

**SOME ETHICAL AND PHILOSOPHICAL ISSUES ARISING FROM
THE USE OF TECHNOLOGY IN EDUCATION**

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Introduction

Background

Everywhere in the world technology is developing very rapidly. Increasingly it affects our lives in more ways than we are consciously aware of. The variety of anticipatory responses to the Y2K problem is but one indication of the degree to which computers are affecting the food we eat, the way we get from place to place, the way we heat and light our homes, the way we maintain the public health, etc.

It is important for us both as citizens and as educators to continually think about the world in which we live and the tools, technological and otherwise, that we have for dealing with that world. As we develop new tools, there are both explicit and implicit ethical and philosophical implications that arise from the uses that we choose to make of these tools.

As a way of framing our consideration of some of these issues let us consider some of the more important kinds of uses that we make of technology in education. In so doing let me be clear that my purpose here is not to resolve these issues but to make them salient. I do not believe that they can be *resolved* in the sense that a problem in mathematics is solved. I do believe that each society must fashion its own ways of considering these issues. Moreover, I think it is important that the questions be revisited frequently, particularly in light of the rapidity of the development of the technology.

[For the sake of specificity, let us consider technology to be synonymous with computers. The justification for this seemingly narrow perspective is the rapid convergence of all media and communications technologies with computer technology.]

Modes of use of technology in education

It seems to me that there are four major kinds of use we make of computers in education. These are

- Computers as a communications medium
- Computers as an archival medium
- Computers as an expository medium
- Computers as an exploratory medium

Computers as a communications medium

In the beginning there was email, largely used by the research community and the military. With the advent of the Internet and the spread of the personal computer, many millions of people worldwide discovered the power of electronic mail – communication that could be both one-to-

one and/or one-to-many, both synchronous and/or asynchronous.

Small groups with specialized interests formed newsgroups and chat groups – arenas for communication among like-minded (and sometimes not so like-minded) people all over the world.

With decreasing bandwidth costs the Internet came to be used for telephony, for streaming audio and video – modes of communication that hitherto either used dedicated cabling or wireless transmission and reception. It is important to note that hitherto the control of synchronous means of reaching large groups with audio and video lay entirely in the hands of governmental agencies such as ministries of communications. This shift away from government and toward the individual as "broadcaster" of information represents a profound change in the nature of control of the dissemination of information in a society.

Computers as an archival medium

Because the computer offers us the ability to search multivariate data efficiently we have begun to compile databases of all sorts that are far more richly indexed than ever before. This means that we are capable of asking and answering not only many more questions, but also many more different kinds of questions.

Because it is now relatively easy to do, we now collect and compile data of all sorts very readily. We often collect data that has no apparent relevance to the purpose of the database into which it is incorporated. This increase in the sheer volume of data further amplifies our ability to ask and answer questions.

Moreover, many of the new kinds of questions we ask of the data we have collected are questions that raise ethical issues. Such issues may simply not have arisen in the past because the questions were not "askable" in any practical way.

Computers as an expository medium

By far the dominant use of the computer in education (at least in the United States) is as an expository medium. In

this use, the computer presents curricular material to the user-learner, and tries to assess how well the presented material has been absorbed and understood.

The presented material may be in the form of text, of sound, of video or any combination of these modes.

It is usually true that in the case of software of this genre, *interactivity* means the software decides on the basis of the results of its assessment of the user-learner's understanding what next to present on the screen.

For the most part, in this mode of use, it is the computer that runs the "conversation" with the user.

Computers as an exploratory medium

Relatively uncommon, but of great intellectual importance, is the use of the computer as a medium for users to explore the breadth and depth of their own understanding of a subject.

Intellectual mirrors and simulations are the most common example of this genre. Such software environments are typically models of complex, interacting systems ranging from airplane flight control systems, to predator-prey ecosystems to the behavior of political electorates.

Simulations allow users to set up an initial situation and then examine the consequences of the initial situation they used to launch the simulation. Users are inevitably led to pose next questions, many in the form of "what-if" questions, and their insight into the structure and behavior of the system they are studying grows.

It should be stressed that simulations are models and that what is learned about the flying of airplanes or the decline of deer population or the voting habits of factory workers is only true in the context of the models of those phenomena that are embedded in the simulations.

For the most part, in this mode of use, it is the user that runs the "conversation" with the computer.

This framework for thinking about the ways in which we use the new tools technology offers us is not so categorically precise as to allow us to parse

the issues we wish to deal with cleanly. A given issue may arise because of the use of the technology as a communications medium but also because of its use as an archival medium. Indeed, in many cases we will find that the same issue is raised by several different uses of the technology. Nonetheless, the framework does offer us a way to begin.

Issues arising from the use of technology as a communications medium

There are four issues I wish to address in this section. They are

- Free speech and the nature of political activity
- The nature of human communication and interaction
- Who are the school's clientele?
- Who controls curriculum?

Free speech and the nature of political activity

In part the way one thinks of this issue is shaped by the degree to which one thinks of the Internet as a "broadcasting" or "publication" medium. To the extent that the communication is in one-to-one mode, i.e. one person communicating privately with another person it would seem that virtually any statement might be acceptable. If, however, a statement is "published" on a publicly accessible web site, or "broadcast" by being sent to large numbers of users then it is possible that laws regarding libel, or hate speech, or other offensive kinds of utterance may apply.

Different societies have different norms for what kinds of public speech are acceptable and not acceptable. The difficulty here lies in the fact that the boundary between what is public speech and what is private speech has become clouded.

The ease with which material can be introduced on the Internet makes possible a particularly insidious kind of social and/or political speech. This consists of visually parodying the appearance of the web site of an opponent but changing the text so as to reflect one's own position. For example, in an election campaign for governor between Smith and Brown, Smith might have registered the URL www.smith.com and used it to present arguments in favor of his/her election. Brown on the other hand, might have registered the URL www.smithforgovernor.com and

placed on this web site arguments that would cause voters to find Smith's position on issues unappealing and that would lead them to turn to Brown as their choice for governor. Cases of this sort have occurred in domestic US elections as well as in sites put up by human rights groups around the world.

Similar behavior can be expected from competing companies. Company A and company B compete to sell soda. A registers the web site www.drink-A-soda.com while company B registers the website www.A-soda-refreshes.com that contains material praising company B's product. Cases like this have occurred repeatedly among competitors in the United States.

Who decides what is offensive speech? It would seem that the offended party is best able to do so. But is this always the case? Who polices the system?

Who enforces the judgments? It would seem that the enforcement of the regulation of undesirable speech is left to the discretion of the Internet Service Provider (ISP). But do we really want to dilute the enforcement of societal decisions that thinly?

Finally, let us consider the following question: What control over the content of websites should a school have? Should a school limit the websites that can be accessed by students from the school's computers? It has become quite common for schools in the United States to do so. The difficulty with efforts of this sort lies in the automaticity of the filtering mechanism. A filter program scans the text of the requested website. If that text contains any of a long list of forbidden words then access to the site is blocked. This has led to such silliness as student being blocked from accessing sites that contain important and current information on breast cancer.

Going beyond websites that students access to consider those that they design and put up themselves, one is led to ask: If a student uses a school's facilities to put up a web site, should the school censor its content? To what extent is a student-generated website like a student newspaper? Arguments can be offered on both sides of this issue.

Carrying this issue one step further: Suppose students use their own resources to put up web sites that refer to school content, practices and personnel, does the school have a right to censor its content? In the United States there are a growing number of such cases in the courts.

The nature of human interaction/communication

Gesture, vocal intonation, eye contact, and immediacy of response are all-important dimensions of human communication. They are, for the most part, not available in situations of computer-mediated communication. Is actual textual content of communication the most important part of communication?

There are two remarks to be made in this regard. The first is that with the advance of such technologies as computer telephony and video conferencing computer-mediated communication is increasingly able to incorporate these dimensions of communication.

The second remark is that this is an issue only to the degree that we think of newer forms of communication *displacing* older forms rather than *augmenting* them.

Independently of whether we may think that such changes in the nature of human communication are desirable or not, the fact remains that in many places youngsters who have access to computers often prefer to interact with friends, even those who are in close physical proximity, by communicating with them electronically. Increasingly, people in workplaces will send email to colleagues in the next office rather than walk down the corridor and speak to them directly. To be sure, there are often good reasons for doing so. I do not wish to express a value judgement here - I simply want to point to the changes in the ways in which we choose to communicate.

Finally, it is worth thinking about the way a human being learns to communicate. Recently, there has been a good deal of public discussion about the question of how early should children begin to use the computer? Much of this discussion has been prompted by the appearance of software claimed by its marketers to be designed expressly for youngsters as young as one year old and intended to accelerate their cognitive development.

To what extent should one permit children's interaction with the computer to displace their interaction with their social (and physical) surround? I choose to say *displace* rather than *replace* since I do not believe that responsible people will argue that the computer should become the focus and locus of a child's development. Clearly, there are no categorical answers to such a question although there will be many different opinions as to the appropriately desirable balance between the social surround and the digital surround.

I remain somewhat skeptical. It seems to me to be clear that not all the aggressive marketing of software designed for one and two year old children is motivated by a concern on the part of commercial software developers for improving the nature and rate of child development.

Who are the school's clientele?

As it becomes easier for parents and school authorities to communicate with one another it becomes necessary to re-examine such questions as what should be parents be able to learn about their children's performance in school? It might well be the case that the answer to such questions at the elementary school level would not be the same as at secondary level. What about when students are away at college or university?

It would seem reasonable that parents and the larger community should be able to learn about a given school's performance vis-à-vis other schools in the district or state? Does the larger community that pays taxes also have a right to learn about the performance of individual classes within schools? Individual teachers? At what point does this access to information begin to obviate and interfere with the role of school administration

This is a special case of a larger issue that arises from the extraordinary success of the computer as communications medium. It is increasingly possible to poll the public directly on all sorts of public policy issues. Some futurists even see such polling mechanisms eroding the need for representative democracy since it would seem that the technology makes possible direct participatory democracy.

At first blush it would seem that this would be desirable. We could return to our idealized notion of ancient Greek democracy. It should be pointed out that one of the inadvertent consequences of a representative form of democracy is that there are built-in delays in the ability of the system to respond to the will of the public. This sort of political "molasses" is an important safeguard against demagoguery of all sorts. It is easy to inflame a public. If passions are allowed to be vented readily and quickly then the rights and freedoms of people are likely to suffer.

Let us return to the impact on education of the computer as a communications medium. The ease of communication also suggests that we rethink the question of who is the audience for the educative function of the school. Might it be that we should think of the parents of the students also as students – at least insofar as they need to be informed about emerging educational policy issues? Should the continuing lifelong education of parents become part of the responsibility of the school that we now think of as educating their children? What about the continuing education of the larger community? Should vocational training (and retraining) for the community, with all its implications for the world of work and the economy become part of the responsibility of the school we now think of as a place for the education of our youngsters? Etc., etc.

Who controls curriculum?

The ease with which anyone can make materials available on the Internet in effect means that everybody can, with relatively minimal effort, become a worldwide publisher. This development can have profound effects on the ways in which schools acquire curricular materials.

Traditionally, the curricular materials in use in a school were the ones approved by the ministry of education and/or the local school authority. In principle, the approval mechanism was a kind of quality control on the materials. In some societies these materials are purchased for use by students with public funds. The repertoire of available and pertinent materials was limited and well prescribed.

At the elementary and secondary level it is the rare teacher, indeed, who has the time, and/or the background, to prepare

curricular materials for use in his/her classes. Thus, the available materials usually set the outer boundaries of learning, teaching and intellectual inquiry in the class.

It is now the case that, in every subject area, there are literally hundreds of websites to which a teacher can turn to get curricular materials for use in his or her class. When this happens, the control that the society has over the curricular content of what is being taught in its classrooms is substantially diluted.

The easy availability of curricular materials has been a boon to the growing home schooling movement. Just as teachers can now find curricular materials that more nearly reflect what they are trying to teach and that fit the needs and background of their students, so too can parents who are educating their children at home.

Clearly, in many ways this amplification of the sources of the curriculum is desirable. It provides the opportunity for students to encounter a much wider range of views and perspectives than before. Nonetheless, it comes at a price that some societies may be unwilling to pay, i.e., the carefully evolved mechanisms that the society fashioned in order to control what is taught in its schools no longer function as before.

The privacy of communication

Serious issues arise when we consider the problem of privacy as it pertains to electronic mail.

We would probably all agree that email sent by an individual from his/her home to another individual ought not be censored in any way. On the other hand, what about email sent by an employee of a company to another employee during business hours on company equipment and relating to company business? In such a case many people would argue that such email ought to be able to be read not only by the person to whom it was addressed but also by company officials. Indeed, it is just such communication that has become an important source of evidence in the current trial of the Microsoft Corporation in the US.

While these two cases may be reasonably straightforward, one can imagine a wide range of intermediate cases where the situation is much less clear. Are teachers in school more like employees using company equipment, or is there relationship to their students one of personal mentoring and counseling?

Should school authorities be permitted to read student email that is sent and/or received on school computers? Suppose there are serious disciplinary issues to be dealt with that the information that is obtained in this way might resolve? In many places we do permit school authorities to search student lockers for weapons. In some places we allow school authorities to test students for drug use. Is reading student email similar or different to these kinds of control that we already give to school authorities?

Electronic mail is not the only setting in which the privacy issue arises. Consider a classroom of networked computers. Many such network configurations allow the teacher to display on his/her monitor the contents on the monitor on any of the students in the class. In almost all such arrangements, this can be done without the students whose work is being monitored being aware of the fact that the teacher is observing.

Normally, when a teacher chooses to observe a student's efforts in class, the student is aware of the fact. Is there a violation of student privacy when this observation can take place without a student's knowledge?

Finally, an interesting privacy issue arises from the proposal of at least one manufacturer of CPU chips in the United States to incorporate into the chip a unique identifying serial number that would be encoded into messages sent from the computer in which that chip was embedded. This would enable messages to be traced back to the machines from which they are sent.

Following the announcement of this proposal, there was a strong and widespread expression of protest and the company acquiesced. The chip will still have a unique identification number, but the default settings would be such that the number would not be incorporated into messages sent from the computer with that CPU.

However, the question remains. In an area of public speech, such as the Internet, does a person have the right to know who is the author of the utterances that he/she encounters? In the US, for example, there is a law that requires political advertising to signed by the parties that pay for the advertising. This is done to protect the public. Is publication on the Internet different? Should it be?

Issues arising from the use of technology as an archival medium

I see two important issues arising in this context. They are

- The privacy of data
- Intellectual property

The privacy of data

The issue of privacy seems to have two aspects – those that arise by virtue of hardware developments and those that arise by virtue of software developments.

The technology of "smart cards" has made it increasingly possible to produce individualized identity cards that contain a great deal of specific and personal information about the holder of the card. The information is electronically encoded on the cards in an integrated circuit chip that is part of the card itself. One of the prospective benefits of such technology is the ability of people to carry in their pockets a card on which is encoded their complete medical history. A person with such a card would not have to wait precious hours or even minutes for a history to be taken in the event of a medical emergency or if they needed medical attention far from home.

Needless to say, there are many potential sources of abuse with this form of technology. But even more prosaic and commonplace forms of electronically readable identification such as "charge cards" with magnetic stripes present difficulties. A growing number of educational institutions are issuing students such electronically readable identification documents. These cards are then used as charge cards in university bookstores and cafeterias as well as identification documents for admission to dormitories and libraries both during and after normal business hours.

By virtue of the fact that the student identification information is read and recorded by computer, university authorities can monitor the comings and goings of individual students as well as many of their taste in food, books, films and other activities. Can the availability of this kind of information lead to abuse and discrimination?

Going beyond the hardware threats to privacy we must also raise the question of the impact on privacy that comes about by virtue of the evolution of more and more powerful software. Does the combination of dramatically expanded bodies of data collected about student comings and goings and purchases along with the availability of dramatically expanded search capabilities constitute a change in kind rather than simply a change in degree? Are there potential threats to intellectual inquiry if a school can track which students are reading which books in the library? Earlier we raised the possibility that clients beyond the school itself may begin to gain access to what has traditionally been regarded as information internal to the school. Will these clienteles cast a shadow over the schools, making them less likely to continue to serve as institutions of free and unrestrained inquiry?

Intellectual property

In principle there is nothing new about the question of the integrity of intellectual property. Students have long been asked to write about what they have learned. Some of them have always found ways to be less than honest in responding to those requests.

What new dimensions to the problem of intellectual property are brought about by virtue of the developments of technology?

In earlier times a student might painfully copy a paragraph or two from an encyclopedia or other reference book while writing an essay on the geography of South America or the Crusades. Now essentially all software tools for writing offer the user the ability to Cut, Copy, and Paste whole blocks of text from essentially any source that can be displayed on a computer screen. This dramatically augmented ability to "quote" the work of others, and the vastly greater repertoire of sources available to any internet

user makes the detection of non-original student work much more difficult.

Are there practical ways of guarding against plagiarism? Several schemes, some imaginative and some heavy-handed have been developed to prevent unbridled abuse. I suspect that with the passage of time more will be developed.

Related to this issue of students "quoting" others without attribution but logically distinct from it is the rapid growth of the "term-paper writing industry". These are people who will, for a fee (usually large), write a paper for a student on any topic the student requests. While this activity is not new, its ability to attract student customers has expanded because of the wide range of materials available on the internet and the ease with which the paper written for hire can be transmitted to its purchaser.

It may be that we need to augment the notion of originality of composition using the written word by adopting a notion from the visual arts. Artists have come to use the word "collage" for a particular kind of assemblage – one in which the individual elements of what is being assembled are taken, usually without alteration from some other source. The originality of the collage inheres not in the originality of the several pieces of which it is constituted but rather in the cleverness of their selection and the interrelationships among the pieces that have been brought together.

Similarly, we may wish to entertain the idea of "written-language collage" – i.e., an assemblage of prose or poetry pieces carefully chosen and linked to one another by the "author". Original work which used to mean that the sequence of words was composed by the "author" save perhaps for the occasional quotation – might now come to mean that the author has assembled a tapestry of related "chunks" of text, sounds, still and moving images, with the originality inhering in the assemblage and not in the individual chunks?

One final notion before leaving the question of intellectual property. A common use of the computer as a communications medium is for the purposes of "chat" – a more or less synchronous communication among two or

more people. The "speaker" types in his/her remarks and they appear more or less simultaneously on the screens of all the people who are "in" the "chat room" at that time. We are led to the following question: who owns "chat" and who can use it?

Issues arising from the use of technology as an expository medium

The issues I wish to address in this section are

- The nature of the school experience
- Private roles in public education

The nature of the school experience

Societies have different kinds of purposes in establishing and operating educational systems. These include transmitting the culture, preparing people for the world of work and equipping them for a lifetime of personal growth and development. For the most part schools play an important role in society's strategy for attaining its educational goals and fulfilling its educational purposes. Thus it behooves us to think a bit about the ways in which the school, with its current structure and modes of practice, helps the society address its educational goals.

By far the most extensive use of the computer in education until very recently and possibly even today is as a medium of direct exposition and instruction. In all likelihood the impetus for this kind of use derives from the assumption that computer can deliver instruction to students at their own pace and in a way that reflects their idiosyncratic needs and backgrounds.

This is not the arena to argue for or against the premises that underlie this use of the computer. For the purposes of this paper, it is sufficient that this kind of use is very widespread.

Schools are organized the way they are, at least in part driven by the economics of bringing together in one place a sufficiently large number of students so as to make the building of buildings and the hiring of teachers an economical proposition. We have somehow concluded that about twenty-five students can be formed into a group

called a class and justify the hiring of a teacher. Further we have somehow concluded that several hundred youngsters, brought together in fifteen to thirty or so classes justify building a building that we call a school.

If we accept the premise that underlies the use of the computer as a didactic device delivering instruction and exposition then, it seems to me, we are obliged to rethink the assumptions that lead to our grouping children into classes and classes into schools in the way in which we currently do.

To be sure there are benefits to be derived from grouping students so that that they interact socially with one another. But there are also costs. Given that instruction can be delivered via the computer maybe the nature of the teacher's role ought to change. If it does, then who is to say that one teacher for twenty-five or so students continues to be the appropriate ratio of teachers to students. Succinctly stated why must all students sit with all other students at the same time and in the same place? What is the argument for transporting children from their homes to classrooms in distant school buildings when they might assemble in small groups in their neighborhoods, and use the now nearly-ubiquitous computer for their daily lessons. In this kind of arrangement students would come to school much less often that they now do and then only to use the truly unique facilities of the school such as the gymnasium or the theater.

I don't wish to argue that this scenario is necessarily better than our current practice. It is simply different and not beholden to the assumptions that led to current practice.

Private Roles in Public Education

In many societies the private profit-making sector is eyeing a wide range of new potential sources of income. In the United States this has come to mean, at least in part, selling goods and services to school children. Until about a decade ago most of this selling took place in the public print press and on commercial radio and television broadcasts.

Then there appeared on the scene a commercial enterprise called Channel One. This enterprise offered to donate a great deal of video equipment to any interested school. In

return the school had to agree to use the equipment to have the students watch news and current event materials that would be broadcast by Channel One and received on the donated equipment. The schools were unable to review the broadcast materials in advance. Moreover, every broadcast included commercial advertisements for consumer goods that the students might be interested in purchasing. It should be pointed out that the legislatures in a number of states in the United States passed laws forbidding public schools in their states to enter into any agreement with Channel One.

Recently the situation has evolved further in the same direction. With the growing use of the Internet in schools students are increasingly subjected to an incessant bombardment of advertisements on the websites they visit imploring them to buy this or that kind of soft drink or junk food or sports shoe. Indeed, many websites that are quite valuable from an educational perspective are obliged to accept advertising in order to defray the costs of maintaining and updating the website.

This leads to the question: Should there be roles for the private sector in public education? Should profit-making corporations be allowed to advertise in materials used in public schools? Should profit-making corporations be allowed to supply hardware to public schools in exchange for either explicit or implicit endorsement of their products?

If we permit teachers to use web sites with advertisements, should we not permit publishers to sell advertising space in textbooks? Should we not permit school authorities to sell poster space in schools buildings?

I don't claim to know answers to these questions. It is tempting to a seemingly principled stance and say that the private sector has no role to play in public education. But the realities of public support for public education may be such that a more acquiescent stance is more realistic.

Issues arising from the use of technology as an exploratory medium

The issues I wish to address in this section are

- The nature of the subject matter
- Where does intellectual authority lie?

The nature of the subject matter –

Although relatively uncommon as a use of the computer in education, I believe that in this domain lie some of the more profound potential impacts on what we conceive the roles of schools to be. I will touch briefly on four subject areas that are central to educational systems everywhere. They are mathematics, the social and natural sciences, the arts and language.

Mathematics is rarely well learned and even more rarely well taught. Typically, students are taught to perform mathematical computations in a rote fashion, with little understanding of when to do any particular computation or why it works. It is rarely the case that students are asked to devise new mathematical structures and to explore them.

Appropriately crafted software environments that allow students to make and explore conjectures can lead to profoundly different views of the subject. There is by now a good deal of evidence in support of this statement.

The teaching of the social and natural sciences also tends in many instances to be dominated by the demand that children learn dates and names. Rarely are they taught that the subjects they are studying are the carefully crafted models and explanations of the world crafted by earlier generations. As potent as these may be they are always subject to revision with the next discovered piece of historical evidence or the result of the next experiment.

The heart of the science enterprise is two-fold. Science is fueled by data and is nourished and grows by the building and exploring of models. The acquisition of data in both the social and natural sciences has truly undergone a revolution since the widespread availability of computers.

At the same time, software environments have been developed that make the building and exploring of models increasingly accessible to students even at quite young ages. Taken together, these two developments stand to

change our ideas not only about science but also the ways in which it is possible and desirable to teach science in schools.

There is a similar kind of opportunity in the arts curriculum. Software environments in the visual and musical arts are enabling people who have not mastered many of the technical procedures of graphic design or harmony and counterpoint to become more than simply appreciators of art and music. Normally, the arts curriculum in schools moves away from engaging children in creative activity and toward studying the "great works" of the past. Without in any way meaning to deprecate the importance of the past and our artistic heritage, I simply note that environments of the sort I refer to can shift the emphasis of the curriculum a bit more in the direction of the individually creative.

Finally, I believe that the language curriculum in schools will be deeply affected by the technology we have developed. Normally, we teach students to write prose in the form of narrative, exposition and argument. We teach them to anticipate the reactions of their readers and use those anticipated reactions to help to structure what they are writing.

Increasingly, we find ourselves reading and writing in hypertext environments where one can no longer anticipate that what one writes will be read sequentially. How can and should this change the ways in which we think of the teaching of written language? This scenario is not remote in time. A growing number of language and literature courses in the US at secondary and post-secondary level now include the design of websites as part of the curriculum.

Where does intellectual authority lie?

Going beyond the effect of new developments in technology on the content and pedagogy of school subjects, we are led to another, and in many ways more important consequence, of the use of technology as an exploratory medium.

What happens to the authority of the teacher when these exploratory tools make it possible for students to generate knowledge for themselves – possibly even things new to the teacher?

Traditionally, we tend to think of schools as places where we send youngsters to learn the ways of the society at the feet of older, wiser and more knowledgeable adults. While these tools are not likely to affect the relative age or wisdom of teachers and students, they are certain to affect the relative state of knowledge. With greater and greater frequency, we find youngsters developing expertise and insight into the subjects of their passions, often exceeding by far the knowledge of the teacher.

I believe that these developments oblige us to relinquish some of the more authoritarian and hierarchical mental models that we may have of schools in favor of a more collaborative community of adults and youngsters each of whom may be both a teacher and a learner.

Conclusion

I have raised many issues, some ethical, some philosophical that we find ourselves confronted with as a result of advances in technology. In some cases, I see reasonably clear resolutions. In others, I find myself much less certain about what should or should not happen.

I know that I will continue to ponder these questions. If this paper inspires other to do the same, I will be most gratified.