there is again a third model whereby it is assumed that the efforts of an individual are more relevant and useful if they are shared with others. In this model collaboration becomes a central concept and networking as a metaphor becomes a buzzword.

Mechanistic metaphors from the world of computing now pervade the worlds of teaching and learning. Teachers interface with students. Students process information. Teachers download ideas and students upload them. Computer experts accept all this as if it were completely natural. We need to remind ourselves, however, that computers were only introduced a century ago: teaching and learning have been around from the beginnings of time. It is important, therefore, to look more closely at the problems underlying these three approaches and then explore how the latest technologies can help deal with these problems.

2 Outside, Systematic Order

Every society organizes and imposes order unto its collective knowledge. In so-called primitive societies this order was integrally linked with key members of the tribe: the chief, medicine man or shaman. Knowledge was power and also secretive. It was only passed on to chosen individuals designated to carry on the tradition. This model continued to inspire early civilizations. The teacher passed on a corpus of knowledge to chosen students.

The rise of the university with Abelard in the twelfth century promised to change this relationship. The roles of professor and student remained. But now it was the students who chose the professor with whom they wished to study. If a professor had nothing to say they would have no students and not be paid. This seeming remedy introduced its own problems because, as teachers know only too well, the world of learning cannot be reduced to a popularity contest. The most profound and valuable knowledge is not always the easiest. We may believe in giving everyone access to knowledge, but that does not mean that all will learn equally. Everyone may have a chance to learn English, French, German or some other language, but that does not mean that everyone will become a consummate master of those languages. Nor is it all a matter of personal choice or opinion. Student A may think that they speak an excellent French, but when they listen to a lecture at the Sorbonne there will be external criteria for determining how well they speak the language. It may be the fashion to debate which books to include or exclude from the standard corpus of literature but even here there are limits. The English student who insists on ignoring Chaucer, Shakespeare, Milton, Pope, Dickens and Austen, will have the same problems of credibility as a French student who believes they can ignore Rabelais, Montaigne, Corneille, Racine and Hugo. Hence the role of scholars lies in organizing the corpus of knowledge in a given field and giving a clear rationales for the boundaries thereof.

In the case of the sciences this corpus or ordered part of knowledge plays an even more central role. The periodic table in chemistry is not just an arbitrary list: it is the basis of many chemical combinations that underly advances in medicine, science and industry. Similarly, library classification systems are vital if we are to have a systematic way of organizing collections of millions of books.

The past centuries have made us very much aware that the systems created even by the greatest experts are fallible and inevitably require some adjustment or even a complete revision. In retrospect, Ptolemy's astronomy needed to be replaced by that of Copernicus. The extraordinary efforts of a Linnaeus in organizing botany required many updates. So we need somehow to communicate the essential value of systematic ordering without trying to limit students to the precise contents of any given system. We need also to find methods of demonstrating the comparative merits and potentials of competing methods of ordering, and classing the world. We need eventually to show this in evolutionary terms. To use an analogy from fishing, classification systems are the mental-map equivalents of nets. We need to show how changing methods historically have increased the size of the sample caught by a given net.

Hence the role of the teacher can no longer simply be one of passing on to the student a given, static method of classification. It may well be that the details of how a major field such as physics or medicine is organized and classed will change drastically within the next decades and thus a teacher needs to convey this subjunctive dimension to the student. This does not mean, however, that students can simply ignore the standard means of organizing knowledge in a given field. A student may feel that they are brilliant in the field of chemistry. But until they can arrive at an explanation that is more encompassing in its explicative powers than the periodic table, they will be advised to continue learning that method. To make a fundamentally new contribution one has to master the best existing classifications in a field, not only show their limitations but provide a more encompassing alternative.

For this reason the process of organizing a corpus of knowledge continues to apply for all disciplines. The systems may change and evolve but the need for systems remains. A combination of past and present experts serves to define the limits of a field, which are codified in standard bibliographies of a field. Curriculum committees attempt high level summaries of a field which are a subset thereof. Courses are subsets of a given curricular corpus. Textbooks are subsets of courses. Tests and exams are subsets of the texts. Evaluations and reviews are commentaries on how the results of a test relate to a course and text.(fig. 1).

a) Corpus of knowledge in a field, defined by experts codified in standard bibliographies.
b) Curricula (high level description of boundaries and therefore subsets of a)
c) Courses (subsets of b)
d) Textbooks (subsets of c)
e) Exams and tests (subsets of d)
f) Evaluations (commentaries on e with respect to c and d)
g) Reviews (commentaries on e and f with respect to c and d).

Fig. 1. Relation between a corpus of knowledge, curriculum, textbook, course, exam, evaluation and review.

3. Personal Ordering

It is the fashion among educators to insist that we have moved from teaching to learning, which they epitomize in phrases such as: "From the sage on the stage, to the guide on the side." Ironically, they typically do so while claiming centre-stage in lectures or at the microphone in public meetings. The more radical proponents of this approach would go further to insist that textbooks can also be dropped from the agenda, the assumption being that students are now so independent that such structured materials are not really necessary. If they were in *Star Wars* their motto would be: "May the structure be with you".

At the same time the efforts concerning constructivist knowledge reflect important problems. For example, in botany very few persons will ever create a system as inclusive as a Linnaeus. Yet most of us do study some botany and make some attempts to organize plants. Every attempt at organization is a learning process. A child who tries to count how many kinds of plants are in their parents' garden is learning something. Indeed such efforts could prove to be vital training for future professional classing of plants in terms of genus, species, variants etc.

While all these exercises may be learning experiences, few learning experiences change the frontiers of learning. Almost invariably, a child's discovery of the differences between conifers and deciduous plants, however exciting to that child, entails a discovery that was made long ago by a pioneer in a field. The challenge for a teacher is to help the child make that re-discovery as if it were being made for the first time: to permit the child to have the full sense of wonder attending to that discovery and at the same time not leave them with a false sense that they are, by virtue of that one experience, now superior to the original discoverer. It is relatively easy to repeat one of Galileo's or Newton's experiments, but that does not mean that everyone who does so is instantly a Galileo or a Newton.

What is needed, therefore, is a context which encourages individual children and students to organize their findings and knowledge on a subject within a framework while at the same time making them aware of the fact that frameworks also have a history. For instance a child may be learning about colour. They create their own list of colours which is also a catalogue or classification system of colours. They may decide that there five, six or eight colours. They are then taught that others have had this idea, that lists of five-eight colours have been made since Antiquity. More advanced children discover that their basic computer monitor has 256 colours while others will learn that there are potentially millions of colours. Only when they have confronted the problems of ordering the complexity of reality, will they be in a position to recognize the need for and value of existing attempts at ordered content.

4. Collaborative Efforts

One obvious way to help children and students see beyond the boundaries of their own experiences is to confront them with the ideas of other children and students. Child A may only see four colours, but that may be because they grew up in a dark place and never had a chance to see the variety of colours in the outside world: the glory of an alpine field of flowers all in vernal bloom. If such a child met Heidi, they would need to revise their list of colours and probably most of their other classification schemes as well.

This comparative dimension is one of the main arguments for having children attend school. At home we are all too easily convinced that we are the only ones in the world to be in a given situation. When we go to school we are likely to discover that other individuals have experienced some of the things we thought or feared were unique to us. When we go to university this sample is increased and most persons, who were accustomed to feeling they were the most intelligent individual in their school, need to adjust their perceptions as they discover that they are surrounded by many other bright young persons.

The new networked environment of computers seems to undermine the need for contact in schools. Actually it cannot replace the reality of human contact. It does, however, broaden the number of persons with whom to draw comparisons: it increases the sample which we use to create our world view. This is especially true in the case of persons with more specialized interests. If I live in a small town I may not reasonably be able to find others with my interests in genetic algorithms, butterflies or the like. If I am connected through a network there will almost always be others with the same specialized interest. Thus collaborative workspaces increase the horizons of topics for which I am likely to find partners for discussion, sharing ideas, learning together. At the same time collaboration is complementary to the traditional corpus of knowledge: it embraces, not replaces other modes.

It is instructive to note the extent to which models from the world of industry and business are impinging on these new approaches to learning. Collaborative has become a new buzzword. So there is much discussion of collaborative work, collaborative design and collaborative learning. A number of academics have attempted to provide a philosophical foundation to this approach under the headings of constructionism (Papert) and constructivist knowledge (e.g. Jonassen, Ravitz). They cite the work of Jean Piaget as proof that individuals change their world view as they evolve from small children to adults. They frequently cite the work of Kuhn to argue that there are paradigm shifts in knowledge and claim that these paradigm shifts occur as a result of consensus building among the great scientists. That these great sceintists are also struggling to discover truth is often downplayed. So too are the great differences between a) scientists who reach consensus using all the criteria, methods, and discipline of scientific experimentation and verification; b) office workers who reach consensus for pragmatic reasons and c) young students who may well reach consensus in terms of popularity and fashion rather than by the strictest rules of scientific rigour.

5. New Approaches to Teaching and Learning

From the above it becomes clear that the revolution introduced by networked computers should not be limited to any one of the three seemingly competing models, namely, systematizing external ordering; empowering personal ordering or in creating collaborative environments for ordering. The revolution lies, rather, in creating a framework where these three approaches are integrated.

One effective way of looking at these changes is in terms of the seven basic components outlined in figure one: a corpus of knowledge, curriculum, course, textbook, exam, evaluation and review. Traditionally these were hierarchically arranged such that persons lower down the system were never able to see, let alone understand, how their subset fit into a bigger whole. Hence a teacher typically had a textbook but often had little idea of how it fit into a curriculum and almost no idea how this in turn fit into the corpus of knowledge in that field. Students were in an even more difficult position. Any penetrating question which touched upon the frontiers of that field would be dismissed on the grounds that it was not in the textbook. Why they were studying a given subject was seldom if ever explained. Nor was it ever easy to understand how the subsets of the whole called exams were determined. And while teachers made fun of students perenially asking: "Is it on the exam?", they usually overlooked the cause prompting such questions. Nor was there any systematic way for students to retrace their steps in terms of evaluation and review to see precisely where they went astray. The hierarchical organization of facts entailed a de-contextualization of knowledge.

The networked computer revolution offers a re-contextualization of these seven basic elements such that students and teachers alike can see how each subset fits into a larger whole. This does not mean that every student will automatically become a researcher at the frontiers of a field. It does mean, however, that any young person, or teacher for that matter, who think they know it all will have a tool for assessing realistically where their particular bit of knowledge fits into a larger picture.

Hence one can acknowledge trends towards collaborative learning, without abandoning the value of traditional knowledge. In practical terms collaborative work is about on-line comparing of notes (the Lotus product by that name is not accidental) concerning possible strategies. In the past this function was fulfulled by letters and telephones. Collaborative design is an on-line sharing of alternative design proposals.

Collaborative learning is an attempt to create courses dynamically on-line, rather than relying on any given static text. All these exercises can be useful and even valuable. It is important to recognize, however that many, possibly even most notes produced in collaborative work will probably retain some sociological interest but not make profound contributions to the collective sum of human knowledge. Similarly in the case of collaborative design. Many will prove to be rough drafts. If the person attains the level of a Leonardo da Vinci or Michelangelo then even rough drafts are of interest, but in most cases drafts are just that: stages in the development of something that is presentable and memorable. This is equally true in the case of collaborative learning. The process of comparing viewpoints can be extremely useful. But unless this occurs in the context of a higher standard each little group will be tempted to define the world in light of their own limitations and the resulting discussions will be correspondingly narrow in terms of their enduring value.

It is very instructive in this context to note the extent to which computer software and hardware have focussed on quantity rather than quality. There are all sorts of programs to measure things, to calculate, to produce spreadsheets of trends. There are very few programs or even buttons within programs that show us stars to indicate the quality of a work. There is a simple reason why this has been so. Computer hardware and software are designed by engineers who think in binary terms: it either works or it does not work; it is either good or bad. Multiple viewpoints of the same materials have traditionally been omitted from the system. We need a system which allows for individual viewpoints on any topic and at the same time provides a context whereby those viewpoints can be weighed in terms of standard views and the criteria accompanying them. For instance, anyone can write something about Leonardo da Vinci. But if the person has never read the man's texts they are likely to be less serious than someone who has taken the trouble to spend two years doing so before daring to have an opinion about what Leonardo actually wrote or meant. So we need more than footnotes of sources. We need contextualizing functions for clues as to how serious is the author. Has the work been vetted by friends, professional colleagues, locally, internationally? Has it appeared privately, through an organization, through a major publisher? Were there reviews? Were these in standard journals or merely in local magazines and papers? Were there different editions? Were there translations into different languages? Quality must become as important a criterion as quantity.

6. Limitations

There is an important strand of modern educational theory that focusses on giving children confidence in their learning abilities. A danger in this approach lies in giving them false confidence that they know when they are still ignorant. The networked solution offers a solution to this problem. Any student can see where the test they are taking fits into a course, text, curriculum and a larger corpus of knowledge. Hence a particularly bright person who has mastered a given course will not have illusions of knowing it all, when they recognize precisely how that course fits into a larger framework.

The networked approach also means that the training part of learning can be codified and mechanized such that persons will, in future, be able to pursue a considerable amount, or perhaps even the whole of training as self-learning, without the need of instructors. Some will no doubt look at this for potential savings in terms of instructors. Here, two things need to be remembered. First, the process of encoding an oral and textbook teaching tradition into electronic form is not nearly as obvious as it may seem and will require if anything more instructors. The economically minded might therefore be tempted to delay the move to electronic versions on financial grounds. But they need to recognize that a shift to computers is a necessity rather than a luxury. In a world where many traditional techniques, crafts, jobs are being replaced by automation, unless the tasks are recorded, the skills therein will go lost. This applies especially in the case of high level tasks in the scientific professions such as engineering, architecture, surveying, and cartography, where new devices are replacing human skills. If we do not codify this knowledge before those who are retiring have died, the advent of electronic methods will have brought a great loss rather than an increase in knowledge.

A second point that needs to be remembered is that training is but a small fraction of learning. Learning is an attitude of constant curiosity, an ever continuing process of discovery. The role of a great teacher has never been to help with memorizing. Their role, rather, has always been one of quiet example, being supportive while forever reminding the student who thought they knew it all that there was more, sometimes revealing a little more, at times confronting the student with the truth that there is a lot more. We can design machines that help pace students, but this human dimension of teaching cannot be mechanized. Taping the lectures of great scholars may show the results of their efforts but this cannot reveal their methods. Students need to see the personal methods of masters, their patient discipline, not just their moments of public show and glory.

Rhetoric may pretend that computers will destroy hierarchies, but this is not true. There will always be experts who know more than the uneducated. The expert and the uneducated person may be equal as human beings, equally worthy of respect for their innate human dignity. But they are not equal in terms of specific fields of knowledge. Faced with a decision at a nuclear power plant, it would be folly to say that a nuclear physicist and a person with no degrees were equally qualified. In such contexts the hierarchy of education will continue to prevail.

What computers can do, however, is to remove some of the negative aspects of hierarchies. In the past the process of moving down the ladder from expert, to curriculum, text, course and finally test was an opaque one insomuch as the person taking the course seldom knew what percentage of the field it actually covered. There was no way of knowing how representative was the test or even the text. The networked computer framework enables this process to become transparent. An enterprising student who has mastered textbook A, can widen their field to discover that there exists textbook B, C, D, E, and F. They can explore how all of these reflect portions of the curriculum and can verify precisely which parts of the curriculum. They can go further to see how the curriculum is itself an abstraction of a larger corpus defined by the field on which it is based. If they so wish they can even quantify this process. Hence a student who has achieved 100% on a given test may determine that the test represents 15% of the contents of the textbook, 8% of the course, 2% of the curriculum and perhaps .05 % of the entire field. This provides both a more realistic and a more sober view of what 100% on a given test might mean in the grander scheme of things. It also introduces a new framework for discussion of standards. For once the links between local schoolroom and the great seats of scholarship have been established clearly, those who lay claim to knowing more than they do can very effectively be brought back to earth. So computers will not replace hierarchy, but they will establish criteria for its legitimation and in the process create a new framework for establishing and maintaining standards.

7. Conclusions.

There are three current models for computers: 1) centralized servers feeding passive dumb terminals; 2) decentralized stand-alone personal computers active in their own right and 3) interactive networked computers in a collaborative environment. It was noted that there are are three analogous models of teaching that go back many centuries. Hence, while it may be the fashion to describe learning in terms of computer jargon, the underlying approaches existed long before computers.

This begged the question how the advent of computers will affect these three competing views. Computers should not bring into focus any single side of this triad. Hence, we challenged claims that computers will produce electronic butlers which replace teachers; those who claim that knowledge will soon be a passive exercise. We suggested instead that computers offer a new synthesis of all three methods, whereby the roles of teachers as leaders, students as individuals and combinations thereof working collaboratively are confirmed.

In the past knowledge was organized hierarchically into at least seven levels where each lower level was a subset of the former: a corpus of knowledge, curriculum, course, textbook, exam, evaluation, and review (cf. fig. 1). By creating new sets of links among these seven levels, computers will transform this hierarchy, making it more transparent and creating a new framework for standards. The computer revolution is not about replacing teaching with learning. It gives us new approaches to both teaching and learning, whereby better teachers are greater learners. There must be ordered content if students are to do meaningful ordering of content. A central role of teachers lies in helping students understand the significance of their ordering in relation to the greater order that is the established corpus of knowledge. To achieve this teachers will always need to remind students that learning is more than a passive exercise of absorbing facts. Learning must be active if learning is to remain a true activity.

Perspective Unit, McLuhan Program, University of Toronto
27 February, 1996.